# Arrow Energy Surat Gas Project

## Landscape and Visual Impact Assessment

# Document Control Sheet

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# Draft Landscape and Visual Impact Assessment

Revision G

Prepared for

Coffey Environments and Arrow Energy Pty Ltd

Prepared by

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# Executive Summary

Coffey Environments (formerly Coffey Natural Systems) is preparing an Environmental Impact Statement for Arrow Energy Pty Limited (Arrow) Surat Gas Project. Design + Planning at AECOM (formerly EDAW AECOM) has been commissioned by Coffey Environments and Arrow to undertake a landscape and visual impact assessment of the coal seam gas field and facility development components of the project.

The assessment aims to provide an objective and transparent review of key impacts on the landscape resource, views and visual amenity within the study area, resulting from the i) design and installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation of the project. As the locations of the facilities will not be known until development progresses across the ~8600km$^2$ project development area (and accordingly are not "fixed" for the purposes of the environmental impact statement), the landscape and visual impact assessment has divided the landscape within the study area into different "types" of landscape of broadly similar characteristics. These provide a framework for assessing the potential impact of each type of project development (and associated activities) on the landscape resource, views and visual amenity within each of the ten "landscape character types".

A key element of the project has been the creation of design responses and measures for the reduction, mitigation and management of potential landscape and visual impacts associated with the key development activities. It is assumed that these mitigation measures will be integrated as part of Arrow's environmental management strategy, and therefore residual impacts are assessed with the assumption that the mitigation measures have been implemented. A number of "beneficial" mitigation measures for long-term legacy have been identified, such as establishment of community facilities or ecological restoration, which could be considered as a value-add or "offset" for unavoidable impacts.

As the exploration and development of the mining and petroleum industry (particularly the coal seam gas industry) expands in this part of southern Queensland alongside the continuation of other large-scale infrastructure (e.g. coal mining and power stations) consideration of landscape and visual cumulative impacts has also been summarised in *Section 11*.

# 1.0 Abbreviations and Glossary

## 1.1 Abbreviations

| | |
|---|---|
| Arrow | *abbr* Arrow Energy Limited |
| AHD | Australian Height Datum |
| CE | Coffey Environments |
| CGPF | Central Gas Processing Facility |
| CLVIA | Cumulative Landscape and Visual Impact Assessment |
| DERM | Department of Environment and Resource Management |
| DEM | Digital Elevation Model |
| EIS | Environmental Impact Statement |
| FCF | Field Compression Facility |
| GIS | Geographic Information System |
| GQAL | Good Quality Agricultural Land |
| IPF | Integrated Processing Facility |
| LVIA | Landscape and Visual Impact Assessment |
| LNG | Liquid Natural Gas |
| TOR | Terms of Reference |
| ZTV | Zone of Theoretical Visibility |

## 1.2 Glossary

For the purposes of this assessment, we have used the definitions below. Where appropriate, definitions have been drawn from British literature, as this is considered by AECOM as providing the best indication of international best practice for landscape and visual impact assessment (LVIA).

**Cumulative Impacts / Effects** may be defined as the additional changes caused by a proposed development in conjunction with other similar developments, or as the combined effect of a set of developments, taken together. (Definition based on *Assessing the cumulative effect of onshore wind energy developments*, SNH, 2009)

**Digital Elevation Modal (DEM)** refers to '*the way in which a computer represents a piece of topography in 3-dimensions as a digital mode, excluding vertical elements e.g. vegetation, buildings*'. The terms Digital Terrain Model, Digital Ground Model and Digital Height Model are also used and are synonymous. (Definition based on *Visual Representation of Windfarms: Good Practice Guidance*, SNH, 2006).

**Landscape Character** is the distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how this is perceived by people.

**Landscape Character Types** are '*distinct types of landscape that are relatively homogeneous in character...generic in nature in that they may occur in different areas in different parts of the country, but wherever they occur they share broadly similar combinations of geology, topography, drainage patterns, vegetation and historical land use and settlement pattern*'. (Definition based on *Landscape Character Assessment: Guidance for England and Scotland*, CA and SNH, 2002).

**Landscape Character Areas** are '*single unique... discrete geographical areas of a particular landscape character type... Each has its own individual character and identity, even though it shares the same generic characteristics with other areas of the same [landscape] type*'. (Definition based on *Landscape Character Assessment: Guidance for England and Scotland*, CA and SNH, 2002).

**Landscape Condition** is '*based upon judgements about the physical state of the landscape...its intactness, from visual, functional, and ecological perspectives. It also reflects the state of repair of individual features and elements which make up the character in any one place*'. (Definition based on *Landscape Character Assessment: Guidance for England and Scotland*, CA and SNH, 2002).

**Landscape Sensitivity** is *'related to landscape character and how vulnerable this is to change… Landscapes which are highly sensitive are at risk of having their key characteristics fundamentally altered, leading to a different landscape character… Sensitivity is assessed by considering the physical characteristics and the perceptual characteristics of landscapes in light of particular forms of development'.* (Definition based on *Topic Paper 6: Techniques and Criteria for Judging Capacity and Sensitivity*, SNH, 2002).

**Landscape Value** is the relative value or importance attached to a landscape (often as a basis for designation or recognition), which expresses national or local consensus, because of its quality, special features including '*perceptual aspects such as scenic beauty, tranquillity...cultural associations....and presence of conservation interests... nationally or locally*' (CA and SNH, 2002).

**Landscape and Visual Impact Assessment (LVIA)** is the '*professional and methodical process by which assessment of the impacts of a proposed development on the landscape and visual resource is undertaken. It comprises two separate and distinct parts – Landscape Impact Assessment and Visual Impact Assessment*'. (Definition based on *Visual Representation of Windfarms: Good Practice Guidance*, SNH, 2006).

**Landscape Impact Assessment** is the process by which assessment is undertaken of the impacts of a proposed development on the landscape, its character and quality. *The Guidelines for Landscape and Visual Impact Assessment* (LI and IEMA, 2002) states that *"Landscape effects derive from changes in the physical landscape, which may give rise to changes in its character and how it is experienced'*.

**Mitigation:** Measures, including any process, activity or design to avoid, reduce, remedy or compensate for adverse landscape and visual effects of a development.

**Project Development Area:** The area where physical development associated with the project (e.g. installation of wells, facilities and infrastructure) may occur.

**Study Area:** The study area for this assessment includes the EIS project development area, defined in **Figure 1**. Due to the intervisibility and the continuum of the character of landscapes adjacent to the project development area (e.g. from areas near Jimbour), the LVIA study area also includes character types and areas adjacent or close to the project development area.

**Visual Amenity:** "Amenity" generally means people's appreciation of a particular place. In the context of this report, it is the visual character of an activity or area (design, colour, texture, scale, foci), which make up the area's "visual amenity". Impacts on visual amenity as perceived by people are clearly distinguished from, although closely linked to, impacts on landscape character and resources.

**Visual Impact Assessment** is the professional and methodical process which is used to assess the impacts of a proposed development on the visual appearance of a landscape and its visual amenity. *The Guidelines for Landscape and Visual Impact Assessment* (LI and IEMA, 2002) states that "*visual effects relate to the changes that arise in the composition of available views as a result of changes to the landscape, to people's responses to the changes, and to the overall effects with respect to visual amenity*".

**Visualisation** refers to computer simulation, photomontage or other techniques to illustrate the appearance of a development. (Definition based on *Visual Representation of Windfarms: Good Practice Guidance*, SNH, 2006).

**Zone of Theoretical Visibility (ZTV)** represents the area over which a development can theoretically be seen, based on a DTM. '*The ZTV usually presents a 'bare ground' scenario; that is, a landscape without screening structures or vegetation. This information is usually presented upon a map base*'. A ZTV is also known as Zone of Visual Influence (ZVI), Visual Envelope Map (VEM) and Viewshed. (Definition based on *Visual Representation of Windfarms: Good Practice Guidance*, SNH, 2006).

# 2.0 Objectives of the assessment

## 2.1 Terms of reference

This assessment has been prepared to address issues related to landscape character and visual amenity identified in the Terms of Reference (TOR) for Arrow's Surat Gas Project. The TOR had been issued by the Department of Environment and Resource Management (DERM) at the time of completion of the assessment. The sections of the TOR applicable to this assessment are as follows:

**Landscape Character**

"*This section should describe in general terms the existing character of the landscape that will be affected by the proposal*" (Section 4.2.1.8).

This section should also "*describe the potential impacts of the project upon the landscape character of the site and the surrounding area. Particular mention should be made of any changes to the broad-scale topography and vegetation character of the area, such as due to spoil dumps, excavated voids and broad-scale clearing.*

*Where appropriate, details should be provided of measures to be undertaken to mitigate or avoid the identified impact"* (Section 4.2.2.5).

**Visual Amenity**

"*This section should describe the existing visual resource, including panoramas that have, or could be expected to have, value to the community whether of local, regional, State-wide, national or international significance*" (Section 4.2.1.9).

This section should also *"analyse and discuss the visual impact of the proposal on views and visual amenity. It should be written in terms of the extent and significance of the changes to the view as experienced. Such views should be representative of public and private viewpoints including places of residence, work, and recreation, from road, cycle and walkways, from the air (where the proposal is likely to be visible from significant flight paths) and other known vantage points during all stages of the project as it relates to the surrounding landscape. The assessment is to address the visual impacts of the project structures and associated infrastructure, using appropriate simulation. Sketches, diagrams, computer imaging and photos are to be used as appropriate where possible to portray the near views and far views of the completed structures and their surroundings from representative locations including public roads, public thoroughfares, and places of residence or work, which are within the line-of-sight of the project. High level consideration should also be given to night time effects of any lighting proposed.*

*Where appropriate, details should be provided of potential management options to be implemented and how these may mitigate or avoid the identified impacts*" (Section 4.2.2.6).

## 2.2 Key objectives

The key objectives of the landscape and visual impact assessment (LVIA) following from the TOR are to:

- Analyse and describe the existing landscape character and visual amenity within the study area, taking into account factors including topographical structure, land use, vegetation cover, built elements, vantage points and key areas of landscape and visual importance;
- Identify the sensitivity of the landscape resource and viewers (visual receptors) to the project;
- Identify potential impacts on landscape character (including landscape features) and visual amenity of viewers during project activities;
- Identify options for design responses and measures for the reduction, mitigation and management of potential landscape and visual impacts associated with the project activities.

# 3.0 Legislative context and standards

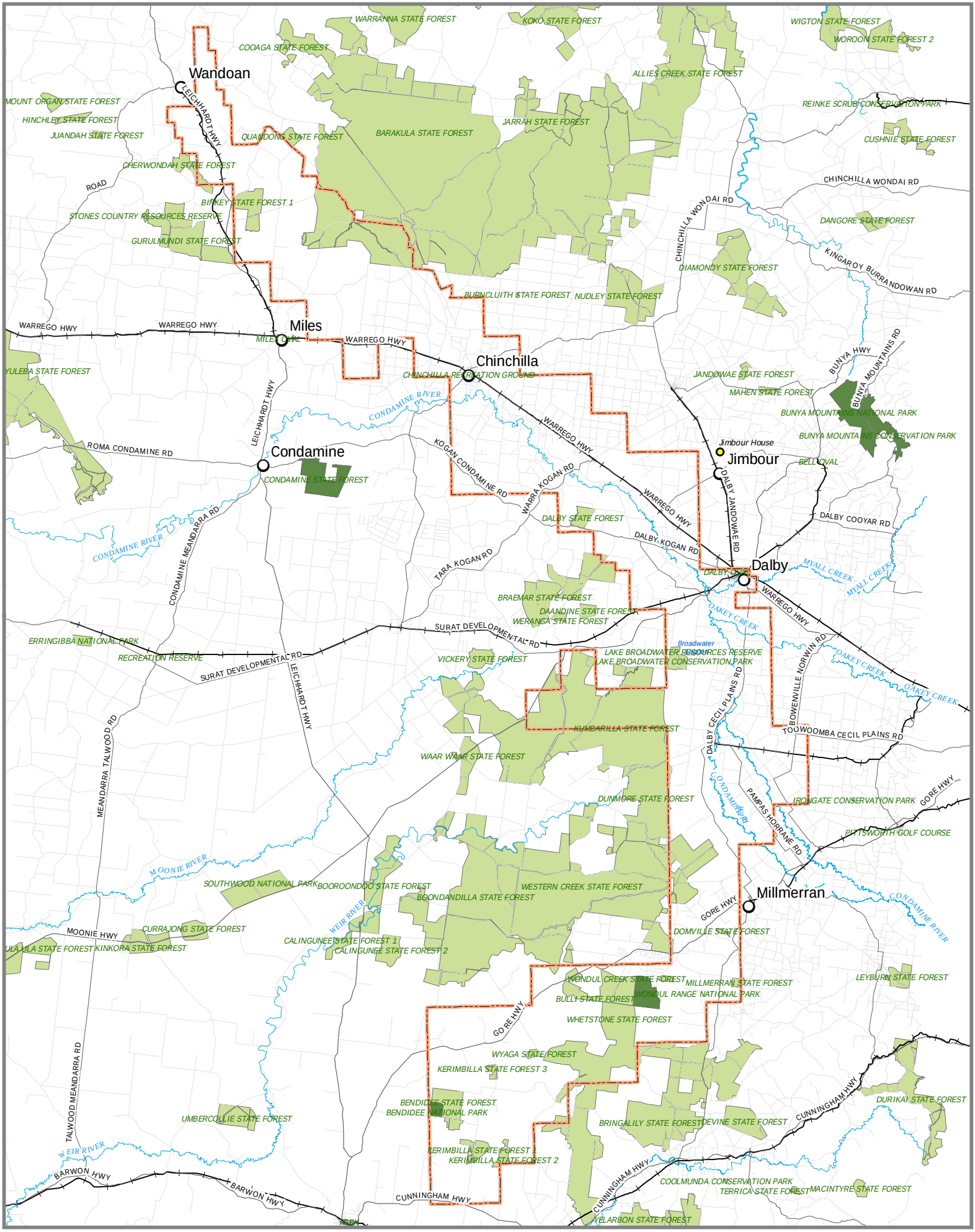
## 3.1 State and local policy and guidance

This section provides an overview of the key planning policies and guidance relating to landscape and visual amenity within the study area. There are three regional council areas within the study area, including Goondiwindi Regional Council, Western Downs Regional Council and Toowoomba Regional Council.

Regional planning policy has yet to be developed and adopted and the local planning schemes for the previous council areas remain active. Relevant state and local policies and guidance are summarised in **Table 1**. Although many of the policies in **Table 1** do not strictly relate to maintaining and enhancing landscape character and visual amenity; their intentions have outcomes that have the potential to influence and affect the landscape and visual resource within the study area. Key designations and features noted in state and local policy, which contain value relating to landscape and visual amenity (including scenic value), are shown on **Figure 1**.

**Table 1 Summary of state and local policy and guidance related to landscape character and visual amenity**

| **State Planning Policy and Guidance** | |
|---|---|
| **Policy** | **Purpose / intent** |
| *Surat Basin Future Directions Statement* (March 2010) | The Surat Basin Future Directions Statement establishes a framework for communities, industry and all levels of government to work collaboratively to ensure growth within the Surat Basin is managed sustainably. It identifies the major issues facing the region and provides an integrated approach to how the region will address those issues. A key challenge in the area is stated to be the management of *"impacts on amenity from increased development*... [and] *conflicts* between different land uses", particularly mining and agriculture. A key initiative of the statement has been the development of a Surat Basin Regional Planning Framework and associated preferred settlement pattern, which was released in draft format in November 2010. |
| *Draft Surat Basin Regional Planning Framework* (November 2010) | The Draft Surat Basin Regional Planning Framework establishes a clear direction for the regional area to manage growth, protect the environment and respond to competing land uses; whilst maintaining a unique lifestyle and building and maintaining liveable communities. It notes the region's strong and traditional agricultural foundation, which is facing unprecedented resource sector growth, leading to major changes in demands on the region's infrastructure, services and character. A key objective of the draft Framework will be the protection and enhancement of the region's "*environmental values which enhance community lifestyles*". One of the key strategies identified to achieve this is the identification, protection and management of the region's "*landscapes of natural, cultural, social and economic value...to meet current and future community and environmental needs*". |
| State Forest Policy for Vegetation Management (October, 2009) | The State Policy for Vegetation Management has been prepared in accordance with Section 10 of the *Vegetation Management Act 1999* (VMA) and aims to "*conserve and enhance networks and corridors of vegetation*". Where clearing of vegetation is permitted, the policy recommends developments to provide a "*vegetation management offset... that ensures the extent of vegetation and associated environmental values are maintained or exceeded*". |
| SPP 1/92 Development and Conservation of Good Quality Agricultural Land (December, 1992) | Good Quality Agricultural Land (GQAL) is protected as a major economic resource. The purpose of the Policy is to ensure the integrity of GQAL for the long term, particularly in terms of protection from encroaching non-agricultural development that may lead to its alienation or diminished productivity. The Policy seeks to address the conservation of GQAL primarily through incorporation of measures within planning schemes. |

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DATUM GDA 1994, PROJECTION MGA ZONE 56

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**LEGEND**

- EIS study Area
- National Parks
- State Forests

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| PROJECT ID | 09513140.01 |
| CREATED BY | GW |
| LAST MODIFIED | GW FEB 2010 |

**FIGURE 1**
**PLANNING POLICY CONTEXT**

**Arrow Energy**
**Surat Gas Project LVIA**

Figure
**F1**

| **Local Planning Policy and Guidance** | |
|---|---|
| **Goondiwindi Regional Council** | |
| ***Inglewood Shire Planning Scheme 2006*** | |
| **Policy** | **Purpose / intent** |
| The Environment | "*The Environment*" is one of the three desired environmental outcomes for guiding development in Inglewood Shire. Its purpose is to ensure the "*environmental and landscape values and historic significance*" of key natural areas and places of cultural and heritage significance (including the Dumaresq River and its tributaries, Coolmunda Conservation Park, Lake Coolmunda [outside of the project development area]) are "*protected and enhanced through compatible development*". |
| ***Waggamba Shire Council Planning Scheme (2006)*** | |
| **Policy** | **Purpose / intent** |
| The Environment | "*The Environment*" is one of the three desired environmental outcomes for guiding development in Waggamba Shire. Its purpose is to ensure the "*environmental, landscape values and historic significance*" of key natural and cultural areas (including Bendidee National Park [located near south-western project development area boundary], and the Dumaresq and Macintyre Rivers, their tributaries and floodplains [outside the project development area]) are "*protected and enhanced through compatible development*". |
| Extractive Industry Code | The purpose of this code is to ensure that extractive operations, including the operation of vehicles on haul routes, have "*regard to the desirable visual character of the locality*" and can be carried out with "*minimal environmental harm*' and '*minimal disruption to the amenity of nearby residential environments...or other sensitive environments (like schools, churches, halls, hospitals, etc)*". In particular, it advocates screening of extractive works, buildings, machinery operating areas and access ways from roads, public vantage points and neighbouring properties. |
| Landscape Policy | The purpose of this policy is to ensure that new development incorporates a landscape strategy that is "*consistent with the positive character of the districts and will enhance a sense of place*'. It advocates use of planting to provide '*visual cohesion between natural and built form*", including use of screen planting, shade planting, buffer planting between incompatible land uses, dust barrier planting and privacy screening. It also includes preferred approaching to the design of water storages (e.g. ring tanks). |
| **Toowoomba Regional Council** | |
| The Toowoomba Regional Council (TRC) formed in 2008. Development within the Toowoomba region is currently regulated by eight different planning schemes; three of which fall within the study area. The council is developing a single integrated planning scheme, which will be formally adopted in early 2012. Until then, the local planning schemes remain active.<br><br>TRC released the Scenic Amenity Study in April 2010 in response to the SEQ Regional Plan policies relating to the identification and protection of scenic amenity values (Part D, section 3.5). The study provides a comprehensive inventory and assessment of scenic quality to identify areas of strategic significance with respect to their visual contribution to the regional image. A key output is a map of scenic amenity indicating the areas of highest to lowest scenic value. | |
| ***Toowoomba Regional Council Scenic Amenity Study 2010*** | |
| **Policy** | **Purpose / intent** |
| Protection and management of the Region's scenic amenity values (including important view corridors and viewing locations) through the future Toowoomba Regional Planning Scheme | Captains Mountain, Commodore Peak and Mount Domville have been identified as areas of high scenic amenity (as illustrated in the diagram below). In addition, many of the irrigation ponds have been rated high in scenic preference by local residents; which has carried through to a high scenic amenity rating for many of the ponds with high visual exposure. Areas of lower scenic amenity include mines, quarries and refuse facilities, including Millmerran mine and power station. The remainder of the landscape within the |

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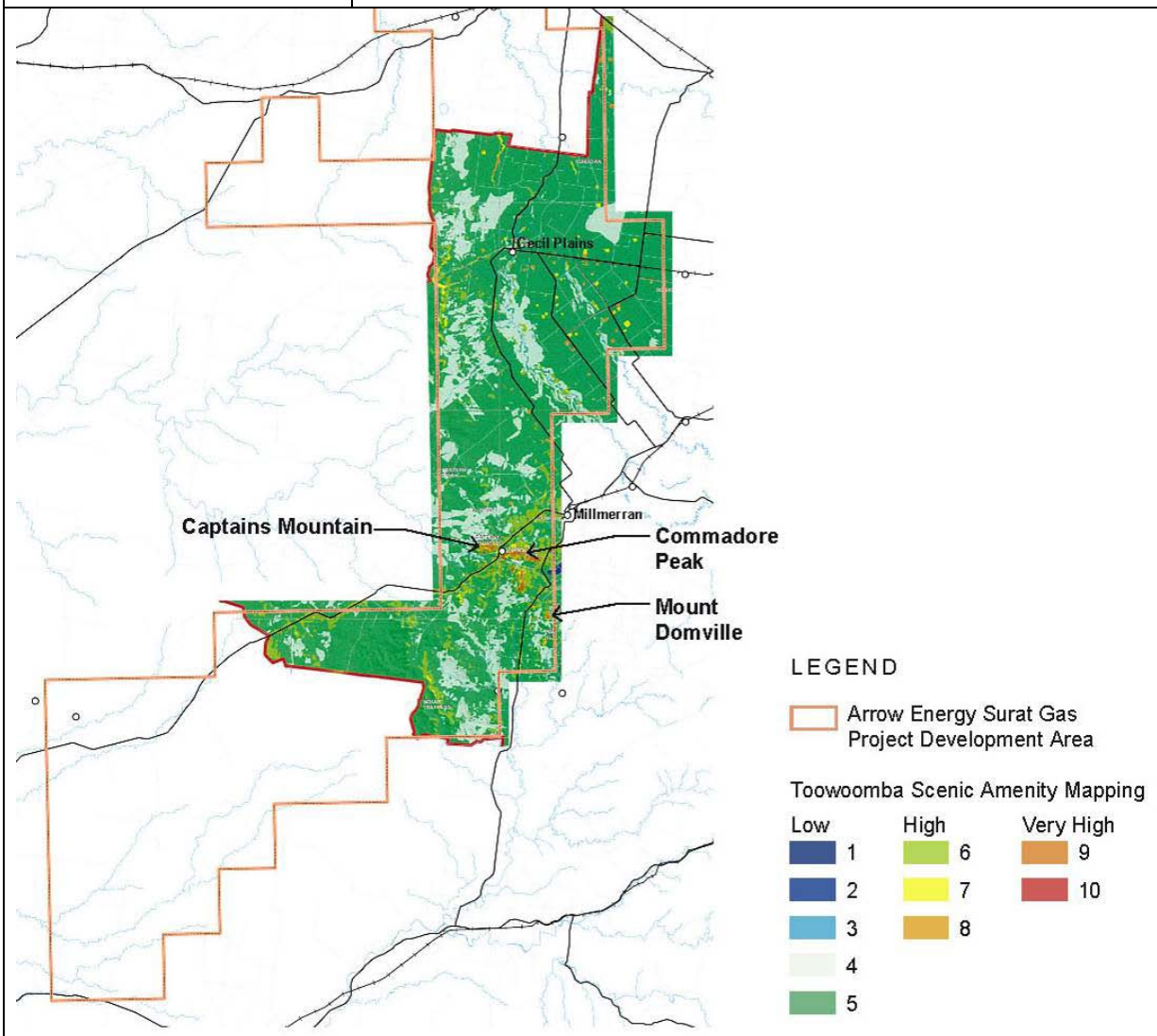
| | study area which sits in the Toowoomba Region (i.e. surrounding Millmerran) is considered to be of moderate scenic preference. |




**Toowoomba Scenic Amenity Mapping within the Arrow Surat Gas Project Development Area**
(Source: Map 4, Toowoomba Regional Council Scenic Amenity Study 2010)

| ***Jondaryan Shire Planning Scheme 2009*** | |
|---|---|
| **Policy** | **Purpose / intent** |
| 'Rural Zone' Code: Character / Landscape | A key objective of this code is to ensure "*development in rural areas is compatible with the desired character and amenity of the area, and with the scenic and landscape values of the area*". In particular, it seeks to:<br>- *"retain existing native vegetation; and effectively screen all non-residential buildings, structures and outdoor use areas from view from surrounding roads and dwellings*"<br>- maintain "*important views to and/or across the site*"<br>- minimise "*disruption to the natural profile of the land*"<br>- minimise "*visual scarring from development*"<br>- ensure "*development is designed and located to protect the air, water and soil quality*" |
| Conservation Overlays Code | A key objective of this code is to ensure that '*areas contributing to the landscape and visual character of the Shire are protected including, Gowrie* |

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| | *Mountain and other significant landforms such as the hill in the south of Oakey Town*' (both features are outside the project development area). In addition, it seeks to protect and enhance '*remnant regional ecosystems, the catchment area of Lake Broadwater... vegetation corridors that link major habitats, and riparian corridors, including those along the Condamine River, Oakey Creek...and Ashall Creek*'. The code suggests an acceptable solution (AS1) would be to locate '*buildings and associated infrastructure...a minimum of 20m from remnant vegetation on and adjacent to the site e.g. within an already cleared area, disturbed area with little potential for rehabilitation, weedy area, an area away from other significant landscape features (e.g. Remnant vegetation along waterways)*'. The code also advocates retaining and protecting '*habitat trees'* (>80cm diameter) and retaining/rehabilitating '*remnant native vegetation*' along each side of watercourses (minimum 25m of each high bank) through their inclusion in open space areas and/or vegetated buffers. Mitigation measures should seek to avoid '*habitat trees'* in the detailed siting of wells or the clearance zones. |
| ***Millmerran Shire Planning Scheme 2006*** | |
| **Policy** | **Purpose / intent** |
| The Environment | "*The Environment*" is one of the three desired environmental outcomes for guiding development in Millmerran Shire. Its purpose is to ensure "*areas of high scenic amenity, remnant vegetation, wetlands, fauna habitats and wildlife corridors and regionally significant open space are protected*" through compatible development. |
| PC 9 Gas, Recycled Water and Oil Pipelines | The purpose of this code is to ensure that "*buildings are located at an appropriate distance from pipelines*" through a minimum 100m buffer between habitable structures and gas pipeline corridors. |
| PC 14 Watercourses | The purpose of this code is to ensure the integrity of riparian areas is maintained through a minimum 10m vegetated buffer from the "*high bank of any watercourse*". |
| PC 19 Excavation and filling | The purpose of this code is to ensure "*both the amenity and safety of users of the site and adjacent land holdings*" is maintained throughout excavation and filling activities. |
| ***Pittsworth District Planning Scheme 2009*** | |
| **Policy** | **Purpose / intent** |
| Overall outcomes for the 'Rural Zone' | A key outcome for this zone is to ensure the integrity of existing "*rural industries*" and "*sites of conservation importance, including cultural and high landscape values*" are protected, so as to ensure "*incompatible uses do not prejudice or impact upon operations*" of these activities or values. |
| 'Rural Zone': PC 7 Gas Pipeline and Electricity Transmission Line | The purpose of this code is to ensure "*buildings are located at an appropriate distance from the gas pipeline*" and advocates a 200m minimum buffer between habitual structures and gas pipeline routes. |
| 'Rural Zone': PC 10 Watercourses / Wetlands / Lakes | The purpose of this code is to ensure the protection of riparian areas and advocates a "*minimum 50m wide development free buffer area is provided extending out from the high bank of any watercourse or edge of all freshwater wetlands*". |
| 'Rural Zone': Extractive Industry –PC 24 Amenity | The purpose of this code is to ensure extractive industry is "*excluded from localities which are, or which adjoin, areas proposed to be residential localities*" and "*haulage traffic does not use routes through residential or rural residential streets*". |
| 'Rural Zone': Extractive Industry –PC 25 Environment | The purpose of this code is to ensure extractive industries do not "*adversely impact on threatened flora and fauna species*". |
| 'Rural Zone': Extractive Industry –PC 27 Landscaping | The purpose of this code is to ensure "*landscaping is utilised where screening of site* [extractive] *activities would reduce adverse aesthetic impact on adjoining land uses*". |
| 'Rural Zone': Extractive Industry –PC 30 Rehabilitation | The purpose of this code is to ensure extractive sites are "*rehabilitated to restore environmental values and prevent degradation of disturbed areas*". |

| **Western Downs Regional Council** | |
|---|---|
| ***Chinchilla Planning Scheme 2006*** | |
| **Policy** | **Purpose / intent** |
| Natural Environment | "*Natural Environment*" is one of the three desired environmental outcomes for guiding development in Chinchilla Shire. Its purpose is to ensure the "*environmental and landscape values and historic significance*" of key natural and cultural areas (including the Condamine River, its tributaries and floodplain) are "*protected and enhanced through compatible development*". |
| ***Dalby Town Planning Scheme 2007*** | |
| **Policy** | **Purpose / intent** |
| The Natural Environment and Leisure | "*The Natural Environment and Leisure*" is one of the seven principles for guiding development in the Town of Dalby. The purpose of the principle is to ensure the integrity of "*natural environment including surface and ground water quality, air quality, habitat corridors, remnant vegetation and ecological values*". The Policy seeks to mitigate "*any potentially adverse impacts on the scenic qualities of Dalby including the Myall Creek corridor, views to the Bunya Mountains and the attractive rural vistas over farmland*". |
| ***Murilla Shire Planning Scheme 2006*** | |
| **Policy** | **Purpose / intent** |
| The Environment | "*The Environment*" is one of the three desired environmental outcomes for guiding development in Murilla Shire. Its purpose is to ensure the "*environmental, landscape values and historic significance*" of key natural and cultural areas (including the Condamine River, its tributaries and floodplain, and the Wildflower Area in Gurulmundi State Forest [outside the project development area]) are "*protected and enhanced through compatible development*". |
| ***Shire of Tara Planning Scheme (2005)*** | |
| Community Wellbeing: Heritage and Character | The objective of this desired environmental outcome is to ensure the "*existing character*" and "*sense of place*" of country towns and settlements, open spaces, natural areas and rural landscapes is maintained and enhanced. |
| Extractive Industry Code | (See above Shire of *Waggamba Shire Council Planning Scheme*) |
| Filling and Excavation Code | The purpose of this code is to ensure filling and/or excavation that results in a significant change to natural ground level is "*visually compatible with the local environment*". |
| ***Taroom Shire Planning Scheme 2006*** | |
| **Policy** | **Purpose / intent** |
| The Environment | "*The Environment*" is one of the three desired environmental outcomes for guiding development in Taroom Shire. Its purpose is to ensure the "*environmental, landscape values and historic significance*" of key natural and cultural areas (including Expedition National Park, Isla Gorge National Park, Precipice National Park, Lake Murphy Conservation Park, Carraba Conservation Park, Glen Leigh Environmental Reserve, Expedition Resources Reserve, Stones Country Resources Reserve, and important wetlands at Palm Tree Creek and Robinson Creek [all outside the project development area]) are "*protected and enhanced through compatible development*". |
| ***Wambo Shire Council Planning Scheme (2005)*** | |
| **Policy** | **Purpose / intent** |
| The Environment | "*The Environment*" is one of the three desired environmental outcomes for guiding development in Wambo Shire. Its purpose is to ensure the "*environmental, landscape values and historic significance*" of key natural and cultural areas (including the Condamine River, its tributaries and floodplain, Lake Broadwater, and the Bunya Mountains [outside the project development area]) are "*protected and enhanced through compatible development*". |
| 'Bunya Mountains Zone' Code: | This code ensures that development within the Bunya Mountains Zone |

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|---|---|
| PC25 Cultural Heritage | includes a landscape strategy that will positively "*contribute to the character of the Bunya Mountains whilst protecting the environmental qualities*" [does not apply to the project development area]. |
| **Material change of use performance criteria codes which are applicable to several planning schemes, including Chinchilla, Inglewood, Murilla, Taroom, Wambo and Waggamba** | |
| **Policy** | **Purpose / intent** |
| 'Rural Zone' Code: PC6 Height | The purpose of this code is to ensure that buildings and structures doe not "*impact adversely on the amenity of the rural zones and is consistent with the predominant rural form*". |
| 'Rural Zone' Code: PC10 Ridgelines and Escarpments | The purpose of this code is to ensure that "*ridgelines and escarpments are maintained in a natural state to protect rural character and landscape values*" in "*rural areas*", through a minimum 50m separation distance between buildings or structures and the ridgeline or escarpment (with the exception of "*rural operational equipment*" e.g. windmills). |
| 'Rural Zone' Code: PC11 Landscaping and External Activity Areas | The purpose of this code is to ensure that landscape strategies associated with development in rural areas "*contribute to a pleasant and functional rural built form*" and "*contribute to the Rural Zone's positive visual qualities*". |
| 'Rural Zone' Code: PC12 Lighting | The purpose of this code is to ensure that the "*design of lighting does not prejudice the amenity of the Rural "Zone" through poorly directed lighting, lighting overspill or lighting glare*". |
| Rural Zone' Code: PC24 Watercourses and Lakes | The purpose of this code is to ensure that development in rural areas will not adversely affect riparian areas and water quality; suggesting a minimum 50m wide vegetated buffer "*from the high bank of any watercourse or lake*". |
| Rural Zone' Code: PC25 Vegetation Retention | The purpose of this code is to ensure that development in rural areas retains vegetation for "*protection of scenic quality*" and "*establishment of open space corridors and networks*". |
| 'Rural Zone' Code: PC40 Protected Areas (PC 35 for Inglewood Shire) | The purpose of this code is to ensure that development in rural areas "*is undertaken to ensure the protection of areas of significant biodiversity and habitat value and high scenic quality*". |
| 'Rural Zone' Code: PC43 Extractive Industries (PC 42 for Inglewood Shire) | This code advocates the "*protection and maintenance of environmental values...local environment and amenity*" when designing extractive industry facilities. |

# 4.0 Method of assessment

## 4.1 Introduction

### 4.1.1 Key references

There are currently no accepted national or state level guidelines for LVIA in Australia. Therefore, the method used for this LVIA has been developed with reference to accepted guidelines from elsewhere, principally:

- The Landscape Institute and the Institute of Environmental Management and Assessment, UK (2002). *The Guidelines for Landscape and Visual Impact Assessment, Second Edition*.

Other relevant guidance notes and documentation used in the assessment include:

- The Landscape Institute, UK (2011). *Landscape Institute Advice Note 01/11: Photography and photomontage in landscape and visual impact assessment*.
- Scottish Natural Heritage and The Countryside Agency, UK (2006). *Topic Paper 6: Techniques and Criteria for Judging Capacity and Sensitivity*.
- Scottish Natural Heritage (2006). *Visual Representation of Windfarms: Good Practice Guidance*.

### 4.1.2 Types of impacts

The LVIA methodology is applicable to the assessment of:

- Short term impacts during the installation of the project including the field compression facilities (FCFs), central gas processing facilities (CGPFs), integrated processing facilities (IPFs), water storage systems, wellheads, field gas and water gathering systems, and major items of temporary construction infrastructure such as temporary construction camps, fencing and compounds);
- Long term impacts during operation of the project (25 year minimum project life); and
- Short term impacts during the decommissioning of the project.

The assessment of residual impact is made assuming that all mitigation measures (see Section 8) have been fully integrated into the project, including landscaping and planting, as well as, recommendations on the siting of specific components of the project.

### 4.1.3 Assessment limitations

There are a number of limitations associated with this assessment, as follows:

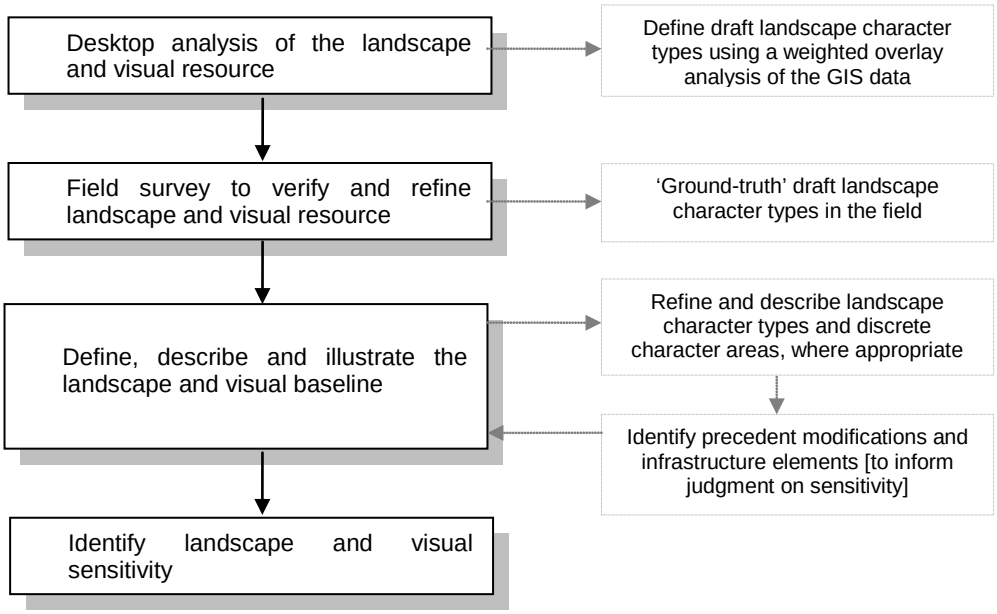
- In order to appraise the impact of the project upon landscape resources, views and visual amenity, general assumptions on the visual appearance of coal seam gas facilities have based upon similar projects (including Daandine and Tipton West which are similar facilities currently operated by Arrow) and specialist advice from Arrow, Coffey Environments and other environmental impact statement (EIS) specialist consultants.
- The LVIA process aims to be objective and describe factually any anticipated changes to landscape resources, views and visual amenity. Potential changes as a result of the project have been defined; however, the significance of these changes requires qualitative (subjective) judgements to be made. The conclusions to this assessment therefore combine objective measurement and professional interpretation.
- The exact quantity, scale and location of the coal seam gas facilities (including the FCFs, CGPFs, IPFs, production wells and water storage facilities) across the entire project development area had not been defined at the time of writing this assessment; however it is assumed that there will be:
    - Six FCFs, six CGPFs and six IPFs and associated water storage facilities located across the five development regions in the project development area, in locations that are yet to be determined.
    - Approximately 7,500 production wells over the life of the project across the project development area located on an approximate 800m grid spacing (with the flexibility of 700m to 1,500m spacing to avoid environmental and physical constraints).

- This assessment considers surface level impacts on the landscape resource, views and visual amenity. Impacts on ecology, soils, groundwater and hydrology are being assessed by other consultants on the EIS team. This assessment does not therefore consider potential changes in land use and/or land cover as a result of impacts on these other environmental features and any subsequent changes in landscape character.

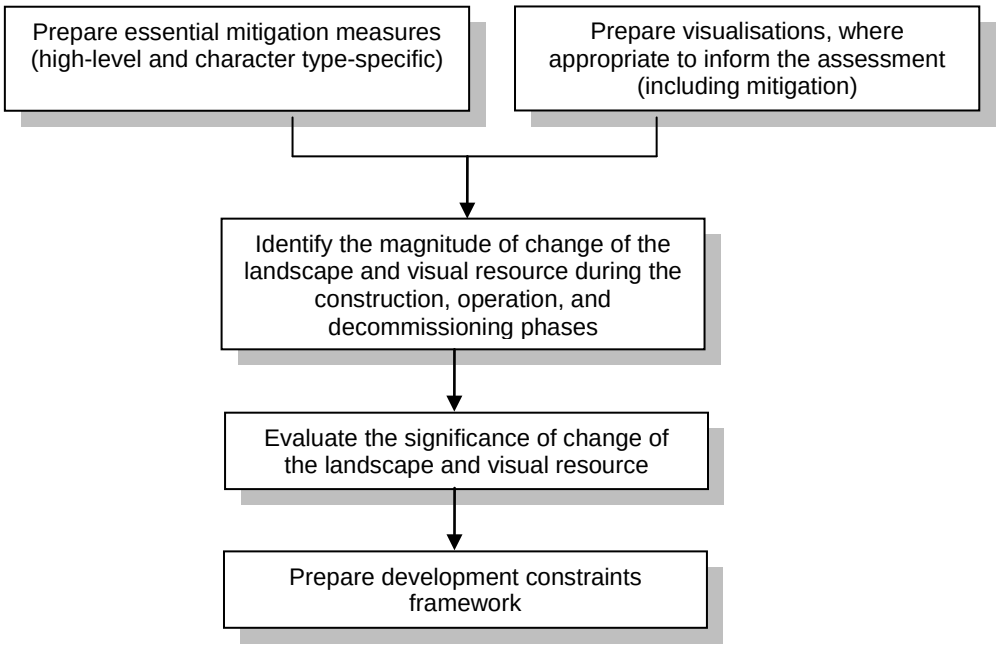
## 4.2 Key steps in LVIA

Key steps of the LVIA are illustrated on the following page.

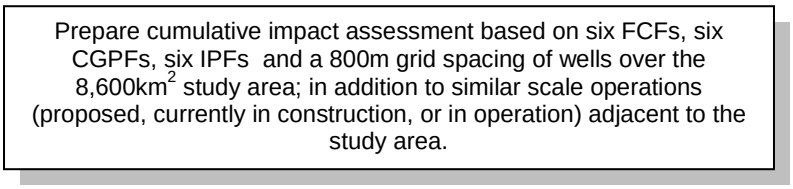
**1. DESCRIPTION OF THE LANDSCAPE AND VISUAL RESOURCE**




**2. EVALUATION OF THE LANDSCAPE AND VISUAL RESOURCE**




**3. CUMULATIVE ASSESSMENT OF LANDSCAPE AND VISUAL IMPACTS**




These steps are described in more detail below.

### 4.2.1 Desktop analysis of the landscape and visual resource

The first task in the landscape and visual assessment involved gathering existing data and other information within the study area. Key information sources included documents and maps on:

- Planning schemes from relevant Local Councils;
- Digital aerial photography;
- Cadastral data (showing roads and all major features, built areas, etc);
- Hydrology/riparian corridors;
- Land use;
- Geology and soils;
- Vegetation (including Queensland Regional Ecosystem Maps);
- Land Resource Area Mapping (Department of Natural Resources and Mines);
- Existing infrastructure e.g. transmission lines;
- Important cultural heritage features e.g. Jimbour House; and
- Designated Tourist Drives, e.g. Adventure Way.

Using this information, a preliminary desktop analysis of the study area's landscape and visual resource was undertaken to inform the baseline assessment. This included analysis of the underlying landscape (e.g. geology, soils, topographical structure), land cover (e.g. vegetation, land use, settlement pattern), landscape value (e.g. reflected in scenic routes/trails and landscape designations including national parks and conservation reserves), and desk-based site analysis (e.g. identification of recognised panoramas and views, key landmarks, such as local peaks).

Where appropriate, Geographic Information System (GIS) analysis was undertaken to assist the assessment e.g. preparation of Digital Elevation Modal (DEM) (see **Figure 2**) and slope analysis. Following this, draft landscape character types were defined using a weighted overlay analysis of the GIS data. This formed the basis of field verification.

### 4.2.2 Field survey to verify and refine landscape and visual resource

Field visits were carried out in October and November 2009 to ground truth the findings of the desktop assessment and take photographs to (a) portray landscape character, (b) inform the viewpoint assessment and selection of viewpoints, and (c) provide data for the production of photographic simulations and visualisations. The field visits focussed on those aspects of the landscape with potential to be of the greatest sensitivity to project activities and gaining an appreciation of those aspects of the project most likely to affect landscape and/or visual values. Records were made in the form of GPS point data, field notes and photographs.

### 4.2.3 Definition, description and illustration of the landscape baseline

Landscape character assessment is a tool for identifying what makes one place different from another. It identifies what makes a place distinctive, without necessarily assigning a value to it. This approach has been used to establish a baseline audit of the current character of the landscape and to provide a framework for measuring the impact of the project.

Broad 'landscape character types' have been defined and provide a framework for describing an area systematically, ensuring judgements can be made based on knowledge of what is distinctive so that changes can respect local character where possible. An understanding of landscape character can be particularly helpful in informing the design and location of new elements in the landscape and especially the design of new built development and potential to apply different types of mitigation.

In summary, the baseline landscape character assessment involved mapping and describing broad landscape character types and discrete landscape character areas within each type (where appropriate), based on the desk-based study, field surveys and liaising with specialists within the EIS project team for more information e.g. in relation to cultural heritage, ecology, soils/geology. Each character type considers:

- Landscape elements e.g. pasture, crops, drainage channels, river/creek corridors, bushland, mature bushland corridors alongside roads, cultural plantings (e.g. planting along property entrance drives).
- Landscape character (including scale, grain and perceptual characteristics such as the sense of remoteness, tranquillity and/or its perceived rural character).
- Landscape value (e.g. landscapes designated for their scenic or landscape importance or valued

recreational function).

The baseline assessment also considers factors which have influenced landscape change in the past and those that are likely to do so in the future e.g. recreational demands, changing agricultural practices, development pressures.

#### 4.2.4 Definition, description and illustration of the visual baseline

The visual baseline is assessed and described in terms of views from selected representative viewpoints within the study area. Likely viewers (visual receptors) who would experience views from these locations include:

- Residents living in settlements and on rural properties (including homesteads and cottages) near the project, particularly the CGPFs and IPFs;
- People working in the countryside or towns;
- Tourists passing through the study area by vehicle, including travellers along designated scenic routes (e.g. 'Adventure Way', between Brisbane and Adelaide) or recreational trails (e.g. Dingo Fence Tourist Drive);
- Recreational users of the landscape on foot or vehicle, including those visiting Lake Broadwater, Jimbour House and state forests;
- Travellers using major and minor roads within the study area, including motorists on the Warrego, Moonie and Leichhardt Highways.

**Selection of representative viewpoints**

Viewpoints were selected in each landscape character type that were representative of the range of views and types of viewers likely to be affected by the project. The location of each viewpoint was recorded on site using a hand-held GPS system. The locations are shown on **Figure 6** and described in *Section 5.*

Photographs were taken by AECOM (during October and November 2009) with a digital single lens reflex (SLR) camera and 35mm digital lens (equivalent of a 50mm focal length lens on a 35mm film camera). Photo stitching software (Canon *PhotoStitch*) was used to piece together the adjoining images. Photographs were used in the visualisation process.

#### 4.2.5 Identification of landscape and visual sensitivity

This step involved classification of the sensitivity of the landscape and viewers (visual receptors) to the project.

The sensitivity of a landscape is determined based on the extent to which it is susceptible or vulnerable to change of a particular type and scale. Sensitivity varies according to the type of development proposed and the nature of the landscape, including:

- Its inherent landscape value (its condition, perceptual qualities, cultural importance, and any specific values that may apply e.g. planning designations based on scenic amenity); and
- The likely congruency of the proposed change (i.e. the extent to which the proposal may fit or be 'visually absorbed' into the scale, landform, land use, pattern, texture of the existing landscape).

For the purposes of this assessment, the sensitivity of a viewpoint is considered to be dependent upon:

- The importance of the view i.e. the scenic qualities of the view, including the presence of other existing manmade elements in the view; and
- The visual receptor (type and volume of viewers); for example, residents and visitors to important/valued landscapes or a designated lookout point, are considered to have a higher sensitivity to their visual environment than, say, visitors to non-designated areas or motorists passing through the broader landscape.

In this assessment, sensitivity is described as *negligible, low*, *medium* or *high* as defined and illustrated in **Table 2** (landscape impacts) and **Table 3** (visual impacts).

#### 4.2.6 Preparation of essential mitigation measures

The preliminary stage of the Surat Gas Project allows some design principles (high-level and landscape character type-specific) to be established as parameters for Arrow's development strategy as part of an iterative process. These parameters may relate to the detailed design, installation, ongoing maintenance and eventual decommissioning phases of the project. Critical measures include options for the siting of new buildings and structures and the provision of hard and soft landscaping (earthworks and planting).

#### 4.2.7 Preparation of visualisations

Visualisations have been compiled to illustrate the potential visual impact of the production wells and IPFs in each

landscape character type. The visualisations have been created from the baseline viewpoints, using 3D AutoCAD drawings issued by Arrow in combination with SketchUp and Photoshop for rendering. Both the "unmitigated" (i.e. does not include any mitigation measures or standard operating procedures) and "mitigated" projects have been represented.

In interpreting the visualisations, two important issues must be considered:

- There is an element of judgement inherent in the representation of changes shown in a photomontage. While the data sources are largely factual, or based on the judgement of professionals, the finished image is ultimately what the modeller believes to be a reasonable imitation of a photograph of the completed project taken in similar conditions; and
- Each photomontage incorporates the lighting seen in the base photograph. It therefore only truly represents the appearance of the project as it would have appeared at that time on that day. The perceptibility of the changes and the visual character of elements of the project will differ under different weather or lighting conditions.

#### 4.2.8 Preparation of zones of theoretical visibility

A 'Zone of Theoretical Visibility' (ZTV) comprises a mapped representation of the area within which a proposed development may have an influence or effect upon views and visual amenity; and is often used as a tool to select representative viewpoints for more detailed assessment. ESRI ArcGIS software has been used to model the ZTV for this LVIA.

Each visualisation is supported by a ZTV which indicates the approximate visibility of the production well and/or IPF in the relevant landscape. The ZTV has been created using ESRI ArcGIS software and 3D AutoCAD drawings issued by Arrow in conjunction with available digital terrain data (20 x 20 metre cell size). Significant blocks of dense vegetation have also been digitised (average vegetation height of 14m has been used) to indicate the role of landform and vegetation within each landscape. In defining the study area for the ZTVs:

- A 10km radius study area for the ZTV of selected representative IPF locations (maximum height of buildings is 12m, excluding the flare and power line structures) has been used to capture all likely significant impacts associated with the operation of this project component;
- A 2km radius study area for the ZTV of any selected representative production well locations (maximum height of the tallest component at the production well sites is approximately 3.2m) has been used to capture all likely significant impacts associated with the operation of this project component.

In interpreting the ZTV, two important issues must be considered:

- The accuracy of the ZTV is affected by the limitation of the contour data that was available for the study area (i.e. 20m contours). Whilst this has been refined by digitally interpolating between the known contour lines to create a more comprehensive model, detailed variations in ground plane are not factored into the ZTV;
- The ZTV was based on the ground surface elevation only, and does not take account of all intervening vegetation (only significant blocks of dense vegetation have been digitised using aerial photos supplied for the project in conjunction with Google Earth imagery), buildings or minor changes in topography, such as road cuttings. Where such features intervene between the viewer and the project (e.g. tree belts alongside roads), then this local visual screening will reduce the visibility of the project components.

#### 4.2.9 Identification and assessment of residual impacts

The residual impact assessment involved:

- Consideration of the "whole of project" impact of the Surat Gas Project (due to the variation of intensity between different parts of the study area i.e. phasing and focus of activity); as well as,
- The residual impact of the project on each landscape character type during construction/installation, operation and maintenance, and decommissioning/rehabilitation.

The following key steps have been taken to assess as the residual impact of the project activities on each landscape character type:

**Identify magnitude of change on the landscape and visual resource**

This step involved prediction of the magnitude of change in the landscape or the view, resulting from the project, taking into account the embedded (designed in) mitigation defined in *Section 8*.

The magnitude of change affecting a landscape or visual receptor depends on the nature, scale and duration of

the particular change that is expected to occur. In a landscape, the magnitude of change will depend on the loss, change or addition of any feature, or any change in the backdrop to, or outlook from, a landscape that affects its character. The effect on a view will depend on the extent of visibility, degree of obstruction of existing features, degree of contrast with the existing view, angle of view, duration of view and distance from the development.

Magnitude of change is described as being *imperceptible, noticeable, considerable* or *dominant.*

**Evaluation of significance of change**

This step involved evaluation of the significance of residual landscape and visual impacts depending on the sensitivity of the landscape or viewer to change, the magnitude of change, and residual effects (including mitigation measures).

No established, measurable technical thresholds of significance exist for landscape and visual impacts (see *paragraph 7.42, page 94* in *The Guidelines for Landscape and Visual Impact Assessment*, LI and IEMA, 2002). Significance is therefore determined by considering the sensitivity of the landscape or visual receptor and the magnitude of change expected as a result of the development. Professional judgement and experience are applied on a case by case basis to identify broad levels of significance for each receptor. Each case is assessed on its own merits as factors unique to each circumstance need to be considered. General principles can be used as a guide to this process and provide transparency about how judgements have been made. These principles are set out in the following diagram and Tables 2 and Table 3.

**Approach to evaluating the significance of change**

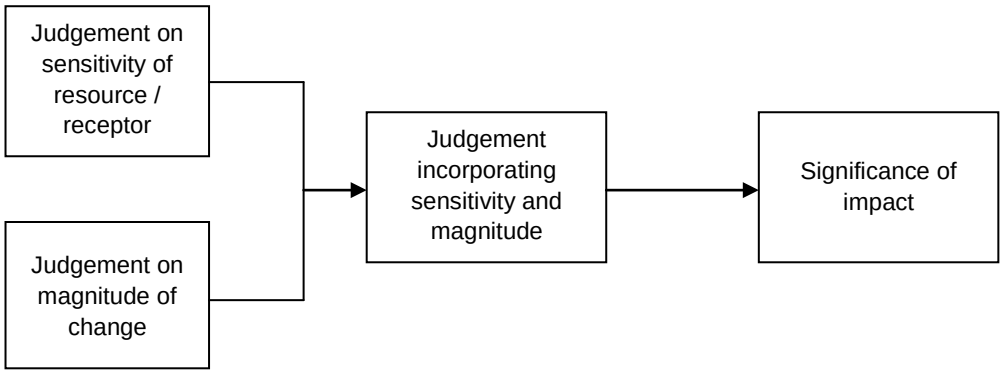


**Table 2 Levels of Significance of Landscape Impacts**

| | | | Magnitude of change in landscape caused by proposed development | | | |
|---|---|---|---|---|---|---|
| | | | **Dominant change** | **Considerable change** | **Noticeable change** | **Imperceptible Change** |
| | | | A clearly evident and frequent/continuous change in landscape characteristics affecting an extensive area, which is likely to fundamentally change the character of the landscape. | A considerable change in landscape characteristics, frequent or continuous and over a wide area or a clearly evident (or dominant) change over a restricted area. | A noticeable change in landscape characteristics over a wide area, or a considerable change over a restricted area, but will not fundamentally change the character of the landscape. | An imperceptible, barely or rarely perceptible change in landscape characteristics. |
| **Sensitivity of landscape to proposal** | **High** | **Indicator**<br>A landscape protected by national designation and/or widely acknowledged for its quality and value; a landscape with distinctive character and low capacity to accommodate the type of change envisaged. | **Major** | **Moderate to major** | **Moderate** | **Minor to moderate** |
| | **Medium** | A moderately valued landscape, perhaps a regionally important landscape and/or protected by regional/state designation, or where its character, land use, pattern and scale may have some capacity to accommodate a degree of the type of change envisaged. | **Moderate to major** | **Moderate** | **Minor to moderate** | **Minor** |
| | **Low** | A landscape valued to a limited extent, perhaps a locally important landscape, or where its character, land use, pattern and scale is likely have the capacity to accommodate the type of change envisaged. | **Moderate** | **Minor to moderate** | **Minor** | **Minor to not significant** |
| | **Negligible** | A landscape which is not valued for its scenic quality or where its character, existing land use, pattern and scale are tolerant of the type of change envisaged, and the landscape has capacity to accommodate change. | **Minor to moderate** | **Minor** | **Minor to not significant** | **Not significant** |

This table is a guide only. The descriptions of magnitude and sensitivity are illustrative only. Each case is assessed on its own merits using professional judgement and experience, and there is no defined boundary between levels of impacts.

**Table 3 Levels of Significance of Visual Impacts**

| | | | Magnitude of change in view caused by proposed development | | | |
|---|---|---|---|---|---|---|
| | | | **Dominant change** | **Considerable change** | **Noticeable change** | **Imperceptible Change** |
| | | | Major changes in view at close distances, affecting a substantial part of the view, continuously visible for a long duration, or obstructing a substantial part or important elements of view. | Clearly perceptible changes in views at intermediate distances, resulting in either a distinct new element in a significant part of the view, or a more wide-ranging, less concentrated change across a wider area. | Minor changes in views, at long distances or visible for a short duration, and/or are expected to blend in with the existing view to a moderate extent. | Change which is barely visible, at a very long distance, or visible for a very short duration, and/or is expected to blend with the existing view. |
| **Sensitivity of viewpoint to proposal** | **High** | **Indicator** | | | | |
| | | Large numbers of viewers or those with proprietary interest and prolonged viewing opportunities such as residents and users of attractive and/or well-used recreational facilities. Views from a regionally important location whose interest is specifically focussed on the landscape e.g. Jimbour House, Lake Broadwater Conservation Park. | **Major** | **Moderate to major** | **Moderate** | **Minor to moderate** |
| | **Medium** | Medium numbers of residents and moderate numbers of visitors with an interest in their environment e.g. visitors to State Forests, including bush walkers, horse riders, trail bikers. Larger numbers of travellers with an interest in their surroundings e.g. designated scenic routes such as 'Adventure Way'. | **Moderate to major** | **Moderate** | **Minor to moderate** | **Minor** |
| | **Low** | Small numbers of visitors with a passing interest in their surroundings e.g. those travelling along principal roads. Viewers whose interest is not specifically focussed on the landscape e.g. workers, commuters. | **Moderate** | **Minor to moderate** | **Minor** | **Minor to not significant** |
| | **Negligible** | Very occasional numbers of viewers with a passing interest in their surroundings e.g. those travelling along minor roads e.g. those travelling along minor routes. | **Minor to moderate** | **Minor** | **Minor to not significant** | **Not significant** |

This table is a guide only. The descriptions of magnitude and sensitivity are illustrative only. Each case is assessed on its own merits using professional judgement and experience, and there is no defined boundary between levels of impacts. A large number of viewers in a category that would otherwise be of low or moderate sensitivity may increase the sensitivity of the receptor.

Using these tables as a basis for assessment, a judgement is made regarding the level of significance of the impact, which is described as being *not significant*, *not significant to minor*, *minor, minor to moderate*, *moderate*, *moderate to major* or *major*. There is often a gradual transition between levels of significance; and where impacts lie on the borderline they may be described, for example as minor to moderate.

Impacts which are graded as being *moderate*, *moderate to major* or *major* are those which the LVIA team consider should be given greatest weight in decision making, relative to other levels of landscape and visual impact. They usually concern immediate landscapes around proposed IPF sites and close views seen by sensitive viewers. Impacts which are graded as being *minor to moderate* levels of impact or less, also constitute effects which warrant consideration, but the team consider these should individually carry little weight in the decision making process.

Impacts are described as being adverse (negative) or beneficial (positive). They can be direct (i.e. directly or physical affecting a landscape resource) or indirect (i.e. physical changes elsewhere which affect the landscape character or views within adjacent or more distant areas). Impacts can be short term (i.e. those occurring during installation/construction of a development) or long term (i.e. those lasting for the life time of the project). In addition, they can be wide-spread or localized.

### 4.2.10 Preparation of development constraints framework

This step translates the 'significance' of an impact on the landscape and visual resource into a level of constraint on each landscape character type, based on the Arrow Surat Gas Development Project Risk-based Framework Approach[1]. In effect, the level of constraint reflects the capacity of the landscape and visual resource to absorb and adjust to impacts arising from the project. Constraints are assigned on the basis of the development constraints framework set out in **Table 4**.

**Table 4 Development Constraints Framework**

| Judgement of Landscape and Visual Impact | Development Constraint | Applicable Framework |
|---|---|---|
| 'Major' | **High** | Very strict development activity and minimal access recommended in this landscape character type, due to the potential for severe or total change to the landscape character, which may detrimentally impact a large number of viewers or those with proprietary interest in the visual landscape and views. Controls should be aimed at integrating development activities with this landscape character type, including its inherent character and visual amenity. If development activity is required in this landscape, a separate detailed study on landscape and visual impact is recommended. |
| 'Moderate to major' | **Moderate** | The landscape character type is at risk of adverse changes to character. Standard operating procedures in conjunction with the application of standard mitigation measures (including mitigation measures specific to the landscape character types) are recommended where development activity occurs, to reduce the intensity of impact on landscape character, views and visual amenity. |
| • 'Moderate'<br>• 'Minor to Moderate'<br>• 'Minor'<br>• 'Minor to not significant'<br>• 'Not significant' | **Low** | There are limited landscape sensitivities and barely perceptible change is anticipated. Standard operating procedures in conjunction with the application of standard mitigation measures (including mitigation measures specific to the landscape character types) are recommended where development activity occurs. |

[1] Document Reference: Coffey Environments (14/12/09) *Arrow Energy Surat Gas Development Project Environmental Impact Statement: Risk-based Framework Approach*, Doc No. 7040_FrameworkApproach_v2.

### 4.2.11 Cumulative landscape and visual impact assessment

The aim of the cumulative landscape and visual impact assessment (CLVIA) is to describe and assess the ways in which the Surat Gas Project would have additional impacts when considered together with other existing, consented or proposed projects of a similar scale in the region. Information to inform the CLVIA is based on approximately five development regions (comprising a total of six FCFs, six CGPFs and six IPFs and water storage facilities) and an 800 m grid spacing of wells over the 8,600 $km^2$ project development area (approximately 7,500 production wells, and associated gas and water gathering infrastructure); in addition to similar scale projects, including other coal seam gas projects adjacent to the study area.

Cumulative landscape and visual impacts resulting from the project and other significant projects in the region are described in *Section 11.* Cumulative ZTVs have not been produced, due to the lack of “fixed location” and facility size information for the Surat Gas Project and other projects included in the CLVIA.

# 5.0 Landscape and visual baseline

## 5.1 Landscape baseline assessment

The study area contains a variety of landscapes including broad open arable plains, elevated native forest and wooded river valleys. The landscapes have been shaped by variations in geology, soils, landform, vegetation and the settlement, and use of these landscapes by people.

Topography within the study area varies subtly, and variations are often linked to changes in the underlying geology and soils. This is most apparent where the soils change from vertosols (largely flat topography) to sodosols (smoothly undulating topography), or where the landscape is influenced by volcanic geology associated with the Bunya Mountains, becoming more undulating and hilly. The topographic analysis of the study area is illustrated in **Figure 2**. The underlying geology and soils within the study area is shown in **Figure 3**.

Ten landscape types (each with discrete landscape character areas within) landscape character type have been identified within the study area, to provide a framework for describing the qualities and features which make each type/area unique. These are identified in **Figure 4** and **Table 5**.

**Table 5 Study area landscape character types and areas**

| | |
|---|---|
| **Type A: Wooded River Valley** | |
| A1 | Condamine Wooded River Valley |
| A2 | Dogwood Creek Wooded River Valley |
| **Type B: Settled Arable Plains** | |
| B1 | Chinchilla to Dalby Settled Arable Plains |
| B2 | Dalby to Tipton Settled Arable Plains |
| B3 | Kupunn Settled Arable Plains |
| B4 | Broadwater Reserve Settled Arable Plains |
| B5 | Cecil Plains Settled Arable Plains |
| B6 | Millmerran Settled Arable Plains |
| **Type C: Sodic Transitional Pastures** | |
| C1 | Wandoan Sodic Transitional Pastures |
| C2 | Chinchilla Sodic Transitional Pastures |
| C3 | Daandine-Ducklo Sodic Transitional Pastures |
| C4 | Kumbarilla Sodic Transitional Pastures |
| C5 | Grassdale Sodic Transitional Pastures |
| C6 | Cecil Plains-Millmerran Sodic Transitional Pastures |
| **Type D: Lowland Native Forest** | |
| D1 | Barakula Lowland Native Forest |
| D2 | Kogan to Braemar Lowland Native Forest |
| D3 | Kumbarilla-Western Creek Lowland Native Forest |
| D4 | Whetstone Lowland Native Forest |
| **Type E: Elevated Native Forest** | |
| E1 | Gurulmundi and Binkey Elevated Native Forest |
| E2 | Whetstone and Bringalily Elevated Native Forest |
| **Type F: Foothill Plains and Valleys** | |
| F1 | Wandoan Foothill Plains and Valleys |
| F2 | Jandowae to Jimbour Foothill Plains and Valleys |
| **Type G: Lowland Brigalow Plains** | |
| G1 | Goombi-Columboola Lowland Brigalow Plains |

| | |
|---|---|
| **Type H: Terraced Brigalow Farmland** | |
| H1 | Millmerran Terraced Brigalow Farmland |
| **Type I: Terraced Brigalow Farmland** | |
| I1 | Captains Mountain Forested Steep Hills |
| I2 | Mount Domville Forested Steep Hills |
| **Type J: Chromosol Undulating Lowlands** | |
| J1 | Kerimbilla Chromosol Undulating Lowlands |

Key characteristics of these character types are described in this section.

## 5.2 Visual baseline assessment

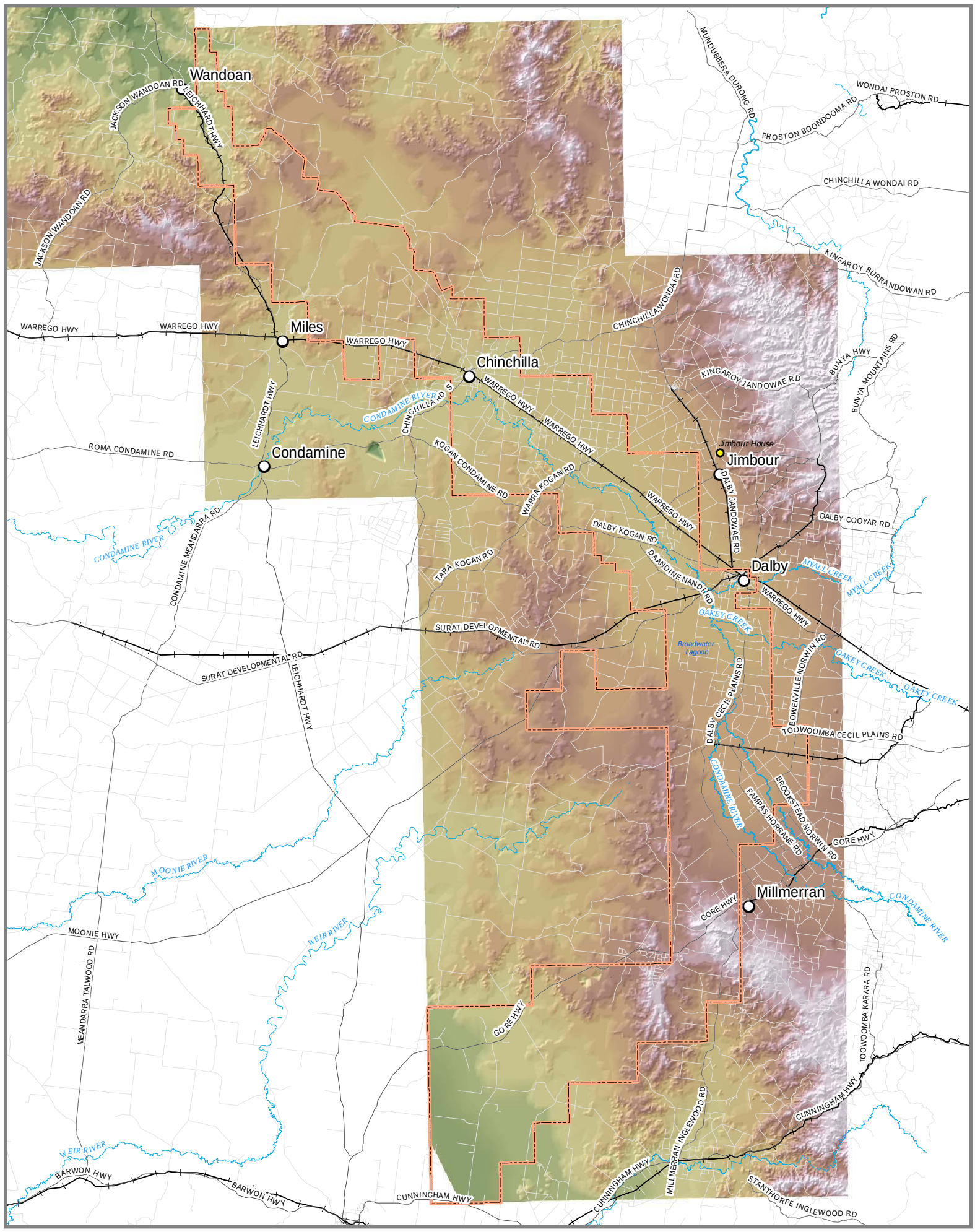
The visual baseline is described in terms of views from selected representative viewpoints within the study area, which respond to the location of residents, settlements, work places, recreational features, recognised vantage points, tourist trails and roads.

Key sensitive visual receptors in the study area are shown on **Figure 5**. With the exception of panoramic south-westerly views from Jimbour House and panoramic northerly views over Millmerran from Commodore Peak lookout, no 'known' prominent elevated locations or lookouts have been identified within the study area; however, the Toowoomba Regional Council 'Scenic Amenity Study' has identified Captains Mountain, Commodore Peak and Mount Domville as areas of high scenic amenity.

Key project components which may be visually prominent within the study area include:

- **Production wells:** the maximum height of the tallest component at the production well sites is approximately 3.2m. These are set within an approximate 10x 10m clearing and located at 800m grid spacing (this spacing will vary from 700 to 1,500m in response to environmental constraints, together with consideration of safety and landholder requirements).
- **FCFs:** the maximum height of proposed facilities within the FCFs is 12m; requiring a total land area of approximately 100m x 50m.
- **CGPFs and IPFs:** the maximum height of proposed facilities within the CGPFs and IPFs is 12m (not including the flare structure). The approximate land requirement of each CGPF (six proposed) is 600m x 250m. The approximate land requirement of each IPF (six proposed) is 800m x 250m (excluding the water storage facilities).
- **Water storage facilities:** the maximum height of the embankments of the proposed water storage facilities is 6m; which are located adjacent to the IPFs, requiring a total land area of approximately 1-2km$^2$.
- **Depots:** located in Dalby (extension to the existing Depot), Miles and Millmerran

Representative assessment viewpoints described for each of the landscape character types are shown on **Figure 6**. A description of the visual resource, including viewpoint descriptions, is provided below for each of the ten landscape character types.

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**LEGEND**

EIS study Area

Elevation

High : 860m

Low : 100m

| | |
|---|---|
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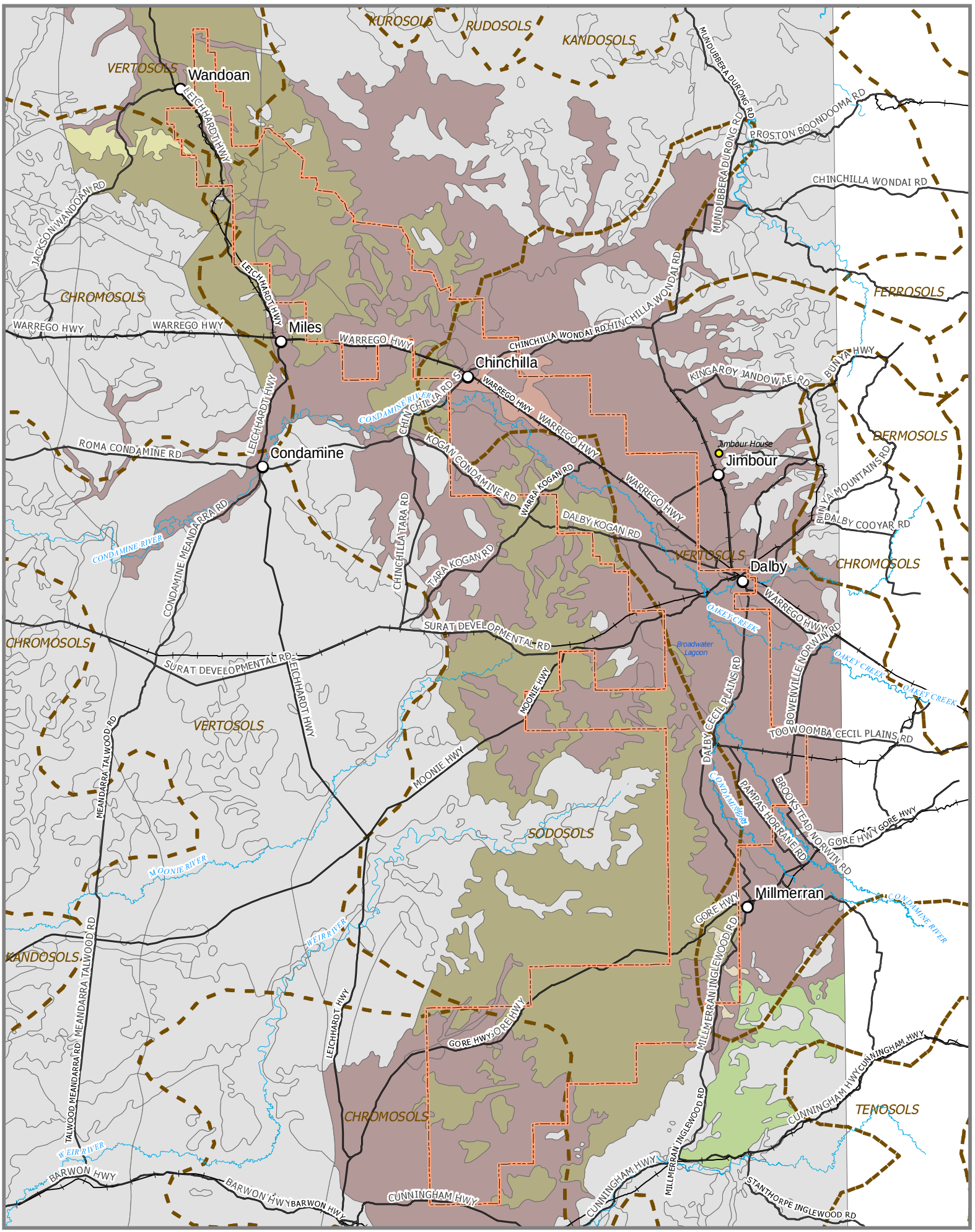
| CREATED BY | GW |
| LAST MODIFIED | GW FEB 2010 |

**FIGURE 2**
**TOPOGRAPHY**

**Arrow Energy**
**Surat Gas Project LVIA**

Figure

**F2**

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**LEGEND**

- EIS study Area
- Dominant Soils
- Dominate Geology
  - ALLUVIUM
  - ARENITE
  - ARENITE-MUDROCK
  - BASALT
  - GRANITOID
  - POORLY CONSOLIDATED SEDIMENTS
  - SEDIMENTARY ROCK
- OTHER

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| PROJECT ID | 09513140.01 |
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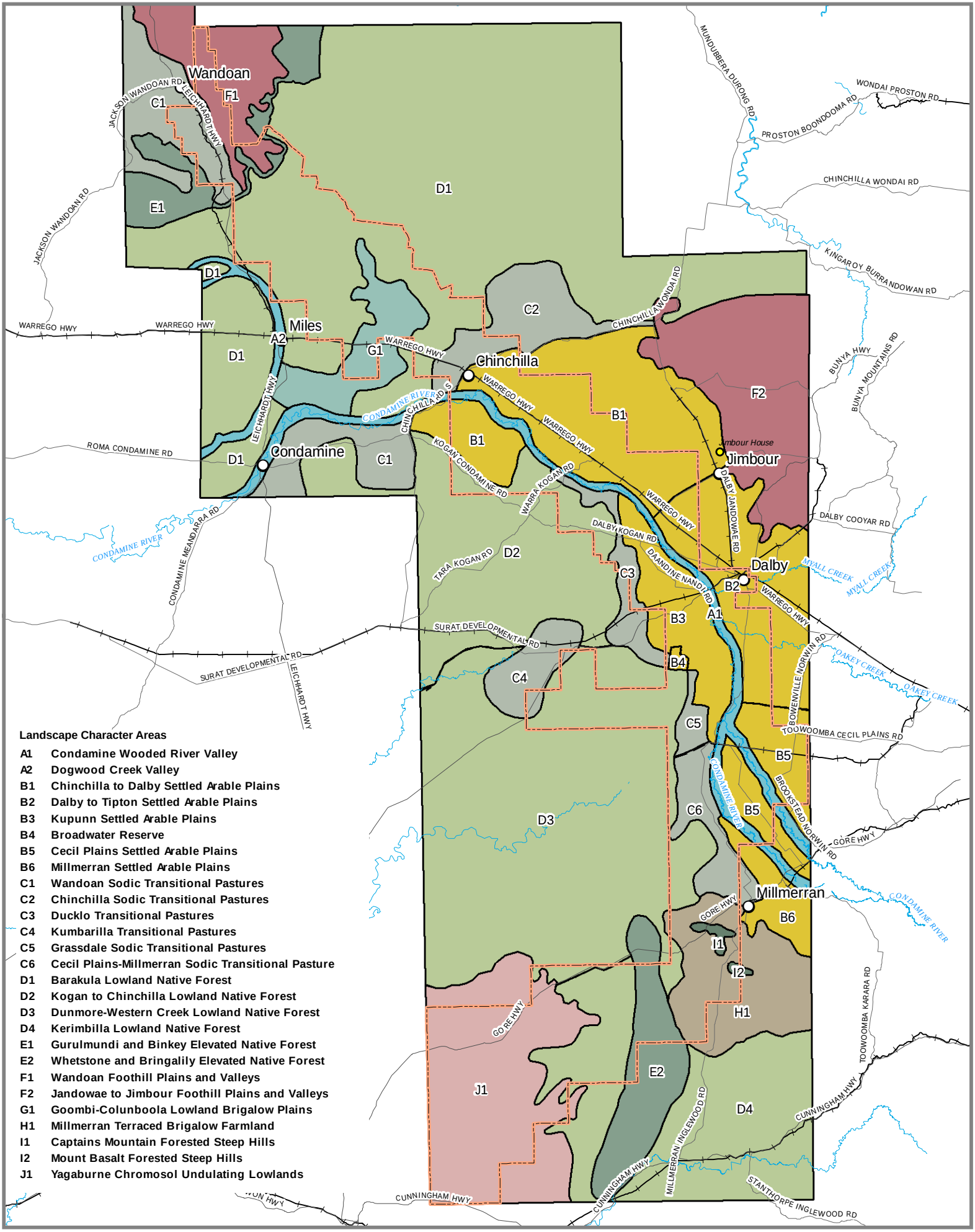
| LAST MODIFIED | GW JUL 2011 |

**FIGURE 3**
**GEOLOGY AND SOILS**

**Arrow Energy**
**Surat Gas Project LVIA**

Figure
**F3**




**Landscape Character Areas**

| | |
|---|---|
| A1 | Condamine Wooded River Valley |
| A2 | Dogwood Creek Valley |
| B1 | Chinchilla to Dalby Settled Arable Plains |
| B2 | Dalby to Tipton Settled Arable Plains |
| B3 | Kupunn Settled Arable Plains |
| B4 | Broadwater Reserve |
| B5 | Cecil Plains Settled Arable Plains |
| B6 | Millmerran Settled Arable Plains |
| C1 | Wandoan Sodic Transitional Pastures |
| C2 | Chinchilla Sodic Transitional Pastures |
| C3 | Ducklo Transitional Pastures |
| C4 | Kumbarilla Transitional Pastures |
| C5 | Grassdale Sodic Transitional Pastures |
| C6 | Cecil Plains-Millmerran Sodic Transitional Pasture |
| D1 | Barakula Lowland Native Forest |
| D2 | Kogan to Chinchilla Lowland Native Forest |
| D3 | Dunmore-Western Creek Lowland Native Forest |
| D4 | Kerimbilla Lowland Native Forest |
| E1 | Gurulmundi and Binkey Elevated Native Forest |
| E2 | Whetstone and Bringalily Elevated Native Forest |
| F1 | Wandoan Foothill Plains and Valleys |
| F2 | Jandowae to Jimbour Foothill Plains and Valleys |
| G1 | Goombi-Colunboola Lowland Brigalow Plains |
| H1 | Millmerran Terraced Brigalow Farmland |
| I1 | Captains Mountain Forested Steep Hills |
| I2 | Mount Basalt Forested Steep Hills |
| J1 | Yagaburne Chromosol Undulating Lowlands |

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**LEGEND**

EIS study Area

Landscape Character Types

- A - Wooded River Valley
- B - Settled Arable Plains
- C - Sodic Transitional Pastures
- D - Lowland Native Forest
- E - Elevated Native Forest
- F - Foothill Plains and Valleys
- G - Lowland Brigalow Plains
- H - Terraced Brigalow Farmland
- I - Forested Steep Hills
- J - Choromosol Undulating Lowlands

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|---|---|
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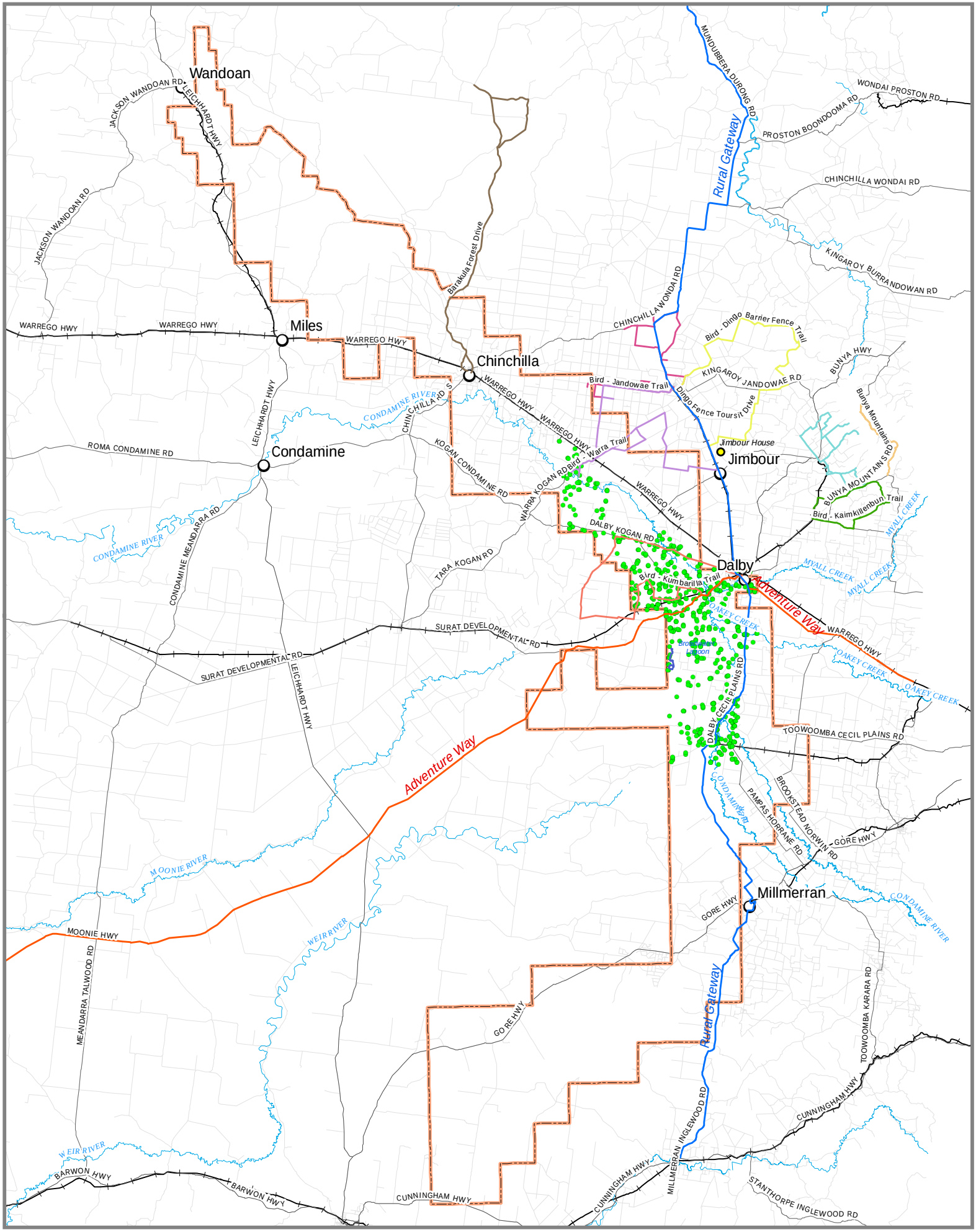
| CREATED BY | GW |
| LAST MODIFIED | GW FEB 2010 |

# FIGURE 4
# LANDSCAPE CHARACTER TYPES AND AERAS

**Arrow Energy**
**Surat Gas Project LVIA**

Figure
**F4**

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**LEGEND**

- EIS study Area
- Potential Sensitive Receptors*
- Rural Getaway
- Adventure Way
- Barakula Forest Drive
- Warra bird watching trail
- Jandowae bird watching trail
- Lake Broadwater bird watching trail
- Bunya Foothills bird watching trail
- Bunya Mountains bird watching trail
- Kaimkillenbun bird watching trail
- Kumbarilla bird watching trail
- Dingo Barrier Fence bird watching trail

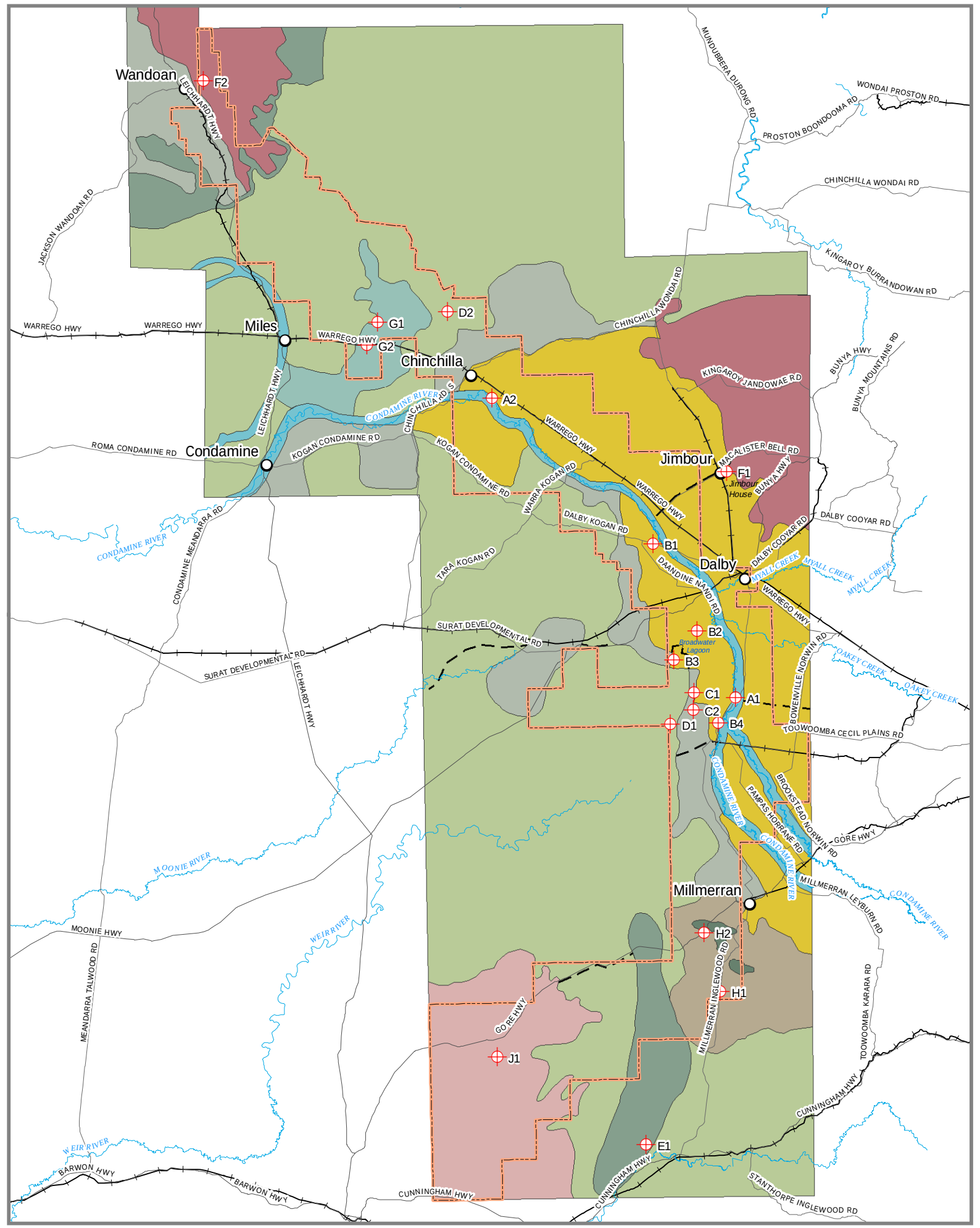
** Dataset used to inform the field survey and location of visual receptors*

# FIGURE 5
# SENSITIVE VISUAL RECEPTORS

**Arrow Energy**
**Surat Gas Project LVIA**

Figure

**F5**




**LEGEND**

- EIS study Area
- Representative Viewpoints

Landscape Character Types

- A - Wooded River Valley
- B - Settled Arable Plains
- C - Sodic Transitional Pastures
- D - Lowland Native Forest
- E - Elevated Native Forest
- F - Foothill Plains and Valleys
- G - Lowland Brigalow Plains
- H - Terraced Brigalow Farmland
- I - Forested Steep Hills
- J - Choromosol Undulating Lowlands

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# FIGURE 6
# REPRESENTATIVE VIEWPOINTS

**Arrow Energy**
**Surat Gas Project LVIA**

Figure
**F6**

## 5.3 Description of the landscape and visual resource

### 5.3.1 TYPE A: WOODED RIVER VALLEY

#### 5.3.1.1 Description of the landscape resource

**Location and boundaries**

This landscape character type is characterised by the wide U-shaped valleys of the Condamine River and Dogwood Creek, with well-vegetated riparian zones providing key visual features in the local and wider landscape.

**Key characteristics**

- Geology dominated by alluvium and lacustrine deposits, producing silt, clay, sands and course gravels throughout the valley
- Wide and shallow river valley with broad sweeping meanders and fairly steep valley sides at bending points
- The main stream channel is joined by several creeks and streams
- An intimate, 'well-treed' character, with dominant species including Queensland Blue Gum, River Red Gum, Ironbark species and Moreton Bay Ash woodland
- Occasional riverside lagoons, which contain a ephemeral wetland character
- Generally comprises a strong sense of tranquillity with a high level of naturalness, forming an important element in the scenic amenity of the wider landscape
- Identified in the Toowoomba Scenic Amenity Study as a landscape of very high scenic preference.
- Trees along river corridor contribute to a strong sense of visual continuity and provide a 'natural edge' to adjacent farmed landscapes
- Interrupted / modified in a few locations for irrigation use e.g. at Tipton Weir, Chinchilla Weir and Dogwood Creek Weir
- Character of the river valley is strongly influenced by the seasons and climatic conditions e.g. rainfall, drought

***Character Area A1: Condamine Wooded River Valley***

This character area follows the valley of the Condamine River, between Chinchilla, Dalby and Millmerran. The river flows in a north-west direction from its source in the Great Diving Range through a mixed landscape of flat arable farmland and grazing pastures between Warra and Cecil Plains, and 'Brigalow Plains' between Chinchilla and Warra. Where it flows through a landscape of arable fields and grazing pastures south of Chinchilla, the *Wooded River Valley* provides a naturalistic feature, in contrast to adjoining agricultural uses. All of the above landscape character type characteristics apply to this character area.

***Character Area A2: Dogwood Creek Wooded River Valley***

This character area follows the valley of Dogwood Creek, west of Miles. The creek flows in a southerly direction from its source near Barakula State Forest to its confluence with the Condamine/Balonne River at Surat. It flows through a landscape of mixed eucalypt and callitris forest, with occasional cleared areas used for native pasture grazing. All of the above landscape character type characteristics apply to this character area.

**Precedent modifications and infrastructure elements**

- Construction of roads, railways and bridges
- Construction of water extraction and holding infrastructure to support adjacent agricultural practices, including irrigated arable farmland and horticulture (e.g. Tipton Weir, Chinchilla Weir and Dogwood Creek Weir)
- Telecommunication infrastructure e.g. utility poles and large-scale pylons south of Warra linking to Braemar and Darling Downs power stations, and south of Chinchilla linking to Kogan Creek power station

#### 5.3.1.2 Description of the visual resource

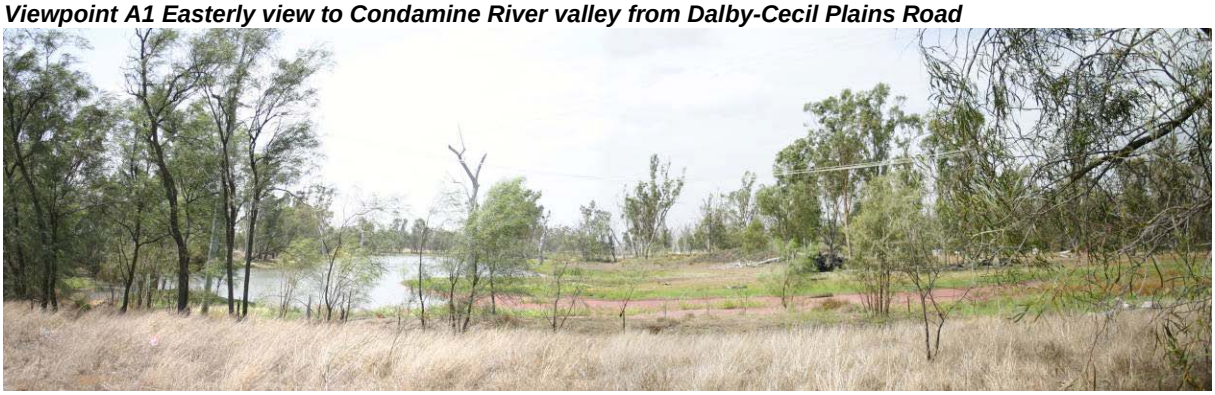
The main viewers (visual receptors) that will be affected by the i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation of the project in the *Wooded River Valley* landscape character type will include:

- Residents living on rural properties (including homesteads and cottages) and settlements within this river valley landscape e.g. Cecil Plains
- People working in the countryside or towns within this landscape, e.g. farming contractors
- Tourists passing through the study area, including travellers along scenic routes, including 'Adventure Way' (between Brisbane and Adelaide) and 'Rural Getaway' (between Mundubbera and Warialda)
- Recreational users of the landscape, including picnickers and anglers
- Motorists travelling along major and minor roads, including the Warrego and Moonie Highways

**Typical viewpoint assessment for future development of coal seam gas facilities**

The nature of existing views from the Wooded River Valley is represented in the following viewpoints:

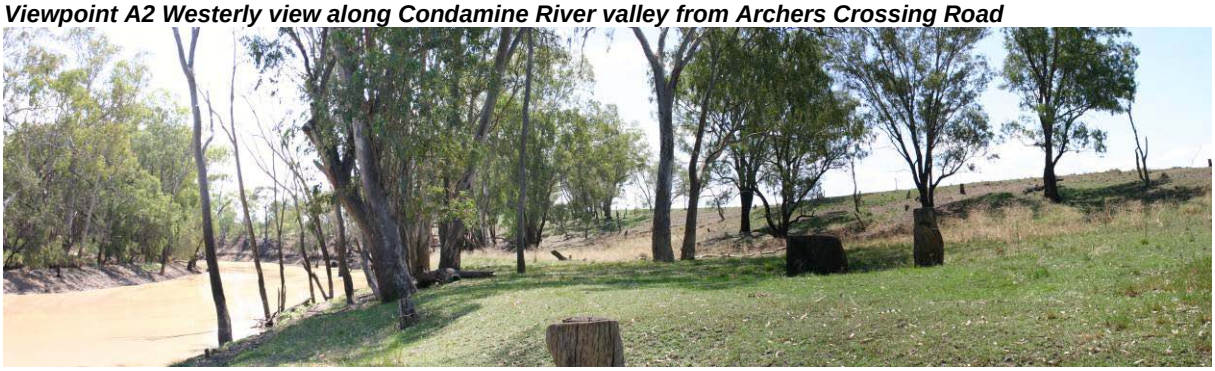
***Viewpoint A1 Easterly view to Condamine River valley from Dalby-Cecil Plains Road***



**Location and description**

This viewpoint has been selected as it represents typical and accessible views within this landscape character type. It is located approximately 5km north-east of Cecil Plains, immediately east of Dalby-Cecil Plains Road, close to the *Settled Arable Plains* landscape character type boundary (GPS location: 326 643, 6 963 425m). The viewpoint looks in an easterly direction across the Condamine River Valley. At this point, a shallow lagoon has formed adjacent to a bend in the river. The concentration of ephemeral grasses, Tea trees, Red Gum and Blue Gum riverine woodland contribute to a riparian character and a strong sense of naturalness and tranquillity, providing a scenic feature and backdrop to the surrounding *Settled Arable Plains* landscape. The fringes of the lagoon are used as rough grazing pastures. Apart from Dalby-Cecil Plains Road and stock fencing, there is little evidence of human influences in this view.

***Viewpoint A2 Westerly view along Condamine River valley from Archers Crossing Road***



**Location and description**

This viewpoint is located approximately 8km south-east of Cecil Plains, immediately west of Archers Crossing Road (GPS location: 269 131, 7 033 999m) and looks in a westerly direction along the Condamine River Valley. At this point, the northern river valley sides are moderately shallow, ascending up to rough grazing pastures on higher land, providing enclosure to the view. In contrast to the southern river valley sides, riparian vegetation cover in this area is fairly sparse, with a selection of mature eucalypt trees and an understorey of native grasses. At this point, the river is used as a source of water for surrounding stock, which contributes to its rural character. The river provides a scenic feature in the surrounding Settled Arable Plains landscape and contains a moderate sense of naturalness and tranquillity. Apart from Archers Crossing Road and stock fencing, there is little evidence of man-made features in this view. However, minor evidence of illegally dumped waste and rubbish detract from views in the local landscape.

### 5.3.2 TYPE B: SETTLED ARABLE PLAINS

#### 5.3.2.1 Description of the landscape resource

**Location and boundaries**

This landscape character type is located on broad low lying level plains of primarily arable farmland with small tributaries, extending in a north-west / south-east band between Chinchilla, Dalby, Cecil Plains and Millmerran.

**Key characteristics**

- Underlying geology of basaltic and sandstone alluvial plains, with predominantly vertosol soils (both black and grey cracking clays, and red or brown loams)
- A flat large scale landscape with an open and exposed character with long distant views and strong skylines
- This rural landscape is considered to be of moderate scenic preference in the *Toowoomba Scenic Amenity Study*.
- Location of small tributaries indicated by swathes of trees, shrubs and grassland, including Poplar Box and Queensland Blue Gum
- Land use is primarily arable farmland (both dryland and irrigation) with a variety of crops (depending on season, water availability and commodity demands), including cotton, wheat, sorghum, maize, as well as horticulture e.g. melons, table grapes
- Very structured and controlled landscape (use of 'laser-levelling' is often evident), primarily used for arable farmland
- Large, rectangular fields are often 'laser-levelled' and lined by irrigation channels, producing a very structured and highly-efficient landscape
- Little fencing, except in marginal areas used as rough grazing pastures e.g. alongside creek valleys, east of Chinchilla
- Large 'ring tanks' (elevated irrigation dams), silos, homestead/cottages and associated trees, irrigation infrastructure, windmills and tree-lined entrances to properties provide variation in this otherwise flat open landscape. The irrigation ring tanks and ponds located in this landscape are rated as high in scenic preference in the *Toowoomba Scenic Amenity Study.*
- Transport corridors are straight in character, reflecting the flat topography and often with minimal road-side vegetation

- Key regional centres include Chinchilla, Dalby and Cecil Plains
- Towns often located at road and railway junctions, comprising train stations and silos, indicating the strong history and use of the landscape for rural commodities
- Dalby and Chinchilla are major timber processing centres for Cypress Pine and to a lesser degree, Spotted Gum, which are found in the State forests and timber reserves in the *Elevated Native Forest* landscape character type
- Signage at property entrances are a distinct personalised and reoccurring feature
- Harmonious rural character, which is valued and celebrated by local communities and visitors

***Character Area B1: Chinchilla to Dalby Settled Arable Plains***



This character area is located on broad low lying level plains of primarily arable farmland (mostly dryland) between Dalby, Chinchilla and Jandowae. The northern part of this area provides a rural setting to Jimbour House. Tributaries meander through the landscape in a south-westerly direction towards the Condamine River. The Warrego Highway, Dalby-Jandowae Road and adjacent railway lines are key linear transport features in this area. The grain silos at Macalister are key landmarks, which are prominent in this largely flat farming landscape. There is a general absence of mining and energy infrastructure in this area, with the exception of Linc Energy's Underground Coal Gasification (UCG) plant located approximately 20km south-east of Chinchilla which includes major industrial structures such as gas to liquids plant and a combined cycle gas turbine power generation plant providing on-site power.

***Character Area B2: Dalby to Tipton Settled Arable Plains***



This character area is located on broad low lying level plains of primarily arable farmland (mixture of irrigated and dryland) between Dalby and Tipton. The western boundary is defined by the Condamine River Valley, which provides borrowed character and creates a vegetated edge/backdrop to the area. Trees lining Oakey Creek provide a 'natural edge' and break between adjacent farmed landscapes. Dalby-Cecil Plains Road is key linear transport feature, providing constant north-south vehicular movement and visual accessibility through this area.

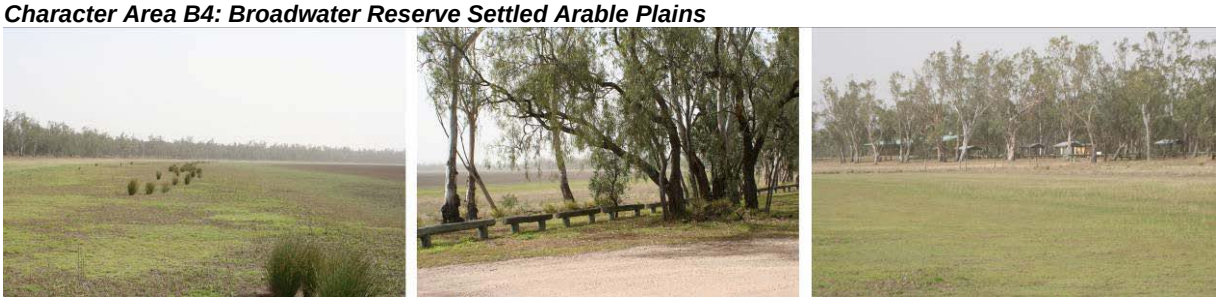
***Character Area B3: Kupunn Settled Arable Plains***



This character area is located west of Dalby, comprising a mosaic of dryland and irrigated arable farmland. The

eastern boundary is defined by the Condamine River Valley, which imparts borrowed character. The western boundary is defined by a transition onto sodosol soils west of Kupunn, which coincides with a changed landform, vegetative character and land use (undulating, grazing pastures and native open woodland). Occasional fields of planted rows of Leucaena (*Leucaena leucocephala*), a legume shrub used for cattle fodder (as shown in the right hand photograph), is a distinctive feature in this area.

***Character Area B4: Broadwater Reserve Settled Arable Plains***



This character area is located south-west of Dalby. Lake Broadwater and the surrounding conservation park provide a key natural feature that is unique in this landscape character type and its wider setting. It is highly valued for conservation and recreation (including boating, camping, picnicking) and provides a distinctive natural feature within this landscape character type. Vegetation within this area is diverse, including mature river red and blue gums, Poplar Box, Tea-tree, Cypress Pines, patches of Brigalow, grevilleas, hakeas and mature Grass Trees. The area surrounding the lake is flat and the lake periodically dries-up (it was empty at the time of this assessment).

***Character Area B5: Cecil Plains Settled Arable Plains***

This character area is located east of Cecil Plains, comprising rich black soils used for irrigated arable farmland. 'Ring tanks', silos, irrigation channels, poly pipes, farm machinery, windmills, farm sheds and farm homesteads are prominent features in this expansive flat landscape of large, rectangular, 'laser-levelled' fields.

***Character Area B6: Millmerran Settled Arable Plains***

This character area is located to the north and east of Millmerran, comprising mostly of dryland arable farmland, with occasional fields of irrigated arable farmland in close proximity to watercourses. The eastern boundary is defined by the Condamine River Valley, which imparts borrowed character. Grasstree Creek, a tributary of the Condamine River, is a key feature in this area and presents a 'natural edge' to adjacent farmed landscapes. The *Forested Steep Hills* at Captains Mountain, Commodore Peak and Mount Domville provide a dramatic south-westerly backdrop to this area. The Gore Highway and adjacent railway line and Millmerran Inglewood Road are key linear transport features in this area.

**Precedent modifications and infrastructure elements**

- This landscape has been highly modified for agricultural practices, including mass clearing and levelling of

land for cultivation of arable farmland, and to a lesser extent, pasture for grazing of cattle and sheep

- Construction of water extraction, transfer and holding infrastructure to support adjacent agricultural practices, including irrigated arable farmland and horticulture (e.g. water bores, ring tanks, irrigation channels, wind mills)
- Notable presence of silos, machinery sheds and irrigation equipment e.g. pumps, poly pipes, drip irrigation systems, sprayers, tractors
- Construction of roads, railways and bridges
- Telecommunication infrastructure e.g. utility poles and large-scale power pylons east of Warra linking to the Braemar and Darling Downs power stations, and north-east and south-west of Chinchilla linking to Kogan Creek power station

#### 5.3.2.2 Description of the visual resource

The main viewers (visual receptors) that will be affected by the i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation of the project in the *Settled Arable Plains* landscape character type will include:

- Residents living on rural properties (including homesteads and cottages) and settlements within this landscape e.g. Dalby, Chinchilla, Brigalow, Warra
- People working in the countryside or towns within this landscape, e.g. farming contractors
- Tourists passing through the study area, including travellers along scenic routes, including 'Adventure Way' (between Brisbane and Adelaide), 'Rural Getaway' (between Mundubbera and Warialda), 'Broadwater Trail' within Lake Broadwater Conservation Park, the 'Warra Trail' and 'Jandowae Trail' (refer to **Figure 5**)
- Motorists travelling along major and minor roads, such as the Warrego and Moonie Highways, including those travelling to work in nearby areas, e.g. workers of Daandine central gas processing facility and Braemar, Darling Downs and Kogan Creek power stations

**Typical viewpoint assessment for future development of coal seam gas facilities**

The nature of existing views from the *Settled Arable Plains* is represented in the following viewpoints:

***Viewpoint B1 South-westerly view across arable farmland from Dalby-Kogan Road towards proposed Theten IPF***

**Location and description**

This viewpoint has been selected as it represents typical and accessible views within this landscape character type towards the proposed Theten IPF (approximately 5km from this viewpoint, to the south-west). It is located on Dalby Kogan Road, approximately 22km north-west of Dalby (GPS location: 307 201, 6 999 803m), and looks in a south-westerly direction towards the proposed Theten IPF. The viewpoint represents viewers travelling along Dalby Kogan Road and Kumbarilla Bird Trail (refer to **Figure 5**), a vehicular-based bird trail through Poplar Box forest, open grassland with River Red Gum and lagoons along the *Condamine River Valley*. At this point, the landscape has a flat, open and exposed character, allowing long distant views across arable fields which meet the horizon. Apart from occasional farm houses and associated planting of trees, there are few vertical intrusions. It is a very structured and controlled landscape, with long straight roads and flat laser-levelled fields. The landscape comprises a harmonious rural character.

***Viewpoint B2 Westerly view across arable farmland from Nandi Tipton Road towards proposed Lynwood IPF***

**Location and description**

This viewpoint has been selected as it represents typical and accessible views within this landscape character type towards the proposed Lynwood IPF (approximately 3km from this viewpoint, to the west). It is located on Nandi Tipton Road, approximately 16km south-west of Dalby (GPS location: 317 523, 6 979 382m), and looks in a south-westerly direction towards the proposed Lynwood IPF. The viewpoint represents viewers travelling along Nandi Tipton Road (refer to **Figure 6**), a sealed local road used primarily by residents in the area, as well as visitors to Grassdale Feedlot, and motorists travelling between the Moonie Highway and Dalby Cecil Plains Road who wish to bypass Dalby. At this point, the landscape comprises a flat, open and exposed character, allowing long distant views across arable fields which meet a forested horizon, where the landscape transitions into *Lowland Native Forest*. Native vegetation in and around Lake Broadwater Conservation Park also contributes to the forested horizon. Apart from minor occurrences of telephone poles and occasional farm houses with associated machinery and tree planting, there are few vertical intrusions. It is a very structured and controlled landscape, with long straight roads and flat laser-levelled fields. The landscape comprises a harmonious rural character.

***Viewpoint B3 Elevated easterly view across Lake Broadwater from Bird Hide along Broadwater Bird Trail***

**Location and description**

This viewpoint has been selected as it represents typical and accessible views from a 'known' lookout within Lake Broadwater Conservation Park. It is located atop a bird hide, along 'Broadwater Bird Trail', immediately south of Lake Broadwater (GPS location: 312 072, 6 972 440m), and looks in an easterly direction across 'the neck' of the lake. At this point, the landscape consists of an open shallow seasonal depression, which was dry at the time of this assessment. The concentration of ephemeral grasses and tussocks, Red Gum and Blue Gum riverine woodland and Poplar Box contribute to a riparian character and a strong sense of naturalness and tranquillity. The reserve also provides a scenic feature backdrop of borrowed character in the characteristic *Settled Arable Plains* beyond (east of this viewpoint). Apart from unsealed trails/tracks and recreation facilities associated with the reserve (e.g. lake side cabins, timber fencing, gravel car parking areas, bird hide, interpretation boards and signage), there is little evidence human influences in this view and the local landscape.

***Viewpoint B4 Westerly view across arable farmland from Nandi Tipton Road towards proposed Tipton South IPF***

**Location and description**

This viewpoint has been selected as it represents typical and accessible views within this landscape character type towards the proposed Tipton South IPF (approximately 9km from this viewpoint, to the west). It is located on Dalby Cecil Plains Road, approximately 4km north of Cecil Plains (GPS location: 322 551, 6 957 736m), and looks in a westerly direction towards the proposed Tipton South IPF. The viewpoint represents viewers travelling along Dalby Cecil Plains Road and the 'Rural Getaway' (refer to Figure 6); a vehicular-based tourist trail between Mundubbera and Warialda. At this point, the landscape has a flat, open and exposed character, allowing long distant views across arable fields which meet a forested horizon. Apart from occasional farm houses with associated machinery and tree planting, there are few vertical intrusions. It is a very structured and controlled landscape, with long straight fence lines and flat laser-levelled fields. The landscape comprises a harmonious rural character.

### 5.3.3 TYPE C: SODIC TRANSITIONAL PASTURES

#### 5.3.3.1 Description of the landscape resource

**Location and boundaries**

This landscape generally lies between the *Settled Arable Plains* and *Lowland Native Forest*, providing a gradual transition between these strongly contrasting landscapes.

**Key characteristics**

- Gently undulating plains on sandstone, with predominantly sodosol soils (both red and grey)
- Soils comprise a gravelly, sandy character
- A transitional landscape between the expansive, flat *Settled Arable Plains* and the *Lowland Native Forest*
- A highly varied landscape, comprising a mosaic of open woodland, rough pastures and dryland arable farmland with scattered farm houses and sheds
- A highly variable range of land cover and landform, contributing to a small-medium scale landscape and enclosed, often intermittent views through trees
- Vegetation dominated by groves of Poplar Box and Grey Box open woodland amongst pasture fields, road side verges, tributaries
- Poplar Box and Grey Box regrowth is a common feature in the margins of pasture fields
- Introduction of Callitris forest at western edges in close proximity to the Elevated Native Forest and Lowland Native Forest landscape character types
- Contains several unsealed local roads (often private), providing access to private properties (including 'Grassdale Feedlot'), state forest and existing coal seam gas properties and associated infrastructure (including Arrow's Tipton West Central Gas Processing Facility)
- Noticeable presence of existing gas wells within arable and pasture fields
- Sparsely settled landscape, containing few towns (Guluguba and Wandoan) and only occasional farm houses
- Fairly rural character with a moderate sense of remoteness in areas away from roads and gas wells

***Character Area C1: Wandoan Sodic Transitional Pastures***



This character area is located in a low-lying basin at the base of the Great Dividing Range, south of Wandoan. It is surrounding by Elevated Native Forest at Binkey and Cherwondah State Forests to the south and Wandoan Foothill Plains and Valleys to the east. Jundah Creek meanders in a northerly direction from the Great Dividing Range, and forms the eastern boundary to this area. The land has been cleared for grazing pastures for cattle, providing a notable contrast in landscape character to the southern densely forested areas. Although the soils transfer to vertosols in northern parts of the area, this change is not reflected in variation of landscape character, e.g. no change in land use or vegetation character.

***Character Area C2: Chinchilla Sodic Transitional Pastures***



This character area is located between the Barakula Lowland Native Forest and Chinchilla to Dalby Settled Arable Plains, north-east of Chinchilla. The southern boundary is defined by Chinchilla Wondai Road, where the landscape transitions into intensive arable farmland. The land has been cleared for grazing pastures for cattle, providing a notable contrast in landscape character to the northern densely forested areas associated with Barakula and Nudley State Forests.

***Character Area C3: Daandine-Ducklo Sodic Transitional Pastures***



This character area is located between the Kogan to Chinchilla Lowland Native Forest and Dalby to Tipton Settled Arable Plains, south-west of Dalby. Part of the eastern boundary is defined by Broadwater Road, which leads to Lake Broadwater Conservation Park. Wilkie Creek and its tributaries meander through the area in a north-south direction. The Moonie Highway and a freight railway line traverse this area in a north-west direction towards Dalby. The Moonie Highway is lined by remnant tree belts (including Poplar Box and Grey Box open woodland), which provide enclosure to the road.

***Character Area C4: Kumbarilla Sodic Transitional Pastures***

This character area is located between Braemar and Kumbarilla State Forests, in a low-lying basin amid *Elevated Native Forest* east of Tara. The land has been cleared for grazing pastures for cattle and some cultivated land in northern parts of the area, providing a notable contrast in landscape character to the surrounding dense forested areas.

***Character Area C5: Grassdale Sodic Transitional Pastures***

This character area is located between the Condamine River and Kumbarilla State Forest, north of Cecil Plains. This landscape has been extensively cleared for pastures grazing of cattle and some dryland irrigation arable farmland. There are several existing gas wells in this area, which link to the nearby Tipton West central gas processing facility (as seen in Viewpoint C1). Grassdale Feedlot (centre photograph above) is a key landmark in this area.

***Character Area C6: Cecil Plains-Millmerran Sodic Transitional Pastures***

This character area is located on the eastern fringe of the Dunmore-Western Creek Lowland Native Forest, between Cecil Plains and Millmerran. The majority of the eastern boundary is defined by the Condamine River and its alluvial plains, which are primarily used for arable farmland. Millmerran-Cecil Plains Road is key a transport route, which traverses this area in a north-south direction.

**Precedent modifications and infrastructure elements**

- This landscape has been modified for agricultural practices, including clearing and levelling of land for cultivation of arable farmland and pasture improvement for grazing of cattle and sheep
- Construction of stock fencing (typical post and wire style), gates and grids, grids, small dams and occasional machinery sheds in grazing areas
- Notable presence of gas wells and associated surface facilities, access tracks and signage (Arrow) in the vicinity of Tipton West central gas processing facility (within Character Area C5: Grassdale Sodic Transitional Pastures), and in the vicinity of Daandine central gas processing facility (within northern part of Character Area C3: Daandine-Ducklo Sodic Transitional Pastures)
- Wilkie Creek open cut coal mine (opened in 1995) and associated large-scale machinery including dozers, scrapers, excavators, front-end loaders and trucks, located in the northern part of Character Area C3:

Daandine-Ducklo Sodic Transitional Pastures

- Construction of roads, railways and bridges
- Telecommunication infrastructure e.g. utility poles and large-scale power pylons south of Warra linking to Braemar and Darling Downs power stations, and to the north-east, south-west and west of Chinchilla linking to Kogan Creek power station

#### 5.3.3.2 Description of the visual resource

The main viewers (visual receptors) that will be affected by the i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation of the proposal in the *Sodic Transitional Pastures* landscape character type will include:

- Residents living on rural properties (including homesteads and cottages) and settlements within this landscape e.g. Wandoan, Guluguba
- People working in the countryside or towns within this landscape, e.g. workers of Wilkie Creek Mine, engineers/specialists inspecting gas wells near Daandine and Tipton West central gas processing facilities, farming contractors, graziers, farm-assistants
- Tourists passing through the study area, including travellers along scenic routes, including 'Adventure Way' (between Brisbane and Adelaide), 'Rural Getaway' (between Mundubbera and Warialda) and Kumbarilla Bird Trail (west of Dalby) (refer to **Figure 5**)
- Motorists travelling along major and minor roads, such as the Dalby-Kogan Road, the Moonie Highway and Millmerran-Cecil Plains Road, including those travelling to work in nearby areas e.g. workers of Daandine central gas processing facility, Braemar and Darling Downs power stations and Cecil Plains Cotton Gin

**Typical viewpoint assessment for future development of coal seam Gas facilities**

The nature of existing views from the Sodic Transitional Pastures is represented in the following viewpoints:

***Viewpoint C1 Westerly view from Wilkins Road across pasture field to an existing gas well***

**Location and description**

This viewpoint has been selected as it represents typical and accessible views within this landscape character type towards an existing gas well and surface facilities (approximately 200m from this viewpoint, to the west). The viewpoint is located on Wilkins Road, approximately 30km south-west of Dalby (GPS location: 316 779, 6 964 749m) with the gas well seen in the middle of the frame. It represents viewers travelling along Wilkins Road, a sealed local road used primarily by residents in the area, workers travelling to gas facilities in the area, visitors to Kumbarilla State Forest, as well as Grassdale Feedlot visitors and employees. At this point the landscape foreground and middle ground contains a fairly flat, open and exposed character, allowing clear views to the gas well and surface facilities. Beyond, there are filtered views to Grassdale Feedlot, including low-rise sheds and offices, holding yards and shade cloths. This view portrays a fairly varied landscape, due to the mixture of land use and land cover, i.e. grazing pastures with distant groves of Poplar Box and Grey Box open woodland, a large-scale feedlot, and presence of gas well and surface facilities.

***Viewpoint C2 South westerly view across pasture farmland from Wilkins Road to proposed Tipton South IPF***

**Location and description**

This viewpoint has been selected as it represents typical and accessible south-westerly views within this landscape character type towards the proposed Tipton South IPF (approximately 4km from this viewpoint, to the south- west). It is located on Wilkins Road, a sealed local road approximately 9km north-west of Cecil Plains (GPS location: 316 653, 6 960 684m). The viewpoint represents viewers travelling along Wilkins Road, including residents in the area, workers travelling to nearby gas wells at Tipton West, visitors to Kumbarilla State Forest, as well as Grassdale Feedlot visitors and employees. At this point, the landscape foreground and middle ground contains a fairly open flat character, with texture and variation provided by the mosaic of rough grazing pastures, groves of Poplar Box and Grey Box open woodland, and areas of re-growth. In the distance, the landscape transitions into *Lowland Native Forest*. The notable absence of built features and natural transition into the *Lowland Native Forest* (including Kumbarilla State Forest), contributes to a moderate sense of remoteness from this viewpoint.

### 5.3.4 TYPE D: LOWLAND NATIVE FOREST

#### 5.3.4.1 Description of the landscape resource

**Location and boundaries**

This landscape character type covers a substantial proportion of the western and northern study area and is largely defined by the densely forested lowlands of predominantly Callitris and Poplar Box forest. It covers several State Forests, including Barakula, Kumbarilla, Western Creek and Whetstone.

**Key characteristics**

- Smoothly undulating landform incised by several narrow dry gullies and creeks
- Creek valleys contain a muddy character, with distinctive rocky outcrops and well-treed valley sides (key species include Poplar Box and Moreton Bay Ash woodland with Wilga)
- Sodosol soils (mostly grey) comprise a gravelly, sandy character which are very hard when dry, prone to crust formation, and are vulnerable to tunnel and gully erosion (particularly along roadsides)
- Dominant species are Cypress Pine (*Callitris glaucophylla*), Wilga (*Geijera parviflora*) and Poplar Box (*Eucalyptus populnea*), with scattered Buloke (*Allocasuarina luehmannii*), Budda (*Eremophila mitchellii*), Warrior Bush (*Apophyllum anomalum*), and Rosewood (*Alectryon oleifolius*). Tree heights in this layer are in the range of 8 –12m.
- Occasional cleared areas used for native pasture grazing, mainly by beef cattle
- Sparsely settled character, with only small towns (e.g. Kogan) and property homesteads and cottages
- Forest encroached by power infrastructure (including transmission pylons, and Braemar and Darling Downs power stations) and coal seam gas facilities and field development near Dalby Kogan Road (although barely perceivable from main roads).
- Modifications to the landscape by power infrastructure and coal seam gas facilities are likely to be clearly visible from the air i.e. forest cleared for gas well development, coal seam gas facilities, power stations, and networks of access tracks, forming a highly structured, geometric landscape pattern
- Generally comprises a high level of naturalness with a strong sense of remoteness away from major roads,

power stations and coal seam gas facilities.

- Dense forest has a strong sense of visual continuity, providing an important natural element and visual backdrop to the wider landscape, as well as a strong sense of enclosure when travelling through it

***Character Area D1: Barakula Lowland Native Forest***

This character area is located in the northern part of the study area, and includes the Binkey State Forest and southern part of Barakula State Forest, which is the largest managed forest in Queensland and supplies much of the state's Cypress Pine timber resource (although timber milling was not evident within the study area during field work). The northern boundary to this area is defined by the Great Dividing Range (Character Area E1: Gurulmundi and Binkey *Elevated Native Forest*), which forms a steep edge and separates the forested areas from the Foothill Plains and Valleys around Wandoan. This densely forested area contains several meandering tributaries which are shallow and muddy in character, fringed by ephemeral grasses, tussocks and Poplar Box woodland.

***Character Area D2: Kogan-Braemar Lowland Native Forest***

This densely forested area is located west of Dalby, centred on Braemar State Forest. East of Kogan, the forest is encroached by power infrastructure (including transmission pylons, and Braemar and Darling Downs power stations), and coal seam gas facilities and field development associated with Daandine and Kogan North central gas processing facilities. Apart from signage, entrance roads and car parking, these facilities are barely perceivable from main roads, although morning and afternoon workforce traffic is currently visible in this landscape.

***Character Area D3: Kumbarilla-Western Creek Lowland Native Forest***


This character area is located west of Cecil Plains, between the Gore and Moonie Highways. It is densely forested and unsettled, with few roads and a network of state forest access tracks. Kumbarilla, Dunmore and Western Creek State Forests cover a large part of the area. South of Lake Broadwater, the forest is encroached by coal seam gas facilities and field development associated with the Tipton West central gas processing facilities. These facilities are enclosed by dense forest and unsealed roads that have restricted access.

***Character Area D4: Whetstone Lowland Native Forest***

This character area is located south-west of Millmerran, south of the Gore Highway. Bulli and Whetstone State Forests cover a large part of the area. The landscape lies at the foothills of an elevated belt of native forest associated with Wondul Range National Park. To the west, the landscape opens up and transitions into *Chromosol Undulating Lowlands*. It is densely forested and unsettled, albeit accessible with a number of roads and state forest access tracks.

**Precedent modifications and infrastructure elements**

- Existing central gas processing facility, water storage facilities, gas wells and associated surface facilities, control rooms, warehouses, workshops, pipelines (for gas and water) and access tracks at Tipton West (opened in February 2007), Daandine (opened in September 2006) and Kogan North (opened in January 2006)
- Gas-fired power stations located 4km south of Dalby-Kogan Road (outside of the project development area), including Braemar (opened in August 2006), Braemar 2 (opened in June 2009), ), and Darling Downs (opened in July 2010). Braemer 3 power station, located 40 km southwest of Dalby, is also planned to open in 2013.
- Rural acreage properties west of Millmerran at 'Millmerran Woods' and 'The Pines'
- Telecommunication infrastructure, large-scale power pylons and associated cleared corridors linking to Braemar and Darling Downs power stations
- Construction of roads, railways and bridges

#### 5.3.4.2 Description of the visual resource

The main viewers (visual receptors) that will be affected by the i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation of the project in the *Lowland Native Forest* landscape character type will include:

- Residents living on rural acreage properties at 'Millmerran Woods', 'The Pines', Kumbarilla and small settlements within this landscape, e.g. Columboola
- People working within this landscape, e.g. State Forest rangers, workers of Tipton West, Daandine and Kogan North central gas processing facilities, engineers/specialists inspecting gas wells near Tipton West, Daandine and Kogan North central gas processing facilities
- Tourists passing through the study area, including travellers along scenic routes, including 'Adventure Way' (between Brisbane and Adelaide), 'Rural Getaway' (between Mundubbera and Warialda), Kumbarilla Bird Trail (west of Dalby) and Barakula Forest Drive (north of Chinchilla) (refer to **Figure 5**)
- Recreational users of the landscape, including picnickers and visitors to the State Forest
- Motorists travelling along major and minor roads, such as the Warrego, Moonie and Gore Highways, and Kogan-Condamine Road, including those travelling to work in nearby areas, e.g. workers of Kogan Creek power station

**Typical viewpoint assessment for future development of coal seam gas facilities**

The nature of existing views from the *Lowland Native Forest* is represented in the following viewpoints:

***Viewpoint D1 Northerly view through a forest clearing from Boundary Road***

**Location and description**

This viewpoint has been selected as it represents typical and accessible northerly views within this landscape character type towards the previously proposed Lynwood IPF (approximately 500m from this viewpoint, to the north-east). It is located on Boundary Road, approximately 11km north-west of Cecil Plains (GPS location: 311 263, 6 957 368m). The viewpoint represents viewers travelling between Kumbarilla State Forest and Dalby Cecil Plains Road. At this point, the landscape has been cleared for cattle grazing and is surrounded by dense Callitris and Poplar Box forest. Apart from unsealed access tracks, stock fencing and sporadic clearing of forest there is little evidence built infrastructure in this view.

***Viewpoint D2 Northerly view along Barakula Forest Drive***

**Location and description**

This viewpoint has been selected as it represents typical and accessible northerly views within this landscape character type along Barakula Forest Drive, a scenic route for tourists and visitors to the area. It is located north of the Blackswamp Road/Auburn Road junction, approximately 15km north-west of Chinchilla (GPS location: 258 737, 7 054 497m). At this point, the road is surrounded by densely layered forest of Callitris, Wattle and Ironbark species with sparse grassland understorey.

### 5.3.5 TYPE E: ELEVATED NATIVE FOREST

#### 5.3.5.1 Description of the landscape resource

**Location and boundaries**

The location and vegetative character of this landscape is closely related to the *Lowland Native Forest*, yet its elevation and varied landform makes this landscape distinctive from the *Lowland Native Forest*. It is located in the northern and southern part of the study area, partly covering Binkey State Forest and Wondul Range National Park, respectively.

**Key characteristics**

- Elevated sandstone landscape (above 400m) with some upland rocky areas
- Sodosol soils (red, yellow and some grey), which comprise a shallow, gravelly to sandy character
- Varied landform typified by elevated plateaus, ridges, escarpments and deeply incised valleys and dry gullies
- Occasional panoramic views above the treeline from elevated plateaus, ridges, escarpments over the surrounding lowlands
- Braemar, Kumbarilla and Danndine State Forests are key features, which consist of naturally occurring Callitris forest, with some Eucalyptus, Casuarina or Acacia species

- Key species include White Cypress Pine, Buloke), Narrow-leaved Ironbark and Rusty Gum, providing strong texture and 'glauca' (blue-green) foliage colour
- Sparse understorey of grasses and small shrubs (mostly Acacia), with exposed soil and rocky areas, reflecting nutrient-poor sandy soils
- Forest provides a strong sense of naturalness and enclosure
- Roads are generally unsealed and seldom used, with the exception of recreational four-wheel drive vehicles and off-road motorcycles
- General absence of infrastructure, albeit cleared corridors for power transmission pylons, which link to Braemar and Darling Downs power stations
- Generally comprises a high level of naturalness with a strong sense of remoteness away from major roads
- Dense forest has a strong sense of visual continuity, providing an important natural element, prominent visual backdrop to the wider landscape, and strong sense of enclosure when travelling through it

***Character Area E1: Gurulmundi and Binkey Elevated Native Forest***

This fairly narrow character area coincides with the location of the Great Dividing Range, which traverses the northern part of the study area, north of Miles. It provides a distinct topographic division between the *Sodic Transitional Pastures* and *Foothill Plains and Valleys* to the north around Guluguba and Wandoan. To the south, the landscape subtly transitions into the Barakula Lowland Native Forest.

***Character Area E2: Whetstone and Bringalily Elevated Native Forest***

This character area comprises an elevated ridge of higher land, south-west of Millmerran, extending in a southerly direction from Western Creek State Forest. Mount Trapyard is a high point in this area (508m). The red-ochre coloured soil in southern parts of the area provides a distinctive and memorable feature.

**Precedent modifications and infrastructure elements**

- Telecommunication infrastructure (including pylons and telecommunication masts), roads (including the Leichhardt and Gore Highways), and unsealed access tracks (e.g. through Wondul Range National Park, Bringalily State Forest and Whetstone State Forest) traverse this area providing access.
- Rural acreage properties are present west of Millmerran at 'Millmerran Woods', 'Cypress Gardens' and 'Forest Ridge'.

#### 5.3.5.2 Description of the visual resource

The main viewers (visual receptors) that will be affected by the i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation of the project in the *Elevated Native Forest* landscape character type will include:

- Residents living on rural acreage properties at 'Millmerran Woods', 'Cypress Gardens' and 'Forest Ridge'
- People working in the countryside within this landscape e.g. State Forest and National Park rangers
- Recreational users of the landscape, including picnickers and visitors to State Forests and Wondul Range

National Park

- Motorists travelling along major and minor roads, such as the Leichhardt and Gore Highways

***Typical viewpoint assessment for future development of coal seam gas facilities***

The nature of existing views from the *Elevated Native Forest* is represented in the following viewpoint:

***Viewpoint E1 South-easterly view from Bybera Road (outside of the project development area)***

**Location and description**

This viewpoint has been selected as it represents typical and accessible views within this landscape character type. It is located approximately 8km north-west of Inglewood (GPS location: 305 518, 6 858 150m) and looks in a south-easterly direction across the alluvial plains and sandstone forest around Inglewood with distant views beyond to the rugged Traprock Hills. The elevated densely forested character exhibits little human influences including traffic in this area, contributing to a strong sense of naturalness and remoteness.

### 5.3.6 TYPE F: FOOTHILL PLAINS AND VALLEYS

#### 5.3.6.1 Description of the landscape resource

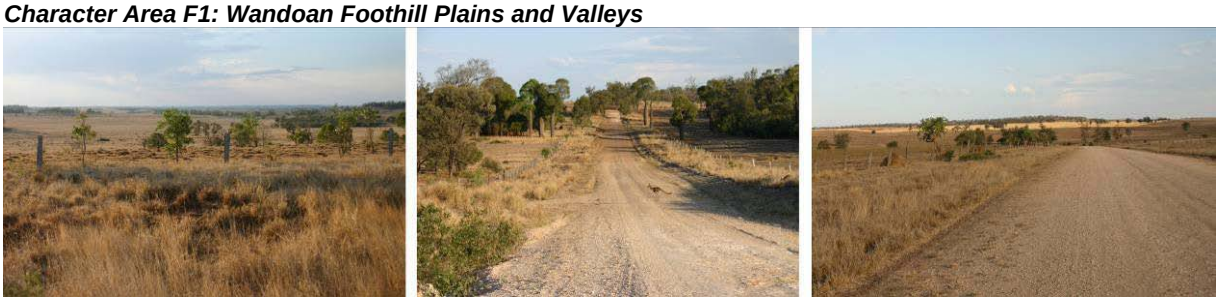
**Location and boundaries**

This landscape character type is located in the northern part of the study area, at the western foothills of the Great Dividing Range, east of Wandoan. It is also located at the western foothills of the Bunya Mountains, east of Jandowae (outside of the project development area).

**Key characteristics**

- Fairly open, elevated smoothly rolling plains with gentle undulations associated with watercourses
- Mixed geology of basalt, sandstones and alluvium, overlain with vertosol soils
- Located at the foothills of the Bunya Mountains and Great Dividing Range, which provide a dramatic backdrop to this landscape
- Watercourses comprise a shallow narrow valley with rocky valley floors, fringed by Poplar Box or Queensland Blue Gum open woodland and grassland
- Predominantly open plains of grazing pastures for cattle
- Some remnant natural areas, including Mahen and Jandowae State Forests
- Groups of mature bottle trees (*Brachychiton australis*) amidst pasture fields are a particularly distinctive and memorable feature of this landscape
- Sparsely settled landscape, with homesteads and cottages, and small towns (such as Jandowae and Jimbour) located along the boundary to the *Settled Arable Plains* landscape character type,
- Jimbour House is a key landmark which sits on an elevated plateau east of Jimbour town, with expansive southerly views over the *Settled Arable Plains* landscape character type north of Dalby
- Long distant views with strong skylines
- Strong rural character with a perceived sense of remoteness and tranquillity away from main roads

***Character Area F1: Wandoan Foothill Plains and Valleys***



This character area is located in the northern part of the study area, at the foothills of the Great Dividing Range, east of Wandoan. All of the above landscape character type characteristics apply to this character area.

***Character Area F2: Jandowae to Jimbour Foothill Plains and Valleys***

This character area is located east of the Chinchilla to Dalby *Settled Arable Plains*, at the foothills of the Bunya Mountains. Although the area lies outside the project development area, there are panoramic south-westerly views over the project development area from Jimbour House, a key cultural feature in the region. All of the above landscape character type characteristics apply to this character area.

**Precedent modifications and infrastructure elements**

- A sparsely settled landscape with homesteads and small towns and a notable absence of large scale infrastructure or built elements
- The landscape has been modified for agricultural practices, including clearing of land for cultivation of dryland arable farmland and pasture improvement for grazing of cattle and sheep
- Construction of stock fencing (typical post and wire style), gates and grids, grids, small dams and occasional machinery sheds in grazing areas
- Construction of roads, bridges and tourist trails, e.g. 'Rural Getaway' (between Mundubbera and Warialda), 'Bunya Foothills Bird Trail', 'Jandowae Bird Trail' and 'Dingo Barrier Fence Bird Trail'
- Telecommunication infrastructure, e.g. utility poles and large-scale pylons south of Jandowae linking to Braemar and Darling Downs power stations

#### 5.3.6.2 Description of the visual resource

The main viewers (visual receptors) that will be affected by the i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation of the project in the *Foothill Plains and Valleys* landscape character type will include:

- Residents living on rural properties (including homesteads and cottages)
- People working in the countryside within this landscape, e.g. farmers, graziers, farm-assistants, farming/grazing contractors
- Tourists passing through the study area, including visitors to Jimbour House and travellers along scenic routes, including 'Rural Getaway' (between Mundubbera and Warialda), 'Bunya Foothills Bird Trail', 'Jandowae Bird Trail' and 'Dingo Barrier Fence Bird Trail' (refer to **Figure 5**)
- Motorists travelling along major and minor roads, such as the Leichhardt Highway, Jandowae Condamine Road, Bunya Highway and Kingaroy Jandowae Road

**Typical viewpoint assessment for future development of Coal Seam Gas facilities**

The nature of existing views from the Wooded River Valley is represented in the following viewpoints:

***Viewpoint F1 Elevated panoramic view from the front gardens of Jimbour House***

**Location and description**

This viewpoint has been selected as it represents typical and accessible views from Jimbour House (c.1876), a heritage-listed house and important cultural asset in this region. It is located at a key arrival point to Jimbour House, between the main circular drive and the pool area (GPS location: 324 809, 7 016 569m), and represents panoramic views available from the front gardens and main house frontage, including the front balcony or verandah. The house is located on an elevated plateau, offering expansive southerly views over the *Settled Arable Plains* landscape character type north of Dalby. From this point, the landscape below is fairly flat arable farmland incised by small tree-lined tributaries. Apart from occasional farm houses, trees, silos and machinery sheds, there are few vertical intrusions. The landscape comprises a strong rural character.

***Viewpoint F2 Elevated panoramic view from Roche Creek Road***

**Location and description**

This viewpoint has been selected as it represents typical and accessible views within this landscape character type, and highlights the characteristic long distant views and strongly defined skylines. It is located east of Wandoan, near the junction of Roche Creek/Nelders Road (GPS location: 201 086, 7 108 879m), and has views in a northerly direction across the northern part of the project development area. At this point, the landscape comprises a smoothly rolling landform, incised by narrow low-lying creek valleys (Roche and Middle Creeks), fringed by Poplar box or Queensland blue gum open woodland. Land use is predominantly open plains of grazing pastures for cattle. The landscape comprises a strong rural character, with a notable sense of remoteness and tranquillity due to the absence of main roads and large scale infrastructure e.g. transmission pylons.

### 5.3.7 TYPE G: LOWLAND BRIGALOW PLAINS

#### 5.3.7.1 Description of the landscape resource

**Location and boundaries**

This landscape character type is located on broad low lying level plains and comprises primarily of a mosaic of grazing pastures with remnant native forest between Goombi, Columboola and Barakula State Forest (west of Chinchilla).

**Key characteristics**

- Underlying geology of sandstones and alluvial plains, overlain by sodosol soils
- A flat to gently rolling large scale landscape with an open character and strong horizons which are absent of built features

- Open plains used for grazing pastures for cattle, with noticeable remnant belts of Brigalow (*Acacia harpophylla*), Belah (*Casuarina cristata*) and Wilga (*Geijera parviflora*) forest
- Layered open forest of Ironbarks and Wattles in elevated areas and plateaus
- Some grazing pastures contain areas of Brigalow re-growth, providing a shrubby character
- Concentration of dryland arable farmland in southern parts, alongside the Condamine River
- Poor grass cover in some areas, leaving exposed patches of shallow pale gravel soil
- Isolated Bottle trees (*Brachychiton australis*) are a prominent feature south of the Warrego Highway, west of Goombi
- Sparsely settled character, with small towns (e.g. Columboola and Goombi), and a scattering of property homesteads and cottages
- Roads are straight, often lined with belts of Brigalow and Wilga forest
- The Ryalls to Hookswood stockroute passes through the northern part of the area in an east-west direction
- The (disused) railway between Chinchilla and Miles (c.1878) is a key linear feature, running alongside the Warrego Highway
- Power transmission pylons extend through the landscape in an east-west direction, north of the Warrego Highway
- Moderate sense of remoteness and tranquillity away from transport and infrastructure corridors

***Character Area G1: Goombi-Columboola Lowland Brigalow Plains***

This is the only character area within the study area and is located between Goombi, Columboola and Barakula State Forest (west of Chinchilla). All the above characteristics apply to this area.

**Precedent modifications and infrastructure elements**

- This landscape would have once been covered by Brigalow, Belah and Wilga forest, and has been extensively cleared for pasture growth for grazing of cattle
- Construction of roads and railway (c.1878)
- Stock fencing (typical post and wire style), gates and grids
- Telecommunication infrastructure, including large-scale power pylons north of the railway line, linking to Braemar and Darling Downs power stations
- Construction of the Ryalls to Hookswood stockroute

#### 5.3.7.2 Description of the visual resource

The main viewers (visual receptors) that will be affected by the i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation of the project in the *Lowland Brigalow Plains* landscape character type will include:

- Residents living on rural properties (including homesteads and cottages)
- People working in the countryside or towns within this landscape e.g. graziers, farm assistants, farm contractors, stockmen using the Ryalls to Hookswood stockroute
- Motorists travelling along major and minor roads, including the Warrego Highway

**Typical viewpoint assessment for future development on coal seam gas facilities**

The nature of existing views from the *Lowland Brigalow Plains* is represented in the following viewpoints:

***Viewpoint G1 North-easterly view towards Barakula State Forest from Davies Road***

**Location and description**

This viewpoint is located approximately 5km north of the Warrego Highway, immediately east of Davies Road. It looks in a north-easterly direction across cleared low-lying *Lowland Brigalow Plains* towards Barakula State Forest, which provides a distant wooded backdrop and enclosure to the plains. From Davies Road, the landform drops away to an open pasture basin, used for grazing of cattle. Fields are large in scale, with clumps and belts of trees (Brigalow, Belah and Wilga) remaining along field boundaries. Apart from Davies Road and stock fencing, there is little evidence of man-made features in this view.

***Viewpoint G2 Southerly view across pasture fields from the Warrego Highway***

**Location and description**

This viewpoint has been selected as it represents typical and accessible views within this landscape character type from the Warrego Highway, a key route within the study area. It is located approximately 25km north-west of Chinchilla (GPS location: 239 742, 7 046 635m), and looks in a southerly direction across a pastoral landscape towards the Condamine River valley and *Lowland Native Forest* south-west of Chinchilla. Blocks of remnant Brigalow, Belah and Wilga forest and occasional isolated Bottle trees provide variation in this otherwise flat open pastoral landscape. The landscape comprises a strong rural character.

### 5.3.8 TYPE H: TERRACED BRIGALOW FARMLAND

#### 5.3.8.1 Description of the landscape resource

**Location and boundaries**

This landscape character type covers the smoothly undulating mosaic of Brigalow-Belah forest, terraced arable plains and lowland pastures south-west of Millmerran.

**Key characteristics**

- Large-scale smoothly undulating plains and low hills on Walloon sandstone, overlain by vertosol soils
- A settled landscape with a strong rural character typified by a complex mosaic of Brigalow forest, terraced dryland arable fields, lowland pastures with scattered farm houses and sheds; contributing to a scenic and memorable landscape
- Gently sloping hill sides are often cultivated through use of contour banks, which accentuate the variation in landform and provides a strong landscape pattern
- Low-lying pasture fields have often been assarted (cleared) from the dense Brigalow-Belah forest, comprising an enclosed character
- Brigalow-Belah forest comprises of a number of layers formed by mature and young trees, dead trees, shrubs (e.g. Wilga, Black Tea Tree, False Sandalwood), herbs, grasses and ground litter such as logs and fallen leaves, forming a dense vegetated character

- Arable and pasture fields often contain remnant copses and belts of Brigalow-Belah forest
- Introduction of belts of Ironbark, Buloke, Cypress Pine and Poplar Box woodland along field boundaries and copses within fields, where the landscape transfers to sodosol soils in western parts
- Millmerran power station chimney is a prominent skyline feature in northern parts of the landscape
- Frequent panoramic views over the surrounding smoothly undulating plains from elevated vantage points
- Notwithstanding the presence of highways, transmission pylons, and Millmerran power station, this landscape has a strong rural character with a general absence of large-scale infrastructure

***Character Area H1: Millmerran Terraced Brigalow Farmland***

This is the only character area within the study area. All the above characteristics apply to this area.

**Precedent modifications and infrastructure elements**

- Extensive clearance of Brigalow-Belah forest for arable farmland and pasture growth for cattle grazing
- Construction of contour banks along hill sides to accommodate dryland arable farmland
- Stock fencing (typical post and wire style), gates and grids
- Millmerran coal mine and power station (east of the project development area)
- Telecommunication infrastructure, including large-scale power pylons linking to Millmerran power station
- Construction of roads (sealed and unsealed)

#### 5.3.8.2 Description of the visual resource

The main viewers (visual receptors) that will be affected by the i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation of the proposal in the *Terraced Brigalow Farmland* landscape character type will include:

- Residents living on rural properties (including homesteads and cottages)
- People working in the countryside or towns within this landscape, e.g. farming contractors
- Tourists passing through the study area, including travellers along the 'Rural Getaway' scenic route between Mundubbera and Warialda (located along the Millmerran-Inglewood Road) (refer to **Figure 5**)
- Motorists travelling along major and minor roads, including the Gore Highway and Millmerran-Inglewood Road
- Motorists travelling along major and minor roads, such as the Gore Highway and Millmerran-Inglewood Road, including those travelling to work in nearby areas, e.g. workers of Millmerran power station

**Typical viewpoint assessment for future development of coal seam gas facilities**

The nature of existing views from the *Terraced Brigalow Farmland* is represented in the following viewpoints:

***Viewpoint H1 North-westerly view across terraced arable plains and lowland pastures from Millmerran Inglewood Road***

**Location and description**

This viewpoint has been selected as it represents typical and accessible views within this landscape character type from elevated vantage points. It is located on Millmerran Inglewood Road, north of the junction to Koorongara Jones Road (323 044, 6 894 692m). The viewpoint represents viewers travelling between Millmerran and Inglewood, including residents in the area, local graziers and farmers, people working in the area, e.g. farm assistants, farming contractors, employees of Millmerran power station), and visitors to the area following the 'Rural Getaway' (a scenic route between Mundubbera and Warialda). The viewpoint looks in a north-westerly direction across terraced arable plains and lowland pastures which are characteristic of this landscape. At this point, the landscape comprises a strongly rural and scenic character, with long distant views to the *Elevated Native Forest* landscape character type at Wondul Range National Park, which provide a scenic rim to the view.

***Viewpoint H2 Easterly view across lowland pastures to Commodore Peak from the Gore Highway***

**Location and description**

This viewpoint has been selected as it represents typical and accessible views within this landscape character type from lowland pasture areas. It is located along the Gore Highway, 27km south-west of Captain Mountain (319 216, 6 908 270m). The viewpoint represents viewers travelling between Millmerran and Goondiwindi, including residents in the area, local graziers and farmers, people working in the area (e.g. farm assistants, farming contractors) and visitors to State Forests and Wondul Range National Park.

At this point, the landscape foreground and middle ground contains a fairly flat open pastoral character, with isolated Cypress trees and distant groves of Brigalow-Belah forest. The *Forested Steep Hills* associated with Commodore Peak provide a memorable backdrop to this view. The notable absence of built features and natural transition into the *Forested Steep Hills* (including Domville State Forest), contributes to a moderate sense of remoteness from this viewpoint.

### 5.3.9 TYPE I: FORESTED STEEP HILLS

#### 5.3.9.1 Description of the landscape resource

**Location and boundaries**

This is a relatively small landscape character type, located south of Millmerran and comprises a series of isolated peaks, including Captains Mountain, Commodore Peak and Mount Domville.

**Key characteristics**

- Steep-sided, isolated hills and ridges in an otherwise low-lying landscape, smoothly undulating landscape

- Hills have an underlying geology of basalt, overlain by vertosol soils
- The steep slopes have probably discouraged clearance of vegetation in the past and, as a result, large blocks of Mountain Coolibah and Ironbark open woodland comprise the dominant and unifying landcover feature of this landscape character type
- Woodland cover on Mount Domville is partly clear for grazing pastures and interspersed with scrub
- Commodore Peak lookout is a key vantage point, offering panoramic northerly views over Millmerran
- Captains Mountain, Commodore Peak and Mount Domville have been identified as areas of high scenic amenity in the Toowoomba Scenic Amenity Study
- The telecommunication tower atop Mount Domville is a highly prominent feature, which detracts from the sense of naturalness and tranquillity in this part of the landscape

***Character Area I1: Captains Mountain Forested Steep Hills***

This character area is located at Captains Mountain, 10km south-west of Millmerran, adjacent to the *Terraced Brigalow Farmland* landscape type (visible in the foreground of the above images). The area is densely vegetated and Domville State Forest covers a large part of the northern hill.

***Character Area I2: Mount Domville Forested Steep Hills***

This character area is located at Mount Domville, 19km south of Millmerran. Landform within this area is particularly steep, rising to a peak, which is sparsely vegetated and contains telecommunication towers, providing a highly prominent feature in the local and wider landscape.

**Precedent modifications and infrastructure elements**

- This landscape at Mount Domville has been modified for agricultural practices, including clearing of vegetation for pasture grazing of cattle
- Construction of unsealed access tracks
- Construction of telecommunication towers atop Mount Domville

#### 5.3.9.2 Description of the visual resource

The main viewers (visual receptors) that will be affected by the i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation of the project in the *Forested Steep Hills* landscape character type will include:

- Residents living on rural properties (including homesteads and cottages)
- People working in the area e.g. State Forest employees, at Captain's Mountain Roadhouse.
- Recreational visitors and tourists to State Forests and Millmerran and District Shooting Club
- Motorists travelling along major and minor roads, such as the Gore Highway, Blackwell Road, Commodore Peak Road, Mount Domville Road

**Typical viewpoint assessment for future development of coal seam gas facilities**

Note: Due to restricted vehicular access to this steep hilly landscape, no viewpoints were recorded from this landscape character type.

### 5.3.10 TYPE J: CHROMOSOL UNDULATING LOWLANDS

#### 5.3.10.1 Description of the landscape resource

**Location and boundaries**

This landscape character type is located on broad low lying level plains of primarily mixed farmland with small tributaries, located below and adjacent to the Whetstone and Bringalily *Elevated Native Forest*, extending in a south-west direction towards Goondiwindi.

**Key characteristics**

- Gently undulating to shelving lowland plains topography lying between approximately 240m and 360m.
- Large land holdings subdivided by occasional fence lines.
- Generally open and rough tussocky pastures with solitary gums and localised patches of scrub
- A number of small and shallow forested tributary creeks flowing in a generally NE to SW direction towards the Weir River, exhibiting rocky and gravelly characteristics and frequently dry.
- Roadside shelterbelts, vegetated tributaries and remnant stands of native Eucalypt woodland and sclerophyll forests combine to create wooded horizons.
- Brigalow and Belah (*Casuarina*) vegetation prominent with some Cypress Pines and localised patches of Grass Trees (*Xanthorrhoea*).
- Fairly inaccessible landscape with few buildings or built elements leading to a strong sense of remoteness, disturbed only where it is briefly traversed by the Gore and Cunningham Highways.

***Character Area J1: Kerimbilla Chromosol Undulating Lowlands***

This character area is located approximately 30km west of Inglewood. This is the only character area of this landscape type occurring within the study area. All the above characteristics apply to this area. There are relatively small discrete blocks of forest including Bendidee and Kerimbilla State Forest. The area is also influenced at its periphery by the adjoining Landscape Type D which includes Whetstone State Forest. The concentration of Grass Trees near the junction of Kelmans/Burradoo Road is a particularly distinctive feature in this area.

**Precedent modifications and infrastructure elements**

- A few sealed roads (Gore and Cunningham Highways), otherwise unsealed tracks
- Stock fencing (typical post and wire style), gates and grids
- Buildings and significant infrastructure elements largely absent

#### 5.3.10.2 Description of the visual resource

The main viewers (visual receptors) that will be affected by the i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation of the project in the *Chromosol Undulating Lowlands* landscape character type will include:

- The few residents living on rural properties (including homesteads and cottages) within this area
- People working in the countryside within this landscape, e.g. farming contractors
- Recreational users of the landscape, for example those accessing the State Forests

- Motorists travelling along minor roads and unsealed tracks or on the Gore Highway and Cunningham Highway which pass through small sections at the north-west and south-west (respectively) of this landscape character type

**Typical viewpoint assessment for future development of coal seam gas facilities**

The nature of existing views from the *Chromosol Undulating Lowlands* is represented in the following viewpoints:

***Viewpoint J1 Westerly view from Wyaga Road across Kerimbilla Chromosol Undulating Lowlands***

**Location and description**

This viewpoint has been selected as it is representative of the typical views obtained within this landscape character type. It is located on Wyaga Road, approximately 50km north-west of Inglewood, some 400m from the Gore Highway (GPS location: 270 499, 6 878 898m). The viewpoint looks in a westerly direction across this landscape character type with Kerimbilla State Forest to the south (left) and natural vegetation associated with a tributary creek beyond which, unseen, lies the Gore Highway. The view comprises an open pasture of rough grasses grazed by cattle and divided by post and wire fences. Sandy and gravelly soils are evident in this view. The openness and large scale of this landscape character type are apparent. With the exception of the road and the fence lines there are no built elements experienced from this viewpoint and the landscape accordingly maintains a sense of remoteness.

# 6.0 Project description and key sources of potential impact

## 6.1 Introduction

This section describes the project location and its key components which are relevant to this landscape and visual impact assessment (LVIA). The assumptions made in the project description in this section are based on Arrow's 'project reference case' (developed in December 2010) which is documented in the '*7040 Arrow LNG Project (Surat Gas) – Project Description (Assumptions and Options)*' report[2].

Arrow proposes expansion of its coal seam gas operations in the Surat Basin through the Surat Gas Project. The need for the project arises from the growing demand for gas in the domestic market and global demand and the associated expansion of LNG export markets.

## 6.2 Project Proponent

Arrow is an integrated energy company with interests in coal seam gas field developments, pipeline infrastructure, electricity generation and proposed liquefied natural gas (LNG) projects.

Arrow has interests in more than 65,000 km$^2$ of petroleum tenures, mostly within Queensland's Surat and Bowen basins. Elsewhere in Queensland, the company has interests in the Clarence-Moreton, Coastal Tertiary, Ipswich, Styx and Nagoorin Graben basins.

Arrow's petroleum tenures are located close to Queensland's three key energy markets; Townsville, Gladstone and Brisbane. The Moranbah Gas Project in the Bowen Basin and the Tipton West, Daandine, Kogan North and Stratheden projects in the Surat Basin near Dalby comprise Arrow's existing coal seam gas production operations. These existing operations currently account for approximately 20% of Queensland's overall domestic gas production.

Arrow supplies gas to the Daandine, Braemar 1 and 2, Townsville and Swanbank E power stations which participate in the National Electricity Market. With ownership of Braemar 2, equity in Daandine and Townsville power stations Arrow has access to up to 600 MW of power generation capacity.

Arrow and its equity partner AGL Energy have access rights to the North Queensland Pipeline which supplies gas to Townsville from the Moranbah Gas Project. They also hold the pipeline licence for the proposed Central Queensland Gas Pipeline between Moranbah and Gladstone.

Arrow is currently proposing to develop the Arrow LNG Project, which is made up of the following aspects:

- Arrow LNG Plant – The proposed development of an LNG Plant on Curtis Island near Gladstone, and associated infrastructure, including the gas pipeline crossing of Port Curtis.
- Surat Gas Project – The upstream gas field development in the Surat Basin, subject of this assessment.
- Arrow Surat Pipeline Project – (Formerly the Surat Gladstone Pipeline), the 450 km transmission pipeline connects Arrow's Surat Basin coal seam gas developments to Gladstone.
- Bowen Gas Project – The upstream gas field development in the Bowen Basin.
- Arrow Bowen Pipeline – The transmission pipeline which connects Arrow's Bowen Basin coal seam gas developments to Gladstone.

## 6.3 Project Overview

The project development area (refer to EIS study area in **Figure 1**) covers approximately 8,600 km$^2$ and is located approximately 160 km west of Brisbane in Queensland's Surat Basin. The project development area extends from the township of Wandoan in the north towards Goondiwindi in the south, in an arc adjacent Dalby. The towns of Brigalow, Cecil Plains, Chinchilla, Columboola, Dalby, Macalister, Millmerran and Warra are located within the project development area. Project infrastructure including coal seam gas production wells and compression and

[2] Document Reference: *CR7040_11_ProjectDescription- Assumptions&Options_Mar2011_v3* (March 2011)

processing facilities (including both water treatment and power generation facilities where applicable) will be located throughout the project development area but not in towns. Facilities supporting the petroleum development activities such as depots, stores and offices may be located in or adjacent to towns.

The conceptual Surat Gas Project design presented in the environmental impact statement (EIS) is premised upon peak gas production from Arrow's Surat Basin gas fields of approximately 1,050 TJ/d. The peak gas production comprises 970 TJ/d for LNG production (including a 10% fuel gas requirement for facility operation) and a further 80 TJ/d for supply to the domestic gas market.

A project life of 35 years has been adopted for EIS purposes. Ramp-up to peak production is estimated to take between four and five years, and is planned to commence in 2014. Following ramp-up, gas production will be sustained at approximately 1,050 TJ/d for at least 20 years, after which production is expected to decline.

Infrastructure for the project is expected to comprise:

- Approximately 7,500 production wells drilled over the life of the project at a rate of approximately 400 wells drilled per year.
- Low pressure gas gathering lines to transport gas from the production wells to compression and processing facilities.
- Medium pressure gas pipelines to transport gas between field compression facilities and central gas processing and integrated processing facilities.
- High pressure gas pipelines to transport gas from central gas processing and integrated processing facilities to the sales gas pipeline.
- Water gathering lines (located in a common trench with the gas gathering lines) to transport coal seam water from production wells to transfer, treatment and storage facilities.
- Approximately 18 compression and processing facilities across the project development area expected to comprise of six of each of the following:
    - Field compression facilities.
    - Central gas processing facilities.
    - Integrated processing facilities.
- A combination of gas powered electricity generation equipment that will be co-located with project infrastructure and electricity transmission infrastructure that may draw electricity from the grid (via third party substations).

Further detail regarding the function of each type of compression and processing facility is detailed below.

**Field compression facilities** will receive gas from production wells and are expected to provide 30 to 60 TJ/d of first stage gas compression. Compressed gas will be transported from field compression facilities in medium pressure gas pipelines to multi-stage compressors at central gas processing facilities and integrated processing facilities where the gas will be further compressed to transmission gas pipeline operating pressure and dehydrated to transmission gas pipeline quality. Coal seam water will bypass field compression facilities.

**Central gas processing facilities** will receive gas both directly from production wells and field compression facilities. Central gas processing facilities are expected to provide between 30 and 150 TJ/d of gas compression and dehydration. Coal seam water will bypass central gas processing facilities and be pumped to an integrated processing facility for treatment.

**Integrated processing facilities** will receive gas from production wells and field compression facilities. Integrated processing facilities are expected to provide between 30 and 150 TJ/d of gas compression and dehydration. Coal seam water received at integrated processing facilities is expected to be predominantly treated using reverse osmosis and then balanced to ensure that it is suitable for the intended beneficial use. Coal seam water received from the field, treated water and brine concentrate will be stored in dams adjacent to integrated processing facilities.

It is envisaged that development of the Surat Gas Project will occur in five development regions: Wandoan, Chinchilla, Dalby, Kogan/Millmerran and Goondiwindi. Development of these regions will be staged to optimise production over the life of the project.

Arrow has established a framework to guide the selection of sites for production wells and compression and processing facilities and routes for gathering lines and pipelines. The framework will also be used to select sites for associated infrastructure such as access roads and construction camps. Environmental and social constraints to development that have been identified through the EIS process coupled with the application of appropriate environmental management controls will ensure that protection of environmental values (resources) is considered in project planning. This approach will maximise the opportunity to select appropriate site locations that minimise potential environmental and social impacts.

Arrow has identified 18 areas that are nominated for potential facility development to facilitate environmental impact assessment (and modelling). These are based on circles of approximately 12km radius that signify areas where development of compression and processing facilities could potentially occur.

Arrow intends to pursue opportunities in the selection of equipment (including reserve osmosis units, gas powered engines, electrical generators and compressors) and the design of facilities that facilitates the cost effective and efficient scaling of facilities to meet field conditions. This flexibility will enable Arrow to better match infrastructure to coal seam gas production. It will also enable Arrow to investigate the merits of using template design principles for facility development, which may in turn generate further efficiencies as the gas reserves are better understood, design is finalised, or as field development progresses.

Key components of the development activities that are relevant to the assessment of landscape and visual impacts are set out in **Table 6**.

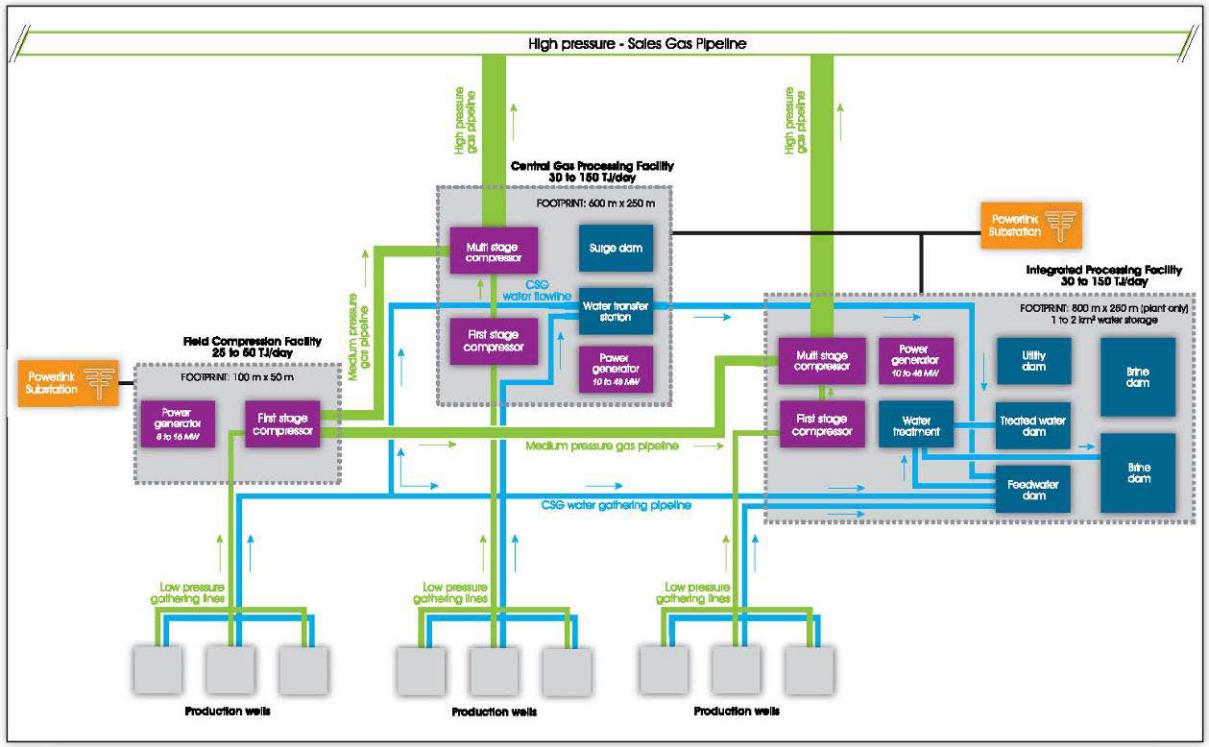
**Table 6 Description of proposed coal seam gas field and facility development**

**Development of gas compression and processing facilities and adjacent infrastructure**

Arrow proposes to develop three types of gas compression and processing facilities, including:

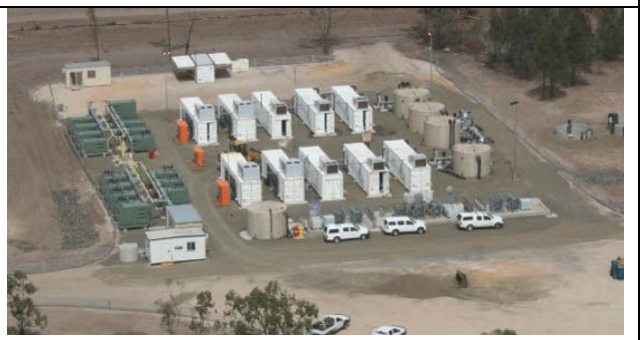
- Field compression facilities (FCFs).
- Central gas processing facilities (CGPFs).
- Integrated processing facilities (IPFs).

The project development area is divided into five broad development regions which are used for purposes of field development planning, including Wandoan, Chinchilla, Dalby, Kogan/Millmerran and Goondiwindi. Arrow intends to locate facilities at approximately 25km intervals throughout the project development area to gather gas and water from production wells. The development of approximately one facility per year from 2014 in proposed. More than one development region may be developed concurrently and parcels within a development region will be developed concurrently (i.e. wells drilled and gathering systems installed), with the construction of FCFs, CGPFs, IPFs and water treatment facilities. The following diagram provides a comprehensive overview of the proposed major infrastructure required to develop the resource, including the key end outputs of high pressure gas and treatment water.




**Facility and Field Overview (source: Arrow)**

| Development of gas compression and processing facilities and adjacent infrastructure | | |
|---|---|---|
| **Facility** | **Description** | **Imagery** |
| Field Compression Facility (FCF) | Approximately six FCFs (requiring a footprint of 100m by 50m for each FCF) are proposed in the project development area which collect and compress gas from a number of pods of wells, to increase the pressure from low pressure to medium pressure, prior to transferring the gas to CGPFs or IPFs. FCFs are located between wells and CGPFs or IPFs, where wellhead pressure is not sufficient to transport gas over the required distance to the CGPFs or IPFs. FCFs will be constructed on skid-mounted modules, which provide flexibility to adjust the facility size during development (i.e. size will be dependent on gas abstraction volumes). The FCFs will be operated remotely with manning for maintenance purposes only and may serve as a base of operations for field personnel and could accordingly incorporate facilities such as offices, crib rooms, and storage.<br>A gas flare stack will be installed at each FCF and flaring will occur as a last resort where large amounts of gas are required to be discharged from the plant and for emergency shut downs. Although the stack height is not yet determined, a maximum height of 23m has been used to represent the worst case scenario for this assessment. The actual height will depend on the space available for the sterile zone, the duty or gas throughput of the facility and the emission velocity. | No image available |
| Central gas processing facility (CGPF) | Approximately six CGPFs (requiring a footprint of 600m by 250m for each CGPF) are proposed in the project development area to collect gas from either medium pressure gas pipelines (from the FCFs) or directly from low pressure gathering systems, compress the gas to a high pressure, and discharge it to the Arrow Surat Pipeline. The CGPFs collect (but do not treat) water directly from the wells into the water transfer station, before pumping it to an IPF for storage, treatment and disposal. Infrastructure is typically 8m to12m high.<br>A gas flare stack (up to 23m) will be installed at each CGPF and flaring will occur as a last resort where large amounts of gas are required to be discharged from the plant and for emergency shut downs. |  <br>**Central gas processing facility (CGPF) (Image source: Arrow)** |
| Integrated production facility (IPF) | Approximately six IPFs (requiring a footprint of 800m by 250m for each IPF) are proposed within the project development area, which contain the same gas compression and processing equipment as a CGPFs, but contain water treatment facilities and storage ponds for coal seam water, treated water and brine (discussed below under the 'Water storage systems'). IPFs receive gas from either medium pressure gas pipelines (from the FCFs) or directly from low pressure gathering systems. The gas is compressed to high pressure and discharged to the high pressure Surat Header Pipeline or Arrow Surat Pipeline.<br>An IPF incorporates gas and water processing facilities in a common site with electricity generation facilities and requires an area of approximately 800m by 250m. Water separated from saturated gas, or received directly from wells or water transfer stations (from CGPFs), is stored and treated onsite, then temporarily stored | No image available |

| Development of gas compression and processing facilities and adjacent infrastructure | | |
|---|---|---|
| | or pumped for beneficial use or disposal (see below for more details on the water treatment facilities).<br><br>A gas flare stack (up tp 23m) will be installed at each IPF and flaring will occur as a last resort where large amounts of gas are required to be discharged from the plant and for emergency shut downs.<br><br>The IPFs will be constructed on skid-mounted components in a modular approach, allowing movement of compression trains to different parts of the project development area if necessary. The IPFs will be manned for a typical 10 hour work day. | |
| Water treatment facilities | Reverse osmosis water treatment facilities (approximately 8m to12m high) will be co-located with the IPFs. They are designed to receive raw water directly from the wells or via the CGPF water transfer station, which is treated to a quality suitable for beneficial uses (e.g. farming irrigation). |  <br>**Reverse osmosis water treatment facility (Image source: Arrow)** |
| Power generation facility | Integrated power generation is the base case power supply for the IPFs, CGPFs and FCFs. Studies are also being conducted to determine the viability of connection to the grid. Power generation facilities are likely to be located within the compounds of each IPF, CGPF and FCF, fuelled by gas supplied from adjacent gas processing facility. Electrical power will be distributed to adjacent facilities (predominantly to drive the compressors and IPF water treatment facilities) via a distribution network, to meet the load requirements. Each power generation facility will comprise a series of gas fired reciprocating engines and related electrical generators and substation equipment. A preliminary footprint of 80m by 150m has been estimated as a sufficient footprint to accommodate a 30MW power generation facility, required at the IPFs and CGPFs. Power generation facilities at the FCFs are anticipated to be half this size. Individual generating sets will comprise an exhaust silencer stack, approximately 7m high.<br><br>The facility will also contain on-site workshop and office facilities and a combined control room / switch room. On-site lubricating oil (clean and used oil) will be stored in a contained storage and handling facility. All other waste liquids from the operation of the facility will be contained and stored on site in tanks, with periodic pump-out by road tanker for off-site disposal/recycling. Domestic water reticulation will be supplied from on-site water tanks, collecting rainwater runoff from the control room roof. Additional water will be imported via tanker if required. |  <br>**Power generation facility (Image source: Arrow)** |
| Alternative | The base case is that power supply for the Surat Gas Project will be achieved through integrated power | No image availlable |

<table>
<tr><th colspan="3">Development of gas compression and processing facilities and adjacent infrastructure</th></tr>
<tr><td>power supply network and distribution</td><td>generation (i.e. power stations installed adjacent to each of the facilities).<br><br>An alternative power supply option for the Surat Gas Project is currently being studied. The arrangement would be to connect to existing high voltage grid connection and distribution infrastructure, including the development of substations to supply electrical zone substations (requiring a footprint of up to 200m by 150m) on Arrow's petroleum leases in close proximity to CGPFs and IPFs (i.e. at areas of greatest load concentration). Distribution lines (132 kV, 33 kV, 22 kV or 11 kV) will provide power to the IPFs, CGPFs, FCFs and other infrastructure as required. This would be coordinated with transmission and distribution network service providers. The typical easement width required for 132kV overhead lines would be 45 to 60m. A 10m-wide access track will be maintained along or adjacent to the centreline of the power line. Where possible, existing roads will be utilised to access powerlines to minimise disturbance. If this study were to conclude the viability of grid connection, then a solution may be achieved through a combination of integrated power generation and grid connected power supply.</td><td></td></tr>
<tr><td>Amenities</td><td>Amenities located within the IPFs include offices, workshops, warehouses, telemetry and control rooms for the remote operation and monitoring of wells (Supervisory Control and Data Acquisition). The massing of amenities buildings is approximately 4m to 8m high.</td><td>  <br>Site amenities (Image source: AECOM)</td></tr>
<tr><td>Workforce accommodation</td><td>There will be five purpose built workforce accommodation facilities adjacent to each IPF. The location of the IPFs (and hence construction camps) and the final size and number of construction camps have not yet been defined; however, they will be sized to accommodate the direct construction labour, direct construction management, well and gathering line installation and commissioning team, earthworks crew and camp operations staff. The construction workforce is predicted to peak in 2016 when two facilities (an IPF and CGPF) will be constructed concurrently. The camps will take 4 weeks to install and include the following facilities:<br>- Individual sleeping quarters with ensuite facilities.<br>- Catering services, commercial kitchen and dining area.<br>- Recreation facilities, such as a television room.<br>- Laundry facilities.<br>Once the facilities have been installed / constructed, it is assumed the workforce accommodation camps will be decommissioned.</td><td>The construction workforce accommodation requirements in each development region over the life of the project is defined in the following table.<br><br><table><tr><th>Construction camp location</th><th>Maximum number of beds required</th><th>Year(s) maximum number of beds required</th></tr><tr><td>Wandoan</td><td>320</td><td>2016 to 2018</td></tr><tr><td>Chinchilla</td><td>310</td><td>2020 to 2022</td></tr><tr><td>Millmerran / Kogan</td><td>275</td><td>2019 to 2020</td></tr><tr><td>Dalby</td><td>300</td><td>2015 to 2019</td></tr><tr><td>Goondiwindi</td><td>290</td><td>2030 to 2031</td></tr></table></td></tr>
</table>

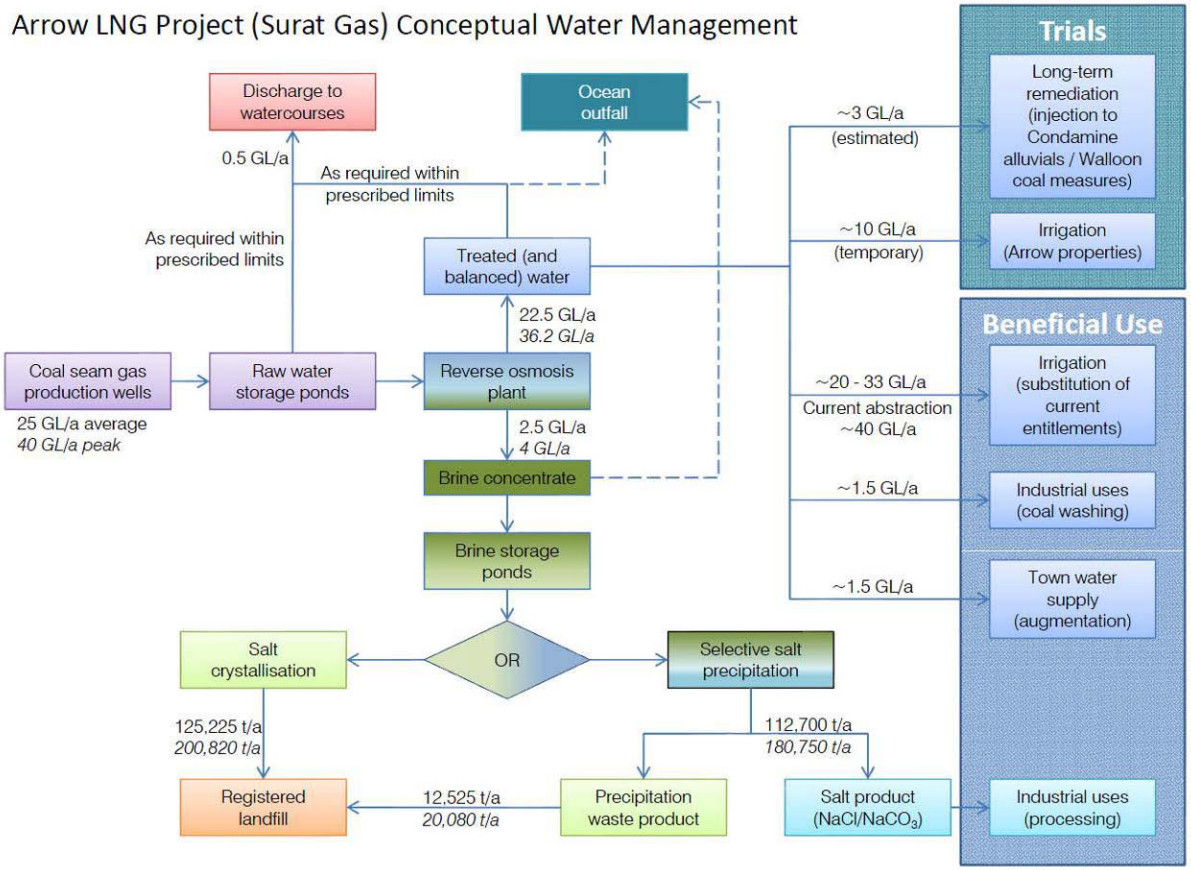
| Field development | | |
|---|---|---|
| **Facility** | **Description** | **Imagery** |
| Production wells and associated infrastructure | Approximately 7500 production wells and associated infrastructure will be installed in the project development area, across the five development regions. The wells will be spaced on an approximate 800m grid (though that may range between 700m to1500m to avoid environmental and physical constraints) and arranged in 'pods' or groups of approximately 10 wells, sharing common access roads. The final number of production wells in each 'parcel' (comprising approximately 100 wells or approximately 10 pods) will ultimately depend on (i) how prospective each parcel proves to be, (ii) what environmental constraints are present within the parcel and (iii) the outcomes of landowner negotiations. Drilling sites are generally cleared / trimmed and levelled (70m by 70m area for standard drill rig; 85m by 85m for hybrid drill rigs), to ensure safe operation of the drilling rig and associated equipment. Wells will be located >200m from any sensitive receptor and nominally drilled to a depth of 150m to 750m. Drilling operations are typically conducted up to 24 hours per day, 7 days per week in two 12 hour shifts (comprising approximately 17 personnel per shift). Once the well is installed, the well site footprint will be rehabilitated and reduced to a nominal 10m by 10m area that will be fenced and signposted to exclude stock and unauthorised access, including a 1.5m hazardous zone around the well. Agricultural operations can continue on land around the well site. Key infrastructure inside the well fencing includes separator vessel, pumps, electric drives and generators, electrical and control panel, instrumentation, and piping and valving at the wellhead to control the flow of the gas and coal seam water from the well to the gathering system. Electricity for well operation will be generated by means of a standalone gas powered engine driving electrical generator at the well. The alternative supply for well heads is from grid-provided power, involving extension of the existing electricity distribution network (this alternative is being studied to determine its viability). |  **Typical wellheads and surface facilities during operation (above left), and construction (above right and above) (Image source: Arrow)** |
| Raw water transfer pipeline | A buried 450mm transfer pipeline (approximately 55km in length, including associated pumps and controls) will provide interconnection of raw water between all of the IPFs. This will provide further flexibility to cope with variations in reservoir production, field development spikes and any restrictions to treatment or disposal. | No image available |
| Treated water pipelines | A network of distribution pipelines will convey treated water to end users in the local region. There will be a practical limitation on the distance that water can be transported using this type of system and the network location and extent will be dependent on the location(s) of the end user market (nominally 5km to 20km radius from each water treatment facility, including associated pumps and controls). | No image available |

| Field development | | |
|---|---|---|
| **Facility** | **Description** | **Imagery** |
| Water and gas gathering lines | Separate saturated gas (low, medium and high pressure) and water gathering lines will be buried (cut and cover method of construction) to transport gas and water from the well to compression and treatment facilities. Low pressure gas gathering lines will be installed to transfer the gas between the wells and FCFs and CGPFs or IPFs, requiring a 15m right of way. Medium pressure gas pipelines will be installed to transfer the gas between the FCFs and CGPFs or IPFs, requiring a 15m right of way. Pipes will be buried at a minimum depth of 750mm (final depth to be agreed with the landowner to minimise disruption to other land uses). High pressure gas pipeline infrastructure will transfer the gas from the CGPFs and IPFs to the Arrow Surat Pipeline (sales gas pipeline); however their design is not yet defined. Once the gathering system is connected in an area, the trench will be backfilled, compacted and revegetated to a standard consistent with surrounding land uses. In sensitive areas (e.g. creek crossings) horizontal directional drilling may be deployed to minimise the impact. |  <br>**Typical post-construction condition of an underground field gas and water gathering system adjacent to access track (Image source: AECOM)** |
| Access tracks | Access tracks will be required for construction and maintenance of the proposed infrastructure, including gas and water gathering systems, production wells, FCFs, CGPFs and IPFs. The location of new access tracks will be determined when the final infrastructure sites have been chosen. |  <br>**Recently constructed access track to existing Tipton West IPF (Image source: AECOM)** |

| Coal seam water storage systems |
|---|

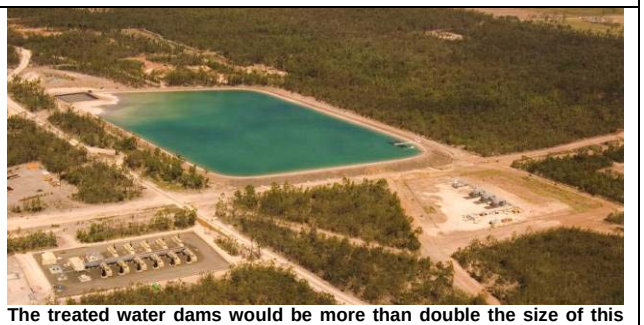
**Coal seam water storage systems**

Approximately 1-2km$^2$ of dams/ponds will be required adjacent to each IPF to store raw/untreated water (840 ML dam), treated water (960ML dam) and brine (2 x 1440ML dams). In addition, the CGPFs will have one small transfer dam (approximately 600 ML), for temporarily holding raw/untreated water. The following flow diagram[3] illustrates the intended management of water during the project operation, from extracting the water from well head facilities, collecting the water in raw water storage ponds, treating the water through reverse osmosis, storing the brine and treated water, and distributing the brine and treated water for disposal or beneficial use e.g. industrial uses, irrigation, town water supply etc. It is assumed that all dam heights will be between 3m and 5m, with a maximum of approximately 6m.




**(Image source: Coffey Environments)**

[3] Document Reference: Coffey Environments (March 2011) *Arrow LNG Project (Surat Gas) – Project Description (Assumptions and Options)*, Doc No. CR7040_11_ProjectDescription-Assumptions&Options_Mar2011_v3

| Coal seam water storage systems | | |
|---|---|---|
| **Facility** | **Description** | **Imagery** |
| Raw water storage ponds | Raw water storage ponds (840ML) adjacent to each IPF capture raw water from the wells prior to treatment. A 600ML transfer dam will also be located at each CGPF, prior to transferring the water to an IPF for treatment. | No image available |
| Brine storage ponds | Two brine storage ponds (1440ML) located at each IPF will collect concentrated brine from the reverse osmosis water treatment plant. Brine will be periodically removed off-site for disposal as land fill or crystallised into beneficial products (subject to technical and economic feasibility studies). During the decommissioning and rehabilitation phase, the contents of brine dams (including brine residue and dam liners) will be removed as waste and disposed of to a licensed facility. | No image available |
| Treated water dam | Treated water dams (960ML) store treated water at the IPFs, ready for beneficial use/distribution, for local demands e.g. irrigation water, agricultural use, urban uses, industrial uses. Dams might be left in-situ if agreed with future landowners, as the water storage capacity may be considered a beneficial end use for the land. However, the base case is that dams will be removed in the decommissioning and rehabilitation phase. |  **The treated water dams would be more than double the size of this 450ML evaporation pond (now prohibited) (image source: Arrow)** |

| Depots | | |
|---|---|---|
| Dalby, Miles and Millmerran Depots | Depots are proposed in zoned industrial precincts in Dalby (including an extension to the existing depot), Miles and Millmerran to accommodate administration, engineering and production, supervisory support, occupational health and safety management, stores, well workover functions and the associated personnel. Support staff based at the depots will peak at 200 (including 50 existing persons working from the Dalby Depot) personnel between 2021 and 2030. The expanded Dalby depot and Miles depot will be operable from 2013. Millmerran depot will be operable from 2018. Staff will perform typically 8 to 10 hour shifts during daylight hours, 5 days per week. | No image available |

## 6.4 Key sources of potential impact

The Surat Gas Project will involve ongoing gas exploration and the progressive development of facilities listed in the above table across different geographic areas within the project development area over approximately 20 years. The impacts will be phased, varying in intensity from location to location depending upon the focus of activities at different times. The project development area is divided into five broad development regions which are used for the purposes of field development planning, including Wandoan, Chinchilla, Dalby, Kogan/Millmerran and Goondiwindi. Initially, the project activities will be focussed on the Dalby and Wandoan regions, including the development of one IPF and two CGPFs in Wandoan Region, and two IPFs, one CGPF and one FCF in Dalby Region.

Upon completion of the Dalby and Wandoan region processing facilities, construction/installation of the next planned FCF, CGPF and IPF will begin in Millmerran/Kogan (including two IPFs, one CGPF and four FCFs), Chinchilla (including one IPF and one CGPF) and finally Goondiwindi (including one IPF, one CGPF and one FCF).

The operational life of each FCF, CGPF and IPF will largely depend on the productive life of the production wells (approximately 15 to 20 years). After the production wells have ceased to be productive, the associated FCF, CGPF and IPF will be decommissioned and the equipment is likely to be moved to wherever the field is expanding to at the time. Production wells will be drilled on an on-going basis year on year i.e. as some wells reach their capacity, others will replace them. Each well will need a "well workover" approximately every three years, requiring a drill-rig to be present on site.

Key sources of potential impacts from the project on the landscape and visual resource are identified in Table 7 below.

**Table 7 Key sources of potential impacts of project activities on the landscape character and visual amenity**

| Proposed Development Activity | Key sources of potential impact on the landscape character and visual amenity |
|---|---|
| **Exploration Well Drilling** | |
| Exploration Drilling | Arrow has conducted significant exploration across the project development area. Upcoming exploration will focus on collecting data on the lesser-explored areas in the northwest and south of the project development area, which will be undertaken in the next three years (2011-13). Exploration drilling consists of three phases:<br>- Phase 1: Stratigraphic holes / Chipholes – Chipholes are drilled to test for the presence, depth and lateral extent of coal, through use of a rotary rig extracting borehole cuttings (chips).<br>- Phase 2: Core Holes – Drilling of core holes involves cutting a solid piece of rock from the bore and desorbing gas from the coal in a laboratory to determine accurate gas composition. The location of exploration wells is flexible and aimed to avoid sensitive areas and minimise impacts to agricultural practises. Arrow will seek to establish approximately 5km spacing between exploration wells.<br>- Phase 3: Pilot wells – Pilot wells are drilled to rapidly assess the production potential of the larger gas reserve being targeted. Each pilot test consists of 5 to 6 wells spaced up to 200m apart in a diamond-shaped layout; typically tested for a period of 6 to 24 months. Separate pilot wells may be drilled at approximately 10km to 20 km intervals. These results will influence the sequence of field development.<br>The drilling of exploration wells is generally conducted 24 hours per day, and operations may be continuous over seven days. These activities may have short term adverse impacts on the landscape character, views and visual amenity within the study area as a result of:<br>- Presence of drilling crew (approximately six personnel per shift, including employees and contracted drilling company personnel).<br>- Installing well site access tracks and flat drilling pad, requiring vegetation clearance or trimming.<br>- Installing a flare for safety purposes.<br>- Conducting of downhole tests to verify presence of viable gas flow rates. |

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| | - Removal of well pad and access road and rehabilitation of the well (plugging of hole), if the well has not accessed a viable gas resource.<br>- Generation of traffic on rural roads as people and materials are moved to and from the work site. |
| **Production Well Design and Installation** | |
| Site Preparation | Site preparation activities to provide access to the drilling site will generally only be conducted during daylight hours and have the potential to lead to short term adverse impacts on the landscape character, views and visual amenity within the study area as a result of:<br>- Installing well site access tracks (co-located with gas and water gathering systems).<br>- Presence of construction crews and earthmoving equipment (e.g. graders, excavators and bulldozers) and associated emissions of noise from vehicles and earthmoving equipment.<br>- Vegetation clearance or trimming (typically 70m x 70m; or up to 85m x 85m if hybrid drill rig is required).<br>- Levelling of a drill pad (if necessary).<br>- Excavation / construction of temporary pits to hold fluids used in the drilling process and water produced during drilling (skips may be used for the collection of fluids during drilling but this is not a uniform drilling industry practice).<br>- Excavation of a pit for a ground flare.<br>- Establishment of construction camp facilities, including portable toilet facilities (may be co-located at IPFs, if practical, to minimise impacts).<br>- Generation of traffic on rural roads as people and materials are moved to and from the work site. |
| Production Well Drilling, and Completion and well site rehabilitation | The drilling of production wells (approximately 150m to 750m in depth) will be conducted in 12 hr shifts, continuously over seven days per week. Due to the phased roll out of the project, this activity has the potential to lead to long term adverse impacts on the landscape character, views and visual amenity within the study area as a result of:<br>- Presence of drilling crews, large scale machinery including delivery trucks, tipper-trucks, excavators, graders, generators, water trucks, tractor with seed distribution equipment (for well site rehabilitation), mechanical and electrical installation equipment, and 50t truck-mounted drilling rig (including 6 drilling rigs during year 1 of operation, 16 drilling rigs during year 2, and 24 drilling rigs during year 3 onwards).<br>- Emissions of noise from the drilling rig and other equipment.<br>- Presence of mobile drilling camp to accommodate the drilling crew whilst working, in close proximity to the drilling rig (if not accommodated in nearby IPF construction camps).<br>- Transportation of the drilling crew between nearby towns and the drilling site in work vehicles (usually 4WD utility vehicles), if the crew is not temporarily accommodated in an adjacent mobile camp.<br>- Presence of chemical toilet facilities.<br>- Presence of fencing (10m by 10m) and signposts to avert stock and prevent unauthorised access.<br>Once the well is installed, the well site footprint will be reduced to a fenced off area of approximately 10m by 10m and rehabilitated to a standard that is consistent with surrounding land, or to a standard agreed with the landholder. |
| **Water and Gas Gathering Infrastructure Installation** | |
| Water and Gas Gathering Infrastructure Installation | An average of 1,100m of high density polyethylene (HDPE) pipe will be installed per production well to transport the extracted gas and water to the nearest FCF, CGPF or IPF. Installation of the gathering systems will be generally conducted section by section during daylight hours including a peak workforce of up to 89 personnel during 2020. This activity has the potential to lead to in short term adverse impacts on the landscape character, views and visual amenity within the study area as a result of: |

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| | - Presence of trenching crew and machinery (e.g. backhoe, trench digger, welding tools, all terrain vehicle with crane to deploy pipe segments) and associated emissions of noise from earthmoving equipment.<br>- The establishment of a 15m by 20m wide "right of way" trenching corridor to install the gathering lines at a depth of approximately 750mm (final depth be agreed with landowners).<br>- Hydrotesting of the gathering systems to ensure operational integrity.<br>- Transportation of the construction crew between nearby towns and the work site in work vehicles (usually 4WD utility vehicles), if the crew is not located in workforce accommodation at IPFs.<br>The following assumptions have been made for this LVIA with respect to installation of the water and gas gathering infrastructure:<br>- Gas and water gathering systems will be located in consultation with landholders and buried at a depth sufficient to ensure agricultural activities (such as pasture grazing, ploughing) reconvene above the gathering systems. In agricultural areas it is assumed that the gathering infrastructure will be located within or adjacent to existing farm tracks and avoid cultivated areas.<br>- Trenches will be backfilled, compacted to a level that is consistent with the surrounding land and protective of the pipes within. The surface will be levelled using earthmoving equipment and revegetated to a standard consistent with surrounding land uses.<br>- In sensitive areas which cannot be avoided, such as creek crossings where normal excavation and installation methods are not sufficiently protective, it is assumed horizontal directional drilling will be deployed to minimise adverse impact.<br>- Automated vents and drains will be installed to remove residual amounts of gas and water along the gathering systems, to improve efficiency. The vents and drains will require ongoing surface level access for during operation for maintenance purposes. |
| **Gas Compression and Processing Facility Installation** | |
| FCFs, CGPFs and IPFs | Arrow proposes to develop three types of gas compression and processing facilities, including:<br>- Six FCFs, requiring 100m by 50m of land per facility.<br>- Six CGPFs, requiring 600m by 250m of land per facility.<br>- Six IPFs, requiring 800m by 250m, and 1-2km2 of land for dams/ponds per facility.<br>At peak operation the construction/installation workforce will comprise up to 60 personnel for the FCFs and up to 140 personnel for the CGPFs and IPFs, including a of mixture of trades and disciplines. Plant and equipment used on the construction site will vary dependant on specific requirements but will likely include, bulldozers, graders, excavators, backhoes, cranes, elevated work platforms, forklifts etc. The development will involve the transportation of large items of plant and equipment (compressors etc.) to the site. Work will typically be undertaken during 10-12 hour day shifts, with staff rotating on 21-day-on 7-day off cycles allowing a constant working program. Some periods of peak activity such as commissioning will involve 24 hour operations conducted in two (or more) shifts. It is assumed a purpose built workforce accommodation camps will be located within walking distance to each IPF during construction/installation phase. These will be demounted following completion of construction activities. Where workforce members are located in nearby towns, transportation will likely be provided by buses and light vehicles (4WDs).<br>The construction and installation of each facility will be phased over approximately 20 years and may lead to long term adverse impacts on the landscape character, views and visual amenity within the study area as a result of:<br>- Presence of construction crews, large scale machinery (e.g. bulldozers, scrapers, graders, excavators, truck (tipper), backhoes, cranes, elevated work platforms, forklifts, generators, water trucks) and associated emissions of noise resulting from machinery and vehicles. |

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| | - Generation of traffic on rural roads as people and materials are moved to and from the work site. |
| Sewage Treatment Plant Design and Installation | The installation the sewage treatment facility for workforce accommodation camps at each IPF during the construction phase may lead to short and long term adverse impacts on the landscape character, views and visual amenity within the study area as a result of:<br>- Presence of construction crews and large scale machinery.<br>- Construction of primary and secondary sewage treatment plant suitable for the construction workforce.<br>Any treated water from the secondary treatment plant will be used for irrigation via dripper or subsurface pipe (it is assumed that effluent, soil and groundwater monitoring programs will be implemented to ensure the irrigation practice remains sustainable and there is no unsustainable release of contaminants into the receiving environment). |
| Electricity Generation Facility Design and Installation | Installation of electrical generation facilities (to take gas/water from nearby production wells and produce power for the FCFs, CGPFs, IPFs and water treatment facilities) may lead to short and long term adverse impacts on the landscape character, views and visual amenity within the study area as a result of:<br>- Presence of electrical generation facility (including 7m high exhaust silencer stacks) at each FCF, CGPF and IPF, on-site workshop and office facilities, a combined control room / switchroom, storage facilities (for storing lubricating oil and liquid waste), and rainwater tanks.<br>- Noise generated during the facility installation.<br>- Generation of traffic on rural roads as people and materials are moved to and from the work site. |
| Water Storage Facility Installation | Installation of the small transfer dam at each CGPF and particularly the 1-2km$^2$ water storage facilities at each IPF may lead to short term adverse impacts on the landscape character, views and visual amenity within the study area as a result of presence of construction crews, large scale machinery (e.g. bulldozers, scrapers, graders, excavators, truck (tipper)) constructing the water storage facilities and the associated noise emissions from machinery and vehicles. |
| Construction of Workforce Accommodation | Purpose built accommodation will be constructed at each IPF, to house construction workforce (nominally, accommodation for 140 workers for the construction of one facility) and well and gathering line installation construction team. Each camp would take up to 4 weeks to construct; until then, workforce would be located in existing accommodation in local towns, including Dalby, Chinchilla and Millmerran.<br>Although the exact location of the IPFs (and hence construction camps) are not yet determined, each construction camp will typically accommodate between 200 and 350 personnel.<br>Camp construction will occur adjacent to the IPFs and may lead to short term adverse impacts on the landscape character, views and visual amenity within the study area as a result of:<br>- Vegetation clearance (including trees, shrubs, grassland) and an increase in impermeable surfaces (i.e. to make way for buildings and facilities);<br>- Presence of construction crews and large scale machinery installing the sleeping quarters, catering services, recreation facilities and amenities (laundry, commercial kitchen, dining area etc) .<br>- Generation of traffic on rural roads as people and materials are moved to and from the work site. |
| **Operation and Maintenance** | |
| Well Site Operation and Maintenance | The production wells will operate 24 hours per day and require 1 operational staff per 50 wells. Well workovers will occur every 3 years for each well, requiring 5 people working for 7 days. The operation and maintenance of the wells may lead to long-term adverse impacts on the landscape character, views and visual amenity within the study area as a result of:<br>- Presence of wellhead facilities (including separator vessel, pumps, electric |

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| | drives and generators, electrical and control panel, instrumentation, piping and valving at the wellhead) contained within a 10x10m fenced compound.<br>- Presence of powered electrical generator, to power the wellhead facilities.<br>- Presence of maintenance crew to carry out the following:<br>• Daily maintenance of wellhead engine and pump for the first few weeks after their installation; which will reduce over time to one visit every 1-2 weeks as the well becomes self-sufficient.<br>• Scheduled monthly maintenance visit (including ongoing maintenance of onsite powered electrical generator).<br>• Maintenance of faulty or failed facilities / components.<br>• Occasional re-drilling of failed or unsuccessful wells in close proximity to the initial well.<br>• "Well workovers" by a workover rig (similar to the type of rig used to originally install the well) approximately every 3 years, involving 5 people for approximately 7 days.<br>The following assumptions have been made for this LVIA with respect to installation of the water and gas gathering infrastructure:<br>- Once the well is established and stabilised, most monitoring of well operation can be carried out remotely via telemetry or installed communication lines leading back to the IPF. Additional visits by maintenance crew may be required for maintenance or intervention work on the well or wellhead surface equipment. Agricultural activities (such as ploughing and pastoral grazing) will continue on land around the well sites. |
| Water and Gas Gathering Line Operation and Maintenance | Gathering infrastructure is generally passive during its operational life although will operate 24 hours per day and will require ongoing maintenance, and may lead to long-term adverse impacts on the landscape character, views and visual amenity within the study area as a result of:<br>- The presence of an open corridor comprising the gathering lines and associated access tracks to facilitate periodic maintenance, with loss of trees and shrubs.<br>- Regular visits, as required to maintain the isolation valves, vents and drains periodically located along the length of the gathering system pipe work (reducing to monthly or quarterly maintenance visits as production stabilises).<br>- Periodic checks of the pipeline infrastructure and occasional repair work, requiring excavation machinery and maintenance crew (in some cases, pipelines may need to be re-routed to avoid potential future damage).<br>- Emissions of noise from maintenance machinery.<br>- Generation of traffic on rural roads as people and materials are moved to and from the work site.<br>NOTE: It is assumed that management of vegetation and erosion along gathering lines will be undertaken concurrently with other operational well site visits. Maintenance is expected to take place during daylight hours between Monday to Friday. Emergency maintenance may be conducted at any time. |
| FCF Operation and Maintenance | The FCFs will be operated remotely and maintained by staff from nearby CGPFs and IPFs, when required. The presence of six FCFs in the development area may lead to long-term adverse impacts on the landscape character, views and visual amenity within the study area as a result of:<br>- The presence of a large-scale FCF components (up to 8-12m high), including gas powered engine, electric motors, compressors, cooling fans, separators, control and safety systems, electrical panels, pipework and emissions of noise from operating equipment.<br>- Scheduled maintenance checks and responsive maintenance of the FCFs and occasional servicing to repair the plant, and associated emission of noise.<br>- Transportation of the maintenance and operation crew between nearby towns in light vehicles (e.g. 4WD utilities) and transportation of maintenance machinery as required on rural roads. |
| CGPF and IPF Operation and | The CGPFs and IPFs will be managed by personnel typically in 10 hour shifts during daylight hours, 7 days per week. "Unmanned periods" will be controlled centrally |

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| Maintenance | and/or via a callout system. The presence of six CGPFs and six IPFs in the project development area may lead to long-term adverse impacts on the landscape character, views and visual amenity within the study area as a result of:<br>- Presence of a large-scale CGPF and IPF components (up to 8-12m high), including gas powered engine, electric motors, compressors, cooling fans, separators, control and safety systems, electrical panels, pipework a gas pipe flare (up to 23m), control rooms, ancillary systems, power generation facility (requiring 7m side exhausts and an overall footprint of 80m x 150m), water transfer station and 600ML transfer dam (CGPFs only) and water treatment facilities (IPFs only), and emissions of noise from operating equipment<br>- Scheduled maintenance checks, responsive maintenance and servicing of the CGPFs and IPFs to repair the plant.<br>- Transportation of the maintenance and operation crew between nearby towns and the CGPF and IPF sites in light vehicles (e.g. 4WD utilities). |
| IPF Water Storage Facility Operation and Maintenance | The 1-2km$^2$ of dams at each IPF may lead to long-term adverse impacts on the landscape character, views and visual amenity within the study area as a result of:<br>- Presence of large scale dams (embankments 3-5m high, with a maximum of approximately 6m), including two 1440ML brine storage dams at each IPF.<br>- Responsive maintenance and emergency maintenance conducted at any time to repair the plant and water storage facilities.<br>- Transportation of the maintenance and operation crew between nearby towns and the IPF site in work vehicles (usually 4WD utility vehicles), if the crew is not located in a temporary mobile camp.<br>The water treatment plant will be automated. Operating information will be transferred electronically to the IPF control room/office and monitored and inspected by relevant staff member(s). |
| Workforce Accommodation | The operational workforce in 2014 is expected to be 122 personnel. The total operational workforce is expected to peak during 2028-2030 at 464 staff each year. Options for accommodating the operational workforce include:<br>- Small mobile drilling camps located near drilling operations for field staff.<br>- A small section of an IPF construction camp may be retained to accommodate well installation and commissioning crews.<br>- Crews may be accommodated in existing residences in local towns (rented or purchased) including Dalby, Chinchilla and Millmerran.<br>The presence of operational workforce accommodation in local towns and/or workforce accommodation camps may lead to long term and short term impacts, respectively, on the landscape character, views and visual amenity within the study area. This may be the result of new accommodation units and associated facilities and the movement of vehicles at the start / end of shifts to the place of work. |
| **Decommissioning and Rehabilitation** | |
| Production Well Decommissioning and Rehabilitation | Production wells will be decommissioned once they reach the end of their resource life. Surface equipment and well site fencing will be removed, well casing will be cut off approximately 1000mm below the ground surface and plugged with concrete, with a statutory sign post erected to mark its location. The well site will be rehabilitated to a land surface that is consistent with the local landscape, or as agreed with the landholders. Activities associated with decommissioning and rehabilitation of production well sites may lead to short-term adverse impacts on the landscape character, views and visual amenity within the study area as a result of:<br>- Presence of large-scale machinery and vehicles (e.g. trucks, excavators, graders, generators, water trucks, tractor with seed distribution equipment (for well site rehabilitation), mechanical and electrical installation equipment, and drilling rig) and associated noise from machinery and vehicles.<br>- Transportation of the construction crew between nearby towns and the well site in work vehicles (usually 4WD utility vehicles and/or and 4WD coaster buses), if the crew is not located in a temporary workforce accommodation.<br>NOTE: It is assumed that surface topsoils will be replaced or existing soils |

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| | ameliorated to a condition suitable for landscape restoration, ensuring erosion controls are in place, drainage lines are re-established and pasture/crop/shrub/forest species are re-instated, allowing agricultural activities (such as ploughing) or forest plantings to recommence after the well sites have been decommissioned. Over the longer-term it is anticipated that the rehabilitation will reinstate the landscape character, views and visual amenity to their former condition . |
| Gathering Infrastructure Decommissioning and Rehabilitation | Gathering pipelines will be flooded and capped and remain approximately 750mm below the ground surface and all associated signage will be removed. Surface facilities such as vents and drains will be removed. Where the pipelines have been accessed to cut and cap them, excavations will be backfilled and levelled and the land revegetated to match surrounding land surfaces. The decommissioning and rehabilitation of the gathering pipelines may lead to short-term adverse impacts on the landscape character, views and visual amenity within the study area as a result of:<br>- Presence of large-scale machinery and vehicles (e.g. backhoe, trench digger, welding tools, all terrain vehicle with crane to deploy pipe segments) and associated noise from earthmoving equipment.<br>- Transportation of the construction crew between nearby towns and the pipeline site in work vehicles (usually 4WD utility vehicles and/or and 4wd coaster buses), if the crew is not located in workforce accommodation camp<br>NOTE: It is assumed that rehabilitation of agricultural land will be determined in consultation with landholders to allow agricultural activities (such as ploughing) to reconvene after the gathering systems have been decommissioned. Over the longer-term it is anticipated that the rehabilitation of gathering line infrastructure will reinstate the landscape character, views and visual amenity to their former condition. |
| FCF, CGPF and IPF Decommissioning and Rehabilitation | Decommissioning and rehabilitation of a FCF, CGPF and IPF will be a project of similar scope and scale to that during construction. The works will be completed in the following manner:<br>- FCF: up to 25 personnel for a period of 4 months.<br>- CGPF: up to 50 personnel for a period of 8 months.<br>- IPF: up to 160 personnel for a period of 8 months<br>Major plant and equipment such as compressors, gas engines, reverse osmosis units, transfer pumps etc. will, wherever practical, be re-used by Arrow. The decommissioning and rehabilitation of these facilities may lead to short-term adverse impacts on the landscape character, views and visual amenity within the study area as a result of:<br>- Presence of large-scale machinery and vehicles (e.g. graders, excavators, tip trucks, low loaders, cranes, fuel delivery trucks and 4WD coaster buses) and associated emissions of noise from the earthmoving equipment.<br>- Accumulation and disposal of waste which cannot be re-used or recycled.<br>- Disturbance of land within the FCF, CGPF and IPF footprints will take time to regenerate, thus adversely impacting the landscape character and visual amenity in the short term.<br>- Generation of traffic associated with the movement of the workforce and plant, equipment and waste to and from the site.<br>NOTE: It is assumed that any brine residue and dam liners will be removed during decommissioning as a waste. Once all equipment and surface features have been removed from a FCF, CGPF and IPF, the site will be graded and levelled (or contoured as appropriate); topsoil will be ameliorated and spread and the land will be seeded or ameliorated using other methods as appropriate with pasture/crop/shrub/tree species to match the surrounding land cover, in consultation with stakeholders and potentially end users. Treated water dams may be left in-situ if agreed with future landowners as the water reticulation capacity may be considered a beneficial end use for the land. The base case however is that dams will be removed and agricultural activities (such as pasture grazing, ploughing) will recommence after the IPFs and water storage facilities have been removed. |

# 7.0 Identification of landscape and visual sensitivity

This section identifies the sensitivity of the landscape resource and visual resource (i.e. considering visual receptors) within each landscape character type, to the types of development proposed as part of the project.

The sensitivity of the landscape and visual resource has been identified in the absence of any mitigation measures. This approach ensures that the sensitivities of each landscape are understood and mitigation can be proposed that addresses these concerns. Mitigation does not change the sensitivity of the landscape, only the magnitude of the resultant effect and consequent significance of the impact.

The representative viewpoints identified and described in *Section 5* have been used to illustrate the assessment of the sensitivity of each landscape character type. To gain an appreciation of the potential visual impact of the production wells and IPFs in each landscape character type refer also to the "unmitigated" visualisations in *Section 9*.

## 7.1 Type A: Wooded River Valley

### 7.1.1 Identification of landscape sensitivity

This landscape is considered to be of very high scenic preference in the Toowoomba Scenic Amenity Study. The key landscape sensitivities of the *Wooded River Valley* landscape character type to the project during i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation are summarised in Table 8:

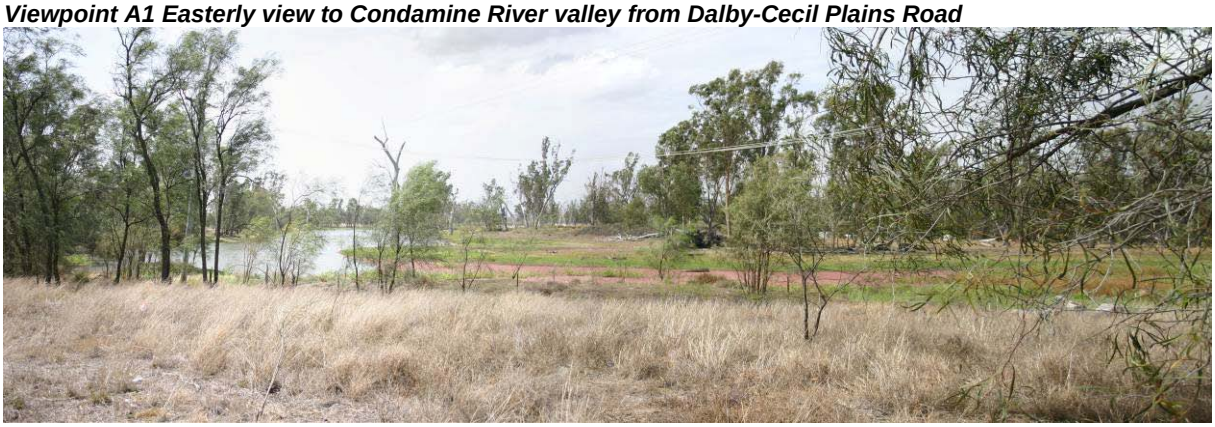
**Table 8 Sensitivity of *Wooded River Valley* landscape character type to the project**

| Development Type | Key sensitivities of landscape character type | Overall inherent sensitivity |
|---|---|---|
| Field Development | The high level of naturalness with an 'organic' landscape pattern is sensitive to introduction of rigid linear elements such as field gas and water gathering systems. | **Medium** |
| CGPF and IPF | The intimate scale, distinctive river valley landform, strong sense of tranquillity and high level of naturalness is incongruent with the scale and nature of a CGPF or an IPF. | **High** |
| FCF | Although the scale and massing of a FCF (footprint of approximately 5,000m$^2$) is substantially less than a CGPF and/or IPF (footprint of minimum 150,000m$^2$), the introduction of a FCF would strongly contrast with the intimate scale, distinctive river valley landform, strong sense of tranquillity and high level of naturalness associated with the landscape character type. | **High** |
| Water Storage Systems | Although there are several precedent engineered water storage facilities (i.e. weirs), the intimate scale, distinctive river valley landform and high level of naturalness renders this landscape sensitive to the introduction of engineered water storage facilities such as raw or untreated dams for brine collection. | **Medium** |
| Depots | N/A; the proposed depots in Dalby, Miles and Millmerran would not directly affect this landscape character type. | **N/A** |

### 7.1.2 Identification of visual sensitivity

The sensitivity of views from the *Wooded River Valley* is represented in the following viewpoints:

***Viewpoint A1 Easterly view to Condamine River valley from Dalby-Cecil Plains Road***

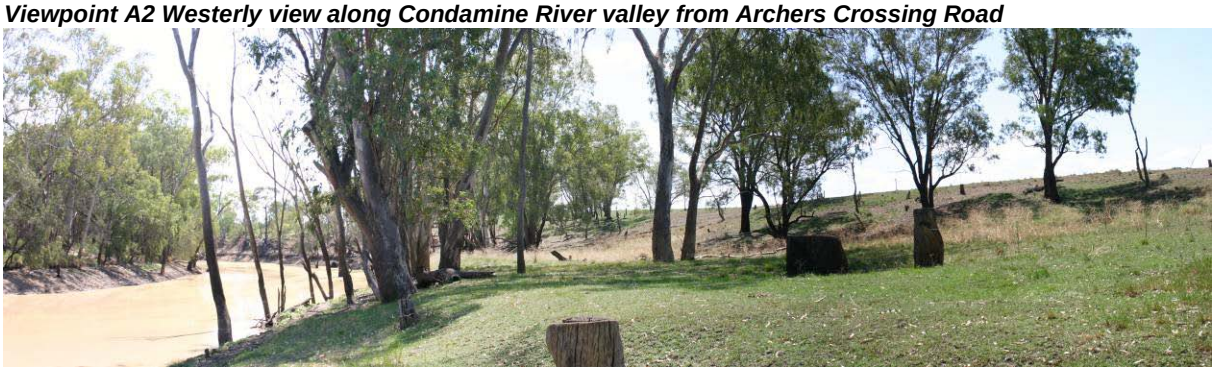


The key visual sensitivities in this viewpoint, which are sensitive to change include:

- The naturally undulating landscape.
- The concentration of riparian vegetation.
- Notable absence of human influences, e.g. buildings, infrastructure corridors, engineered water storage facilities (such as irrigation 'ring tanks').
- Relative scarcity of this landscape character type within the study area.
- Substantial level of naturalness and visual contrast to the adjacent flat agricultural plains.
- Medium sensitivity of receptors including residents living on nearby rural properties, people working in the countryside or towns within this landscape, e.g. farming contractors and scenic drivers and tourists travellers along 'Rural Getaway' (between Mundubbera and Warialda).

Overall, this viewpoint is considered to have a **medium** sensitivity to the change proposed (e.g. introduction of field development, FCF, CGPF, IPF and water storage facilities), due to its scenic qualities (i.e. its strong sense of naturalness and tranquillity), the notable absence of human influences and the medium sensitivity of viewers.

***Viewpoint A2 Westerly view along Condamine River valley from Archers Crossing Road***



The key visual elements in this viewpoint, which are sensitive to change include:

- The naturally sloping landform of the river valley sides.
- Remnant mature riparian trees.
- Notable absence of man-made features e.g. buildings, infrastructure corridors, engineered water storage facilities (such as irrigation 'ring tanks').
- Medium sensitivity of receptors, including residents living on nearby rural properties, people working in the countryside or towns within this landscape, e.g. farming contractors and occasional recreational users of the landscape, including picnickers and anglers.

Overall, this viewpoint is considered to have a **medium** sensitivity to the change proposed (e.g. introduction of field development, FCF, CGPF, IPF and water storage facilities), due to its scenic qualities (i.e. its strong sense of naturalness and tranquillity), the notable absence of built elements such as buildings or retaining and the medium sensitivity of viewers.

## 7.2 Type B: Settled Arable Plains

### 7.2.1 Identification of landscape sensitivity

This rural landscape is considered to be of moderate scenic preference in the *Toowoomba Scenic Amenity Study*. The key landscape sensitivities of the *Settled Arable Plains* landscape character type to the project during i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation are summarised in **Table 9**:

**Table 9 Sensitivity of *Settled Arable Plains* landscape character type to the project**

| Development Type | Key sensitivities of landscape character type | Overall inherent sensitivity |
|---|---|---|
| Field Development | The structured, regular landscape pattern and precedent modifications (including water extraction) and infrastructure elements gives this landscape character type a low inherent sensitivity to the introduction of rigid linear elements such as field gas and water gathering systems. However, its perceived harmonious, highly visually homogeneous, rural predominantly agricultural, and extensive planar and open character increases the sensitivity to change related to gas extraction. | **Medium** |
| CGPF and IPF | The presence of large scale machinery sheds on rural properties and Linc Energy's UCG plant (located approximately 20km south-east of Chinchilla) provide some visual context for the introduction of similarly scaled buildings and structures (e.g. an IPF and/or CGPF). However, the highly visually homogeneous, predominantly agricultural, and the extensive planar and open character within this landscape makes it sensitive to the introduction of industrial scale gas-related facilities. | **Medium** |
| FCF | Although the scale and massing of a FCF (footprint of approximately 5,000m$^2$) is substantially less than a CGPF or IPF (footprint of minimum 150,000m$^2$), the introduction of a FCF would strongly contrast with the extensive planar and open rural character associated with the *Settled Arable Plains* landscape character type. | **Medium** |
| Water Storage Facilities | The introduction of elevated dams for raw, treated water or brine would contrast with the use and colouring of precedent water storages ('ring tanks') in this landscape; however, assuming the water storage facility takes on a similar character (i.e. general size, embankment slope/height) to existing 'ring tanks' (and the contents would not be discernible from ground level), the sensitivity would be reduced. | **Low** |
| Depots | Assuming the depots will be located in zoned industrial precincts (i.e. not within residential precincts), the introduction of a new depot in Millmerran and the expansion of the existing Dalby Depot will be in context with an area / precinct containing land use and buildings of similar scale and character, therefore reducing the overall sensitivity to this type of development. | **Low** |

### 7.2.2 Identification of visual sensitivity

The sensitivity of views from the *Settled Arable Lands* is represented in the following viewpoints:

***Viewpoint B1 South-westerly view across arable farmland from Dalby-Kogan Road***

The key visual elements in this viewpoint, which are sensitive to change include:

- The flat, open and exposed character of the landscape with views to the horizon.
- Notable absence of vertical intrusions.
- Medium sensitivity of visual receptors, including residents living on nearby rural properties, people working in the countryside within this landscape (e.g. farming contractors), and scenic drivers and tourists travellers along 'Kumbarilla Bird Trail'.

The landscape in this view comprises a very structured and controlled character that may render it more accommodating of substantially engineered, regulated development. This viewpoint isconsidered to have a **medium** sensitivity overall to the change proposed (e.g. introduction of field development, FCF, CGPF, IPF and water storage facilities), due to the highly visually homogeneous, predominantly agricultural, and extensive planar and exposed character in conjunction with the medium sensitivity of viewers.

***Viewpoint B2 Westerly view across arable farmland from Nandi Tipton Road***

The key visual sensitivities in this viewpoint, which are sensitive to change include:

- The flat, open and exposed character of the landscape with views to the horizon.
- Notable absence of vertical intrusions.
- Although local residents are sensitive receptors, the overall sensitivity of receptors from this point is considered to be low, due to the low numbers of people likely to experience this view, including a lack of tourist and recreational users, who have a particular interest in the visual qualities of the landscape.

This viewpoint comprises a harmonious rural and flat, open, exposed character and is considered to have a **low** sensitivity overall to the change proposed (e.g. introduction of field development, FCF, CGPF, IPF and water storage facilities), due to the precedent structured and controlled landscape character and the low sensitivity of viewers.

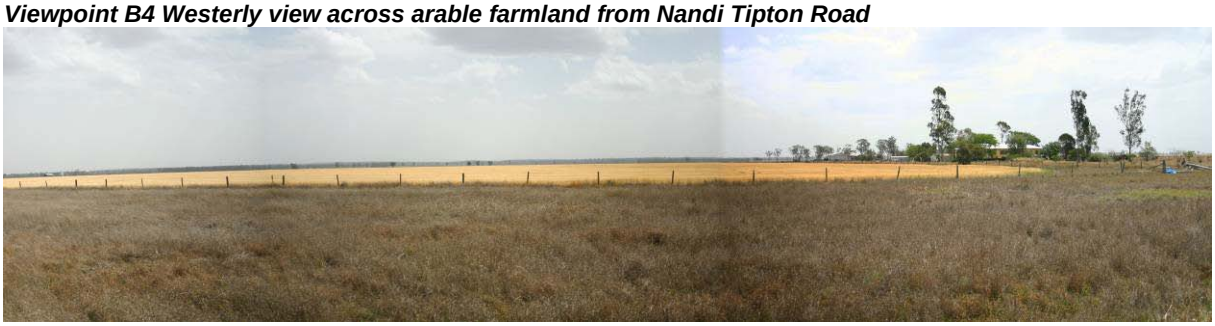
***Viewpoint B3 Elevated easterly view across Lake Broadwater from Bird Hide along Broadwater Bird Trail***

The key visual elements in this viewpoint which are sensitive to change include:

- The natural landform (shallow depression).
- The strong sense of naturalness and tranquillity.
- The concentration of riparian vegetation.
- Notable absence of intrusive human influences e.g. buildings, infrastructure corridors, engineered water storage facilities (such as irrigation 'ring tanks').
- High sensitivity of receptors, including people living, visiting and working within Lake Broadwater Conservation Park (e.g. park ranger and users of the Broadwater Bird Trail)

Overall, this viewpoint is considered to have a **high** sensitivity to the change proposed (e.g. introduction of field development, FCF, CGPF, IPF and water storage facilities), due to its scenic qualities (i.e. its strong sense of naturalness and tranquillity), the notable absence of human influences, and the high sensitivity of viewers whose interests specifically focus on the landscape.

***Viewpoint B4 Westerly view across arable farmland from Nandi Tipton Road***



The key visual sensitivities in this viewpoint, which are sensitive to change include:

- The flat, open and exposed character of the landscape.
- Notable absence of vertical intrusions.
- Medium sensitivity of receptors, including residents living on nearby rural properties, people working in the countryside within this landscape (e.g. farming contractors), and scenic drivers and tourists travellers along the 'Rural Getaway', between Mundubbera and Warialda.

Although the landscape in this view comprises a very structured and controlled character that may render is more accommodating of similar highly engineered, regulated development; it is considered to have a **medium** sensitivity overall to the change proposed (e.g. introduction of field development, FCF, CGPF, IPF and water storage facilities), due to the harmonious rural and flat, open, exposed character with a notable absence of vertical intrusions and the medium sensitivity of viewers.

### 7.2.3 Precedent coal seam gas infrastructure

The following image assists in appreciating the extent to which the introduction of gas wells and surface facilities[4]

[4] It should be noted that the design of the production wells and associated surface facilities have modified since these facilities were

in the *Settled Arable Plains* landscape character type will impact upon the view. The image was taken during a site visit in October 2009, east of Grassdale Feedlot (within *Character Area B2: Dalby to Tipton Settled Arable Plains*), between an arable field and a 'ring tank'.

The following image assists in appreciating the extent to which the introduction of gas and water gathering lines in the *Settled Arable Plains* landscape character type will impact upon the view. In this image, the gathering lines have recently been laid between an arable field (currently actively farmed) and an existing unsealed road and verge. The alignment is indicated by the safety signage and line of reduced groundcover. The image was taken during a site visit in October 2009, near Grassdale Feedlot on Wilkins Road, approximately 30km south-west of Dalby.


## 7.3 Type C: Sodic Transitional Pastures

### 7.3.1 Identification of landscape sensitivity

This landscape is considered to be of moderate scenic preference in the *Toowoomba Scenic Amenity Study*. The key landscape sensitivities of the *Sodic Transitional Pastures* landscape character type to the project during i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation are summarised in Table 10:

**Table 10 Sensitivity of *Settled Arable Plains* landscape character type to the project**

| Development Type | Key sensitivities of landscape character type | Overall inherent sensitivity |
|---|---|---|
| Field Development | The high degree of variation in this landscape (e.g. varied landform and land cover), contained views, and the noticeable presence of existing gas wells within arable and pasture fields, gives it a lower inherent visual sensitivity to the introduction of field gas and water gathering systems. | **Low** |
| CGPF and IPF | Although this landscape has a small-scale rural character with a moderate sense of remoteness, there is some precedent for large scale buildings (albeit rural, low rise in character). Views within this landscape are fairly contained by vegetation and changes in landform; decreasing the sensitivity of the landscape to built form at the scale of a CGPF and/or an IPF. | **Low** |

installed, in c.2006 (refer to visualisations in the "landscape character type-specific mitigation measures" section).

| | | |
|---|---|---|
| FCF | As there is some precedent for large scale buildings (albeit rural, low rise in character), and views within this landscape are fairly contained by vegetation and changes in landform; the *Sodic Transitional Pastures* landscape character type landscape is less sensitive to the introduction of a FCF (footprint of approximately 5,000m$^2$), whose scale and massing is substantially less than a CGPF or IPF (footprint of minimum 150,000m$^2$). | **Low** |
| Water storage facilities | The small-medium scale character of this landscape comprising a high degree of variation and notable absence of existing large-scale water storage facilities makes this landscape sensitive to the introduction of such infrastructure. | **Medium** |
| Depots | N/A; the proposed depots in Dalby, Miles and Millmerran will not directly affect this landscape character type. | **N/A** |

### 7.3.2 Identification of visual sensitivity

The sensitivity of views from the *Sodic Transitional Pastures* is represented in the following viewpoints:

***Viewpoint C1 Westerly view across pasture field to an existing gas well from Wilkins Road***

The key visual sensitivities in this viewpoint, which are sensitive to change include:

- Fairly rural character.
- Notable absence of large scale water storage facilities.
- Although local residents are sensitive receptors, the overall sensitivity of receptors from this point is considered to be low, due to small numbers of people likely to experience this view combined with lack of recreational users of the landscape, who have a particular interest in their visual environment.

Although this viewpoint comprises a fairly rural and flat, open, exposed character; it is considered to have a **low** sensitivity overall to the change proposed (e.g. introduction of field development, FCF, CGPF, IPF and water storage facilities), due to the precedence for gas well and surface facilities and the low sensitivity of viewers.

***Viewpoint C2 South-westerly view across pasture farmland from Wilkins Road***

The key visual sensitivities in this viewpoint, which are sensitive to change include:

- Moderate sense of remoteness.
- Notable absence of human influences e.g. buildings, infrastructure corridors, engineered water storage facilities (such as irrigation 'ring tanks').

- Although local residents are sensitive receptors, the overall sensitivity of receptors from this point is considered to be low, due to small numbers of people likely to experience this view combined with lack of recreational users of the landscape, who have a particular interest in their visual environment

Although this viewpoint comprises a moderate sense of remoteness and a notable absence of built features; it is considered to have a **low** sensitivity overall to the change proposed (e.g. introduction of field development, FCF, CGPF, IPF and water storage facilities), due to the low sensitivity of viewers.

### 7.3.3 Precedent coal seam gas infrastructure

The following images assist in conceiving the introduction of gas wells and surface facilities[5] in the *Sodic Transitional Pastures* landscape character type. The images were taken during a site visit in October 2009, near Grassdale Feedlot (within *Character Area C5: Grassdale Sodic Transitional Pastures*) on Wilkins Road, approximately 30km south-west of Dalby.

The following image was taken from Kogan-Condamine Road during a site visit in October 2009, east of Wilkie Creek (within *Character Area C3: Daandine-Ducklo Sodic Transitional Pastures*) where the landscape transitions to the *Settled Arable Plains* landscape character type.

[5] It should be noted that the design of the production wells and associated surface facilities have modified since these facilities were installed, in c.2006 (refer to visualisations in the "landscape character type-specific mitigation measures" section).

## 7.4 Type D: Lowland Native Forest

### 7.4.1 Identification of landscape sensitivity

This landscape is considered to be of moderately high scenic preference in the Toowoomba Scenic Amenity Study. The key landscape sensitivities of the *Lowland Native Forest* landscape character type to the project during i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation are summarised in Table 11.

**Table 11 Sensitivity of *Lowland Native Forest* landscape character type to the project**

| Development Type | Key sensitivities of landscape character type | Overall inherent sensitivity |
|---|---|---|
| Field Development | Although there is a high level of perceived naturalness in this landscape, there is precedence for gas well development and its visual screening capabilities give this landscape an inherently lower visual sensitive to introduction of any proposed field gas and water gathering system than more open landscape character types. | **Low** |
| CGPF and IPF | There is precedence for coal seam gas development at Daandine, Kogan North and Tipton West and this landscape character type has visual absorption capabilities making it less visually sensitive to the further introduction of a CGPF and/or IPF. However, there is a high level of perceived naturalness and remoteness in this landscape, and the dense vegetation cover is sensitive to change/loss. | **Medium** |
| FCF | Although the scale and massing of a FCF (footprint of approximately 5,000m$^2$) is substantially less than a CGPF or IPF (footprint of minimum 150,000m$^2$), the introduction of a FCF would contrast with the high level of perceived naturalness and remoteness in this landscape. | **Medium** |
| Water storage facilities | The introduction of highly engineered water storage facilities and required forest clearing would contrast with a high level of perceived naturalness and remoteness in this landscape. The precedence of water storage facilities at Daandine, Kogan North and Tipton West, and the visual enclosure from the wider landscape serves to slightly reduce the sensitivity of this landscape.. | **Medium** |
| Depots | Assuming the Miles depot will be located in a zoned industrial precincts (i.e. not within residential precincts), the introduction of a new depot in Miles will be in context with an area / precinct containing land use and buildings of similar scale and character, therefore reducing the overall sensitivity of this landscape to this type of development. | **Low** |

### 7.4.2 Identification of visual sensitivity

The sensitivity of views from the *Lowland Native Forest* is represented in the following viewpoints:

***Viewpoint D1 Northerly view through a forest clearing from Boundary Road***

The key visual elements in this viewpoint, which are sensitive to change include:

- The forest makes it visually contained from the wider landscape.
- Although there are likely to be small number of people experiencing this view, the overall sensitivity of receptors from this point is considered to be medium, due to such users as residents living on nearby rural

properties, people working in the countryside within this landscape (e.g. farming contractors), and visitors to Kumbarilla State Forest.

Although the surrounding forest and little evidence of human influence contribute to a sense of naturalness in this view, it is considered to have a **low** sensitivity overall to the change proposed (e.g. introduction of field development, FCF, CGPF, IPF and water storage facilities), due to the medium sensitivity of viewers and the visual containment from the wider landscape.

***Viewpoint D2 Northerly view along Barakula Forest Drive***

The key visual elements in this viewpoint, which are sensitive to change include:

- A high degree of naturalness and remoteness. The dense forest makes it contained from the wider landscape, reducing its visual sensitivity.
- Medium sensitivity of receptors, including residents living on nearby properties, people working within this landscape (e.g. State Forest employees), and scenic drivers and tourists travelling along 'Barakula Forest Drive'.

Although this flat low-lying forested landscape provides good visual enclosure from the wider landscape, the viewpoint is considered to have a **medium** sensitivity overall to the change proposed (e.g. field development, FCF, CGPF, IPF and water storage facilities), due to its scenic qualities (i.e. high degree of naturalness and remoteness) and the medium sensitivity of viewers. Forested areas are anticipated to be more visually sensitive to grid-like development with larger individual development footprints, when viewed from the air.

### 7.4.3 Precedent coal seam gas infrastructure

The following images assist in conceiving the introduction of gas wells and surface facilities[6] in the *Lowland Native Forest* landscape character type. The first image illustrates a recently installed production well at close range (prior to rehabilitation of disturbed areas to reduce the well site footprint), and was taken during a site visit in October 2009 approximately 40km west of Dalby, near the Daandine CGPF (within *Character Area D2: Kogan-Braemar Lowland Native Forest*). The second image shows filtered views through native forest and was taken during a site visit in October 2009, near the Tipton West CGPF, between Lake Broadwater Conservation Park and Kumbarilla State Forest (within *Character Area D3:Kumbarilla-Western Creek Lowland Native Forest*).

[6] It should be noted that the design of the production wells and associated surface facilities have modified since these facilities were installed, in c.2006 (refer to visualisations in the "landscape character type-specific mitigation measures" section).

The following image assists in conceiving the introduction of a central gas processing facility in the *Lowland Native Forest* landscape character type. The image was taken during a site visit in October 2009, at Arrow's Daandine Coal Seam Gas project, approximately 40km west of Dalby, 400m south of Dalby Kogan Road (within *Character Area D2: Kogan-Braemar Lowland Native Forest*).

The following image assists in conceiving the introduction of an electrical generation facility in the *Lowland Native Forest* landscape character type. The image was taken during a site visit in October 2009, approximately 40km west of Dalby, north of the Daandine CGPF (within *Character Area D2: Kogan-Braemar Lowland Native Forest*).

The following image assists in conceiving the introduction of a water storage facility[7] in the *Lowland Native Forest* landscape character type. The image was taken during a site visit in October 2009, approximately 40km west of Dalby, north of the Daandine CGPF (within *Character Area D2: Kogan-Braemar Lowland Native Forest*).

## 7.5 Type E: Elevated Native Forest

### 7.5.1 Identification of landscape sensitivity

This landscape is considered to be of moderately high scenic preference in the Toowoomba Scenic Amenity Study. The key landscape sensitivities of the *Elevated Native Forest* landscape character type to the project

[7] Although this image is useful to indicate the scale of water storage facilities proposed (approximately 100ha of dams), it should be noted that the use of evaporation dams (as seen in this image; installed in c.2006 has been phased out in preference to the treatment of saline water for beneficial reuse.

during i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation are summarised in Table 12.

**Table 12 Sensitivity of *Elevated Native Forest* landscape character type to the project**

| Development Type | Key sensitivities of landscape character type | Overall inherent sensitivity |
|---|---|---|
| Field Development | This elevated forest landscape provides an important natural element and prominent visual backdrop to the wider landscape. The introduction of rigid linear elements such as field gas and water gathering systems and required forest clearing would contrast with high level of perceived naturalness, remoteness and visual continuity in this landscape, particularly when viewed from the air. | **Medium** |
| CGPF and IPF | The introduction of a large scale CGPF and/or IPF (require a footprint of minimum 150,000m$^2$)) and associated access tracks would contrast with high level of perceived naturalness, remoteness and visual continuity in this landscape, whose elevated forests provide an important natural element and prominent visual backdrop to the wider landscape. | **Medium** |
| FCF | Although the scale and massing associated with introducing an FCF (footprint of approximately 5,000m$^2$) would be substantially less than a CGPF or IPF, the high level of perceived naturalness, remoteness and visual continuity in this landscape, would be sensitive to the development of a FCF. | **Medium** |
| Water storage facilities | The introduction of highly engineered water storage facilities and substantial forest clearing required (approximately 100ha of dams) would contrast with high level of perceived naturalness, remoteness and visual continuity in this landscape. | **High** |
| Depots | N/A; the proposed depots in Dalby, Miles and Millmerran would not directly affect this landscape character type. | **N/A** |

### 7.5.2 Identification of visual sensitivity

The sensitivity of views from the *Elevated Native Forest* is represented in the following viewpoints:

***Viewpoint E1 South-easterly view from Bybera Road (outside of the project development area)***

The key visual elements in this viewpoint, which are sensitive to change include:

- The naturally elevated and smoothly undulating landscape.
- The concentration of native vegetation.
- High degree of naturalness and remoteness with a notable absence of human influences e.g. buildings, infrastructure corridors, engineered water storage facilities (such as irrigation 'ring tanks').
- Although there are likely to be small number of people experiencing this view, the overall sensitivity of receptors from this point is considered to be medium, due to such users as residents living on nearby rural properties, people working in this landscape (e.g. State Forest employees), and visitors to State Forests and National Parks.

This densely forested landscape provides some visual enclosure from the wider landscape. The viewpoint is considered to have a **medium** sensitivity overall to the change proposed (e.g. introduction of field development,

FCF, CGPF, IPF and water storage facilities), due to its elevated landform, its scenic qualities (i.e. high degree of naturalness and remoteness with a notable absence of human influences) and the medium sensitivity of viewers.

## 7.6 Type F: Foothill Plains and Valleys

### 7.6.1 Identification of landscape sensitivity

The key landscape sensitivities of the *Foothill Plains and Valleys* landscape character type to the project during i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation are summarised in Table 13.

**Table 13 Sensitivity of *Foothill Plains and Valleys* landscape character type to the project**

| Development Type | Key sensitivities of landscape character type | Overall inherent sensitivity |
|---|---|---|
| Field Development | The introduction of rigid linear elements such as field gas and water gathering systems would contrast with the perceived strong rural character, sense of remoteness and tranquillity. The presence of woodland with some low-lying, visually contained areas would help integrate field development into the landscape setting. | **Medium** |
| CGPF and IPF | The fairly open, sparsely settled rural character and absence of large-scale buildings, in conjunction with the presence of Jimbour House and available views across the gently rolling foothills, makes this landscape sensitive to the introduction of any CGPF and/or IPF. | **High** |
| FCF | Although the scale and massing of a FCF (footprint of approximately 5,000m$^2$) is substantially less than a CGPF or IPF (footprint of minimum 150,000m$^2$), the introduction of a FCF would strongly contrast with the open, sparsely settled rural character associated with the *Foothill Plains and Valleys* landscape character type, which includes a highly sensitive place of historic and cultural heritage, Jimbour House. | **High** |
| Water storage facilities | The fairly open, smoothly rolling character with an absence of highly engineered water storage facilities makes this landscape moderately sensitive to the introduction of such infrastructure. | **High** |
| Depots | N/A; the proposed depots in Dalby, Miles and Millmerran would not directly affect this landscape character type. | **N/A** |

### 7.6.2 Identification of visual sensitivity

The sensitivity of views from the *Foothill Plains and Valleys* is represented in the following viewpoints:

***Viewpoint F1 Elevated panoramic view from the front gardens of Jimbour House***

The key visual sensitivities in this viewpoint, which are sensitive to change include:

- High sensitivity of receptors, including visitors and residents of Jimbour House, a regionally important location with interests focussed on the landscape, which contains a memorable strong rural character.

Overall, this viewpoint is considered to have a **high** sensitivity to the change proposed (e.g. introduction of field development, FCF, CGPF, IPF and water storage facilities), due to the historic and cultural importance of Jimbour House combined with the high sensitivity of viewers whose interests are specifically focussed on the landscape.

***Viewpoint F2 Elevated panoramic view from Roche Creek Road***

The key visual sensitivities in this viewpoint, which are sensitive to change include:

- The naturally undulating landscape with long distant views with strong skylines.
- Strong rural character, with a notable sense of remoteness and tranquillity.
- Notable absence of human influences e.g. major transport corridors, transmission pylons, engineered water storage facilities (such as irrigation 'ring tanks').
- Low sensitivity of receptors, including residents living on nearby rural properties and people working in the countryside within this landscape e.g. farmers, graziers, farm-assistants, farming/grazing contractors.

Despite the low sensitivity of viewers, this viewpoint is considered to have a **medium** sensitivity overall to the change proposed (e.g. introduction of field development, FCF, CGPF, IPF and water storage facilities), due to its scenic qualities (i.e. its strong rural character and sense of naturalness and tranquillity) and the availability of long-distance views with a notable 'un-built' skyline.

## 7.7 Type G: Lowland Brigalow Plains

### 7.7.1 Identification of landscape sensitivity

The key landscape sensitivities of the *Lowland Brigalow Plains* landscape character type to the project during i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation are summarised in Table 14.

**Table 14 Sensitivity of *Lowland Brigalow Plains* landscape character type to the project**

| Development Type | Key sensitivities of landscape character type | Overall inherent sensitivity |
|---|---|---|
| Field Development | The open character, strong horizons and absence of comparative infrastructure (such as farm machinery) are the main sensitivities of this landscape to the introduction of rigid linear elements such as field gas and water gathering systems. The landscape is not conserved or highly valued for its scenic amenity, and the presence of Brigalow and Wilga forest would help integrate field development into the landscape setting. | **Low** |
| CGPF and IPF | The large scale of the landscape, relatively high level of openness, remoteness and tranquillity and absence of significant built elements make this landscape character type vulnerable to disturbance by the introduction of large scale features such as IPF. The presence of forest and changes in landform would assist in integrating such forms into the landscape. | **Medium** |
| FCF | Although the scale and massing of a FCF (footprint of approximately 5,000m$^2$) is substantially less than a CGPF or IPF (footprint of minimum 150,000m$^2$), the introduction of a FCF would contrast with the high level of openness, remoteness and tranquillity and absence of significant built elements in this landscape. The presence of forest and changes in landform would assist in integrating a FCF to some degree. | **Medium** |

| | | |
|---|---|---|
| Water storage facilities | The naturally rolling landform with an absence of precedent water storage facilities render this landscape potentially sensitive to the introduction of highly engineered large scale dams adjacent to an IPF. | **Medium** |
| Depots | N/A; the proposed depots in Dalby, Miles and Millmerran would not directly affect this landscape character type. | **N/A** |

### 7.7.2 Identification of visual sensitivity

The sensitivity of views from the *Lowland Brigalow Plains* is represented in the following viewpoints:

***Viewpoint G1 North-easterly view towards Barakula State Forest from Davies Road***

The key visual sensitivities in this viewpoint, which are sensitive to change include:

- Remnant Brigalow, Belah and Wilga trees are sensitive to change.
- Openness of the low-lying flat pasture plains.
- Low sensitivity of receptors, including residents living on nearby rural properties, people working in the countryside or towns within this landscape e.g. graziers, farm assistants and stockmen travelling using the Ryalls to Hookswood stockroute.

The landscape in this view comprises a semi-natural (i.e. some remnant forest) and flat, open character. It is considered to have a **low** sensitivity overall to the change proposed (e.g. introduction of field development, FCF, CGPF, IPF and water storage facilities), due to the low sensitivity of viewers and the presence of forest which provides visual enclosure from the wider landscape and could be used as part of a landscape framework to site facilities in less visually sensitive locations.

***Viewpoint G2 Southerly view across pasture fields from the Warrego Highway***

The key visual sensitivities in this viewpoint, which are sensitive to change include:

- The flat, open character of the landscape.
- Strong rural character.
- Remnant Brigalow, Belah and Wilga trees.
- Low sensitivity of receptors, including residents living on nearby rural properties and people working in the countryside within this landscape e.g. graziers, farm-assistants, farming/grazing contractors.

The landscape in this view is fairly open and comprises strong rural character. It is considered to have a **low** sensitivity overall to the change proposed (e.g. introduction of field development, FCF, CGPF, IPF and water storage facilities), due to the low sensitivity of receptors and the presence of forest, which could be used as part of a landscape framework to site facilities in less visually sensitive locations.

## 7.8 Type H: Terraced Brigalow Farmland

### 7.8.1 Identification of landscape sensitivity

This landscape is considered to be of moderate scenic preference in the Toowoomba Scenic Amenity Study. The key landscape sensitivities of the *Terraced Brigalow Farmland* landscape character type to the project during i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation are summarised in Table 15.

**Table 15 Sensitivity of *Terraced Brigalow Farmland* landscape character type to the project**

| Development Type | Key sensitivities of landscape character type | Overall inherent sensitivity |
|---|---|---|
| Field Development | The introduction of rigid linear elements such as field gas and water gathering systems would interrupt the smoothly undulating plains and low hills and disturb the scenic rural character. The presence of Brigalow-Belah forest and changes in landform would help integrate field development into the landscape setting. | **Medium** |
| CGPF and IPF | The smoothly undulating landform with low hills, strong rural character, expansive views and memorable scenic qualities make this landscape character type vulnerable to disturbance by the introduction of large scale features such as IPF. | **High** |
| FCF | Although the scale and massing of a FCF (footprint of approximately 5,000m$^2$) is substantially less than a CGPF or IPF (footprint of minimum 150,000m$^2$), the introduction of a FCF would contrast with the smoothly undulating landform with low hills, strong rural character, expansive views and memorable scenic qualities. | **High** |
| Water storage facilities | The smoothly undulating landform with low hills and an absence of precedent water storage facilities render this landscape potentially sensitive to the introduction of highly engineered large scale dams. | **High** |
| Depots | N/A; the proposed depots in Dalby, Miles and Millmerran would not directly affect this landscape character type. | **N/A** |

### 7.8.2 Identification of visual sensitivity

The sensitivity of views from the *Terraced Brigalow Farmland* is represented in the following viewpoints:

***Viewpoint H1 North-westerly view across terraced arable plains and lowland pastures from Millmerran Inglewood Road***

The key visual elements in this viewpoint, which are sensitive to change include:

- The open landscape of distinctive rolling terraced arable plains.
- Strong rural and scenic character.
- Notable absence of vertical intrusions allowing clear distant views to Elevated Native Forest at Wondul Range National Park, which provide a scenic rim.
- Medium sensitivity of receptors, including residents living on nearby rural properties, people working in the countryside within this landscape (e.g. farming contractors), and scenic drivers and tourists travellers along the 'Rural Getaway'.

Overall, this viewpoint is considered to have a **medium** sensitivity to the change proposed (e.g. introduction of field development, FCF, CGPF, IPF and water storage facilities), due to the openness of the landscape, its scenic

qualities (i.e. distinctive rolling terraced arable plains, comprising a strong rural character), the notable absence of vertical intrusions and the medium sensitivity of viewers.

***Viewpoint H2 Easterly view across lowland pastures to Commodore Peak from the Gore Highway***

The key visual sensitivities in this viewpoint, which are sensitive to change include:

- Although the landscape comprises a open character, it is fairly enclosed from the wider landscape through changes in landform and forest.
- Sense of remoteness.
- Clear distant views to *Elevated Native Forest* at Commodore Peak, which provide a scenic rim.
- Medium sensitivity of receptors travelling along the Gore highway (a key route between Millmerran and Goondiwindi), including residents living on nearby rural properties and people working in the countryside within this landscape (e.g. farming contractors).

Although the landscape in this view is fairly enclosed from the wider landscape, it is considered to have a **medium** sensitivity overall to the change proposed including e.g. introduction of field development, FCF, CGPF, IPF and water storage facilities), due to the openness of the landscape, its scenic qualities (i.e. sense of remoteness and visual relationship to Commodore Peak, which provides a scenic rim) and the medium sensitivity of viewers.

## 7.9 Type I: Forested Steep Hills

### 7.9.1 Identification of landscape sensitivity

This landscape is considered to be of high scenic preference in the Toowoomba Scenic Amenity Study. The key landscape sensitivities of the *Forested Steep Hills* landscape character type to the project during i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation are summarised in Table 16.

**Table 16 Sensitivity of *Forested Steep Hills* landscape character type to the project**

| Development Type | Key sensitivities of landscape character type | Overall inherent sensitivity |
|---|---|---|
| Field Development | The natural steep-sided hilly landform is sensitive to the introduction of rigid linear elements such as field gas and water gathering systems. | **High** |
| CGPF and IPF | The steep landform and absence of large scale buildings renders this landscape incongruent with scale and nature of a CGPF and/or IPF. | **High** |
| FCF | Although the scale and massing of a FCF (footprint of approximately 5,000m$^2$) is substantially less than a CGPF or IPF (footprint of minimum 150,000m$^2$), the introduction of a FCF would strongly contrast with the character of this landscape, consisting of natural steep-sided hilly landform with an absence of large scale buildings. | **High** |
| Water storage facilities | The natural steep-sided hilly landform and absence of highly engineered water storage facility renders this landscape incongruent to the introduction of such infrastructure. | **High** |
| Depots | The proposed depots in Dalby, Miles and Millmerran would not directly affect this landscape character type. | **N/A** |

### 7.9.2 Identification of visual sensitivity

No viewpoints were recorded from this landscape character type (due to restricted vehicular access to this steep hilly landscape). However, the likely visual sensitivities associated with this landscape character type which are sensitive to change include:

- The elevated steep-sided landform, which punctuates the skyline and is highly prominent from the surrounding low-lying landscape.
- Captains Mountain, Commodore Peak and Mount Domville (identified as areas of high scenic amenity in the Toowoomba Scenic Amenity Study).
- A notable absence of visible man-made features in this landscape (with the exception of the telecommunication tower atop Mount Domville).

This landscape is widely visible from the surrounding low-lying landscape and has a high level of scenic amenity, as noted in the Toowoomba Scenic Amenity Study. It is therefore considered to have a **high** sensitivity overall to the change proposed.

## 7.10 Type J: Chromosol Undulating Lowlands

### 7.10.1 Identification of landscape sensitivity

This landscape is considered to be of moderate scenic preference in the Toowoomba Scenic Amenity Study. The key landscape sensitivities of the *Chromosol Undulating Lowlands* landscape character type to the project during i) construction/installation, ii) operation and maintenance, and iii) decommissioning and rehabilitation are summarised in Table 17.

**Table 17 Sensitivity of *Chromosol Undulating Lowlands* landscape character type to the project**

| Development Type | Key sensitivities of landscape character type | Overall inherent sensitivity |
|---|---|---|
| Field Development | A high level of openness and absence of comparative infrastructure (such as farm machinery) are the main sensitivities of this landscape to the introduction of field development. The landscape is not highly valued and the wooded shelterbelts and horizons would help integrate field development into their landscape setting. | **Negligible** |
| CGPF and IPF | The large scale of the landscape, relatively high level of openness, remoteness and tranquillity and absence of significant built elements make this landscape character type vulnerable to disturbance by the introduction of large scale features such as a CGPF and/or IPF. The wooded horizons could assist in integrating such forms and the landscape is not highly valued for its scenery. | **Low** |
| FCF | Although the scale and massing of a FCF (footprint of approximately 5,000m$^2$) is substantially less than a CGPF or IPF (footprint of minimum 150,000m$^2$), the introduction of a FCF would contrast with the character of this landscape, comprising a high level of openness, remoteness and tranquillity and absence of significant built elements. The wooded horizons would assist in integrating an FCF to some degree, therefore reducing its sensitivity. | **Low** |
| Water storage facilities | The landscape is not highly valued but there are no precedent water storage facilities within this landscape character type which render it potentially sensitive to the introduction of dams. | **Low** |
| Depots | N/A; the proposed depots in Dalby, Miles and Millmerran would not directly affect this landscape character type. | **N/A** |

### 7.10.2 Identification of visual sensitivity

The sensitivity of views from the *Chromosol Undulating Lowlands* is represented in the following viewpoint:

***Viewpoint J1 Westerly view from Wyaga Road across Kerimbilla Chromosol Undulating Lowlands***

The key visual sensitivities in this viewpoint, which are sensitive to change include:

- The vegetated character of the horizon which is sensitive to punctuation by infrastructure elements.
- Mature trees associated with the creek corridors, roadside shelterbelts and State Forest.
- Notable absence of man-made features e.g. buildings, farm machinery and engineered water storage facilities (such as irrigation 'ring tanks').
- Low sensitivity of receptors likely to experience the landscape, principally due to the very low numbers affected as well as the type of receptors, e.g. workers, farming contractors, negligible numbers of residents living within the area, people passing at speed on the Gore or Cunningham Highway or occasional recreational users of the State Forest, such as picnickers.

The landscape in this view comprises a distinctively 'un-built' forested skyline. However, it is considered to have a **low** sensitivity overall to the change proposed (e.g. including field development, FCF, CGPF, IPF and water storage facilities), due to the low sensitivity of viewers and the presence of forest which provides visual enclosure from the wider landscape and could be used as part of a landscape framework to site facilities in less visually sensitive locations.

# 8.0 General and landscape character type-specific mitigation measures

## 8.1 General mitigation measures for the project development area

The baseline conditions and inherent sensitivities (identified in Section 5.0 and Section 7.0), key sources of potential impact (identified in Section 1.1) and an understanding of relevant policies outlined in Section 3.0 have highlighted the importance of incorporating detailed mitigation measures into Arrow's environmental management strategy to reduce and manage the impact on the landscape resource, views and visual amenity.

The landscape and visual mitigation framework outlined in the following flow diagram and discussed in greater detail in Section 8.0 is based upon a mitigation process that seeks, as a first priority, to eliminate or minimise potentially significant adverse landscape and visual impacts through careful design and siting of infrastructure then, secondly, to implement detailed design tailored to the specific location to manage adverse impacts.

The process also illustrates how landscape and visual impacts will be minimised for the life of the project, through construction and facility maintenance to the decommissioning stage and beyond. The majority of these mitigation procedures are regarded as essential to all infrastructure components across the study area. A number of the mitigation measures imply a degree of flexibility in application to tailor them to the particular landscape conditions and setting e.g. colour of facility. These are discussed in Section 8.0 which relates the mitigation measures to the landscape types described in this assessment. A number of 'beneficial' mitigation measures are identified for long-term legacy, such as establishment of community facilities or ecological restoration which could be considered as a value-add or 'offset' for unavoidable impacts.

Where facilities are proposed in highly sensitive areas (i.e. landscape with a "high" development constraints framework), development requirements (including site-specific mitigation measures and monitoring) should be specifically negotiated with administering bodies (e.g. the Department of Environment and Resource Management), as part of the environmental management strategy for the Surat Gas Project to avoid significant adverse impacts on landscape character and visual amenity.

## APPLICATION OF LANDSCAPE AND VISUAL MITIGATION FRAMEWORK

(Discussed in more detail in the table that follows)

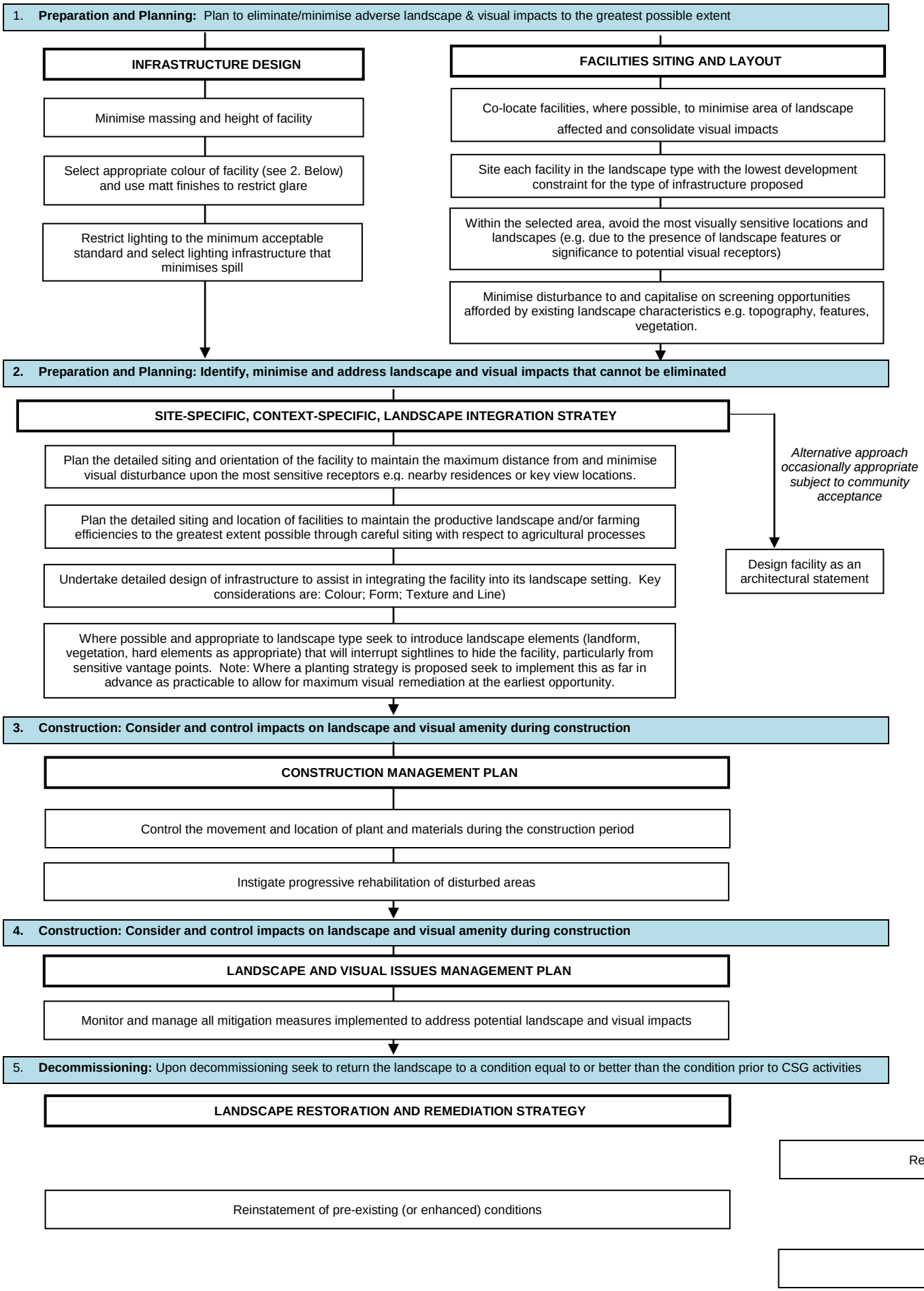


**Table 18 Activity based mitigation measures for the project development area**

| Proposed mitigation | Description of proposed mitigation | Required mitigation for each project activity | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **1) PREPARATION AND PLANNING: PLAN TO ELIMINATE/MINIMISE ADVERSE LANDSCAPE AND VISUAL IMPACTS TO THE GREATEST POSSIBLE EXTENT** | | | | | | | | | | |
| **1a) Infrastructure Design Principles** | | | | | | | | | | |
| | | Gas well site preparation | Gas well drilling operations | Well site completion | Gathering infrastructure design and installation | FCF, CGPF and IPF components | | | | Water Storage Design and Installation |
| | | | | | | Sewage treatment plant design and installation | Facility design and installation | Power Generation Facility Design and Installation | IPF: Water Treatment Facility Design and Installation | |
| Infrastructure Engineering Design | Minimise massing and height of proposed facilities: Design facilities to occupy the smallest space consistent with operational and safety standards to minimise loss of natural or rural landscape elements that contribute to landscape character and to reduce the potential extent of visibility. The planned construction footprint should be as small as possible to avoid unnecessary removal of vegetation, thereby retaining the natural character of the landscape and retaining screening vegetation as much as possible (as discussed further below). | **X** | | | **X** | **X** (mitigation applies to entire FCF, CGPF and IPF sites) | | | | **X** |
| Infrastructure Design Treatments | Select an appropriate colour for each facility and use matt finishes to restrict glare:<br>- The selection of colours for the proposed facilities should respond to the surrounding visual character of the landscape i.e. colours and textures (see more detail in point 2 below).<br>- Design buildings and other infrastructure to reduce glare as follows:<br>• By accounting for the angle of the sun at different times of the day and year to project components.<br>• Selection of materials with low-glare properties, such as those with non- or low-gloss finishes, and buildings finishes in non-glossy paints in colours and textures to blend with the surrounding landscape. | **X** | **X** | | | **X** (mitigation applies to entire FCF, CGPF and IPF sites) | | | | |
| Infrastructure Materials | Construct new buildings in the vicinity of existing structures using similar materials and consider opportunities for facilities to mimic rural structures already present in the landscape e.g. fencing, gates, sheds, grain stores etc. | **X** | | | | **X** (mitigation applies to entire FCF, CGPF and IPF sites) | | | | |

| Proposed mitigation | Description of proposed mitigation | Required mitigation for each project activity | | | | | |
|---|---|---|---|---|---|---|---|
| Road entrance design | Road entrances to IPFs should be designed with clear signage to ensure that the project fits well into the existing character of property entrances and signage, and promotes a legible and high quality responsible profile for Arrow. | | | **X** | **X** | **X** (mitigation applies to entire FCF, CGPF and IPF sites) | **X** |
| Lighting Design | Restrict lighting to the minimum acceptable standard and select lighting infrastructure that minimises light spill: The proposed FCFs, CGPFs, IPFs, gas wells and water storage facilities will operate at night and therefore require night lighting. Design of lighting should be kept to a minimum necessary for security and safety and should be designed to limit light spill into adjacent rural areas (including properties) and into the sky. Lighting to be designed with reference to the following:<br>- Use downcast lighting to reduce night time visual impacts.<br>- All lighting installed at permanent sites to have guards to direct light downwards.<br>- Lighting to be installed with reference to AS4281 – 1997: Control of obtrusive effects of outdoor lighting.<br>- Use passive means of lighting, such as the installation of reflector roadway markers, lines, warnings or information signs and attach reflectors to furnishings.<br>- Use solar powered light-emitting diode (LED) studs to highlight roadways and paths of travel, where possible and appropriate. | | | **X** | | **X** (mitigation applies to entire FCF, CGPF and IPF sites) | **X** |
| **1b) Facilities Siting and Layout** | | | | | | | |
| Facilities Siting – site selection | Co-locate facilities where possible, to minimise the area of landscape affected in order to consolidate visual impacts. This entails, to the greatest extent possible:<br>- Centralising facilities in one location.<br>- Seeking expansion of existing facilities in preference to the development of new locations.<br>- Siting facilities with reference to other facilities that may already be present in an area e.g. power stations (IPFs), roads (pipelines) etc.<br>- Where possible work with other LNG operators to consolidate infrastructure locations and corridors. | **X** | **X** | **X** | **X** | **X** (mitigation applies to entire FCF, CGPF and IPF sites) | **X** |

| Proposed mitigation | Description of proposed mitigation | Required mitigation for each project activity | | | | | |
|---|---|---|---|---|---|---|---|
| Facilities Siting – site selection | Site each facility in the landscape type with the lowest development constraint for the type of infrastructure proposed. Each landscape type has different inherent capacities to absorb the different landscape and visual effects arising from the facilities proposed. **The landscape and visual development constraints model** (developed in this LVIA) should be consulted at the site selection phase and provides guidance on those landscapes most able to accommodate change. However, it is recognised that in some instances other development constraints (e.g. ecological constraints, operational requirements), may take precedence and necessitate development in areas with a lower landscape or visual capacity to absorb the change required. In these cases, the importance of the mitigation measures is increased. | **X** | | | **X** | **X** (mitigation applies to entire FCF, CGPF and IPF sites) | **X** |
| Facilities Siting – site selection to minimise landscape and visual impact | Within the selected area, avoid the most visually sensitive locations and landscapes (e.g. due to the presence of landscape features or significance to potential visual receptors):<br>- Avoid siting facilities close to unique natural landscape features or distinctive scenery (e.g. Lake Broadwater, Captains Mountain) as the human eye will be drawn to such features and the visual consequences will appear more evident.<br>- Avoid siting close to valued man-made landscape elements (e.g. Jimbour House).<br>- Avoid locations where the facility would punctuate the skyline in distant views in preference for locations where the facility would be viewed against a backdrop of landform or vegetation.<br>- Avoid locations that would be prominent when viewed from significant local or regional vantage points (as identified in this LVIA) including the bird hide and camping areas at Lake Broadwater and the view from Jimbour house.<br>- Site facilities with the lowest potential impact on key visual receptors; particularly considering the potential for visual access from significant view locations corridors (e.g. Cunningham Highway), key centres of habitation (e.g. towns such as Dalby, Chinchilla, Millmerran) and where they would be visible from private residences, schools etc. Affected areas will differ between landscape types, for example the acceptable distance between a residence and an IPF may be less in forested landscapes than open areas due to the effect of screening vegetation.<br>**These criteria are explored further below and in the landscape type-specific mitigation measures** | **X** | | | **X** | **X** (mitigation applies to entire FCF, CGPF and IPF sites) | **X** |

| Proposed mitigation | Description of proposed mitigation | Required mitigation for each project activity | | | | | |
|---|---|---|---|---|---|---|---|
| Facilities Siting – site selection and layout | Minimise disturbance to and capitalise on screening opportunities afforded by existing landscape characteristics particularly topography and vegetation:<br>- In undulating landscapes seek opportunities to locate facilities in natural depressions or areas which are surrounded by more elevated land that limits the potential to obtain more distant views. Avoid siting tall or bulky infrastructure components in elevated areas which would increase their potential visibility in more distant views.<br>- Use opportunities created by existing breaks in native vegetation for locating infrastructure to the greatest extent possible, to reduce disturbance of existing vegetation and provide a framework for the introduction of the new facilities.<br>- Avoid removal of existing vegetation to the greatest extent possible. In particular, clearance of significant feature or habitat trees (>80cm diameter) should be avoided, particularly in the detailed siting of wells, gathering lines and associated clearance zones.<br>- As a general rule, the location of any CSG facility should particularly respond to the different densities of vegetation for the areas within which they will be located (explored in further detail in Section 8.0):<br>a) **Dense forest**: large-scale FCF, CGPF and IPF facilities should be located a minimum of 500m from sensitive visual receptors such as tourist trails, roads, residences and 1km from existing centres of habitation (towns). Existing vegetation may be used as a framework for further planting of locally endemic species, to filter views to any proposed large-scale incongruous CSG components. | **X** | | | **X** | **X**<br>(mitigation applies to entire FCF, CGPF and IPF sites) | **X** |
| | b) **Open woodland**: large-scale facilities should be located a minimum of 1km from sensitive visual receptors i.e. towns, tourist trails, roads and existing vegetation may be used as a framework for further planting of locally endemic species, to filter views to any proposed large-scale incongruous project components. | | | | | | |

| Proposed mitigation | Description of proposed mitigation | Required mitigation for each project activity | | | | | |
|---|---|---|---|---|---|---|---|
| | c) **Partly vegetated**: large-scale facilities should utilise existing vegetation as a framework for additional planting of locally endemic species, to filter views to any proposed large-scale incongruous project components and form a visually sympathetic transition into surrounding more open landscapes. In this vegetation type, large-scale facilities should be located a minimum of 2km from sensitive visual receptors i.e. towns, tourist trails, major roads.<br>d) **Open landscapes**: planting is potentially inappropriate unless it can be designed to mimic shelterbelts already present. In this landscape, large-scale facilities should be located a minimum of 3km from sensitive visual receptors such as tourist trails and major roads and 5km from existing centres of habitation (towns).<br>**These criteria are explored further in landscape type-specific mitigations (below)**. | | | | | | |

| 2) PREPARATION AND PLANNING: IDENTIFY, MIMIMISE AND ADDRESS LANDSCAPE AND VISUAL IMPACTS THAT CANNOT BE ELIMINATED | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **2a) Site-Specific, Context-specific, Landscape Integration Strategy** | | | | | | | | | | |
| | | | | | | **FCF, CGPF and IPF components** | | | | |
| | | Gas well site preparation | Gas well drilling operations | Well site completion | Gathering infrastructure design and installation | Sewage treatment plant design and installation | Facility design and installation | Power Generation Facility Design and Installation | IPF: Water Treatment Facility Design and Installation | Water Storage Design and Installation |
| Detailed siting and orientation | Plan the detailed siting and orientation of the facility to further minimise visual disturbance to the most sensitive visual receptors e.g. nearby residences or key view locations:<br>- Consult with landowners and neighbouring occupiers in relation to the location of permanent infrastructure.<br>- In the detailed site planning, maintain the maximum possible distance from the proposed facility and sensitive receptors. Where numerous receptor groups will be affected consider views in order of importance of impact and number of people affected i.e. significant vantage points, views experienced by large numbers of viewers, private residences, temporary views experienced from moving vehicles etc.<br>- Plan the detailed site layout such that the narrowest part of infrastructure faces towards any residences or other sensitive receptors that may be, unavoidably, affected.<br>- Follow natural contours or existing tracks. | **X** | | | **X** | **X**<br>(mitigation applies to entire FCF, CGPF and IPF sites) | | | | **X** |
| Maintenance of productive landscapes | Plan the detailed siting and location of facilities to maintain the productive landscape and/or farming efficiencies to the greatest extent possible through careful siting with respect to agricultural processes:<br>- Consult with landowners and neighbouring occupiers in relation to the location of permanent and temporary infrastructure to ensure that proposals minimise short-term disturbance of agricultural operations and maximise the potential for long-term restoration to former agricultural capacity. | **X** | | | **X** | **X**<br>(mitigation applies to entire FCF, CGPF and IPF sites) | | | | **X** |

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| | - With the landowner, consider any opportunities that may arise to create synergies between CSG facilities and longer-term farming production e.g. dam creation; formation of access tracks that may be beneficial to the farmer long-term. | | | | | | |
| Detailed Modifications to infrastructure design | Undertake detailed design for infrastructure to assist in integrating the facility into its landscape setting. Key considerations are: Form; Colour; Texture and Line.<br>- Form/Massing: Facility components to be massed to reduce the extent of screening required and, where appropriate, to be slender and low profile to minimise visual dominance and better blend with the large scale character of the Surat Basin landscape. Repeat the forms of existing landscape elements in the design of infrastructure and mitigation measures.<br>- Colour: where the colour of infrastructure, signage etc. is not prescribed by AS standards select a colour for infrastructure with reference to the following parameters:<br>• The selected colour should assist in blending the facility into the backdrop - this may be either the ground plane or the backdrop colour depending upon the specific viewing situation. The most prevalent shade or shades should be selected, for example olive greens in forested landscapes; straw-beiges in agricultural zones; grey where the facility will appear against the sky. See the Figure 7 Suggested Colour Palette that follows this table.<br>• In selecting colour selection consider seasonal differences (e.g. due to the presence or absence of crops).<br>• Select a matt colour approximately two shades darker than the selected prevalent shade, since this will be more visually recessive and will counter the potential influences of fading over time (due to sunlight etc.).<br>• In practical terms, it is recommended that Arrow create a limited palette of appropriate colours for application within each landscape type across the area from which the appropriate colour can be determined in the field.<br>- Texture: In very sensitive viewing situations consideration may be given to painting a camouflage pattern that mimics the background texture (e.g. DualTex). However, this would only be necessary if entering areas with a 'High' or 'No Go' development constraint. | **X** | | | **X** | **X**<br>(mitigation applies to entire FCF, CGPF and IPF sites) | **X** |

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| | - Line: Use the natural line of the landscape to reduce visibility and assist integration:<br>• Follow the natural contours of the land.<br>• Follow existing roads, tracks etc for access tracks and pipelines.<br>• Where linear features such as gathering lines and access tracks cross densely forested areas adjacent to roads (including tourists tracks), bent alignments are preferable to long straight tracks cutting directly through the forest. This will avoid dominant linear viewing corridors and thus ensure better integration with the landscape and visual resource.<br>**These criteria are explored further in landscape type-specific mitigations below.** | | | | | | |
| Landscape Strategy | The design of the facilities should respond to the landscape character types and visual setting within which they will be located. This will entail adopting one of the following strategies:<br>a) Hide / substantially screen the structure in the landscape (i.e. through interruption of sightlines as explored further below); and/or,<br>b) Where screening is difficult or undesirable (e.g. in a characteristic open landscape), the infrastructure design should be as simple and elegant as possible to minimise visual clutter and intrusion. The infrastructure design should resemble farm equipment/structures already commonly found in the landscape type e.g. farm sheds, 'ring tanks'; or<br>c) Design the infrastructure as a statement feature in the landscape to highlight its presence (this approach is not commonly adopted in the rural landscape unless desired by the community) – explored further below.<br>**These criteria are explored further in landscape type-specific mitigations below**. | **X** | | | **X** | **X**<br>(mitigation applies to entire FCF, CGPF and IPF sites) | **X** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sightline Interruption/ Screening | **Strategy A: Seek to hide / screen the facility**: Where possible and appropriate to landscape type seek to introduce landscape elements (landform, vegetation, hard elements as appropriate) that will interrupt sightlines to, particularly from sensitive vantage points. Consider the location of sightline interruption i.e.<br>a) Close to the facility e.g. perimeter planting. Generally this is the most practicable since this will control views from many directions. However, where particularly sensitive viewer groups are affected and/or in situations where perimeter planting would be ineffective consider options to locate sightline interruption.<br>b) Close to the viewer e.g. fencing or shelterbelt planting adjacent to the property line of an affected residence where it will have a greater but more localised effect on the particular viewer affected. | **X** | | | **X** | **X**<br>(mitigation applies to entire FCF, CGPF and IPF sites) | **X** |
| | **Strategy B: Seek to integrate the facility**: Where the facility cannot be appropriately screened and where possible and appropriate to landscape type seek to make detailed modifications to the infrastructure and surrounding landscape to assist in integrating the facility into its landscape setting. Key considerations are:<br>- Minimise all visual clutter to the greatest extent possible to create facilities and associated infrastructure that are as simple and elegant as possible.<br>- Give full consideration to all of the strategies for form; colour; texture and line which are discussed above, to assist in making the facility visually recede to the greatest possible extent (in both space and time) into its landscape setting. | **X** | | | **X** | **X**<br>(mitigation applies to entire FCF, CGPF and IPF sites) | **X** |
| Planting strategy | Where planting is proposed for sight-line interruption purposes (screening) or for integration purposes:<br>- Ensure there is sufficient space allowance in the site layout and design (taking all safety and vegetation set-back requirements into account) to allow for a landscape buffer to be installed to the perimeter of the site, or in an alternative, equally effective location. Consider any security requirements in determining space requirements. | **X** | | | **X** | **X**<br>(mitigation applies to entire FCF, CGPF and IPF sites) | **X** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | - Allow sufficient time for planting to achieve its required results. Ideally vegetation proposed to screen FCFs, CGPFs and IPFs will need to grow to a height of approximately 12m to be fully effective. Therefore, seek to implement buffer planting as far in advance as practicable to allow for maximum visual remediation at the earliest opportunity, ideally when the facility is first operational. Ideally, undertake planting prior to construction to provide the maximum opportunity for establishment of screening properties. To ensure any new planting plays an effective role in the mitigation process (e.g. as a visual buffer), lead-in times for new planting should be worked into the detailed schedule of works programme to the greatest extent possible. Lead-in time will depend on the plant stock size and species. For example, Poplar Box tube stock would take 3-4 years to reach a semi-mature size [approximately 3-4m high], and therefore ideally needs to be planted at least 4 years prior to the operation of the IPFs to provide any reasonable early screening benefit . Insufficient lead in time may result in the need to plant more advanced container or bagged plants to achieve the desired result within the operational timeframe.<br>- Where appropriate and practicable incorporate excess spoil from site excavations into bunding at the base of the proposed buffer planting (to increase the overall height of the screen planting (Note: Bunding should have a maximum gradient of 1:3m to facilitate ease of maintenance and long-term plant response). This is not appropriate for all landscape types. | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | - Any new tree and shrub planting, proposed as part of a detailed landscape design for the project, should help integrate each component into its surrounding landscape i.e. planting should anchor it and make it part of the landscape and rural character of the area (including screening / filtering views). This will influence the:<br>• Form of appropriate vegetation – natural, rural, formal (e.g. forested blocks, with straight edges, irregular woodland blocks, shelterbelts, formal avenues, scattered trees etc.).<br>• Structural composition of vegetation assemblages (e.g. trees, shrubs and understorey, dense scrub, sparse scrub).<br>• Species selection. This should be undertaken with reference to the naturally occurring local ecosystem, where possible using plants sourced from local provenance (e.g. Callitris and Brigalow communities etc).<br>• Refer to relevant planning policies in the design and selection of species for screening and integration works e.g. Landscape Policy in Waggamba Shire Council Planning Scheme.<br>Planting that does not follow these requirements may be as disturbing to landscape character as the facility they are seeking to integrate.<br>- Consideration may also be given to planting screening vegetation within the facility compound where appropriate (this would ideally be designed into the facility from the outset). Ensure the screening consists of mixed plants of local provenance including some fast growing species, as appropriate to the landscape type.<br>**These criteria are explored further in landscape type-specific mitigations (below)**. | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **2b) Alternative Strategy: Design facility as an Architectural Statement** | | | | | | | | | | | |
| Modifications to infrastructure design | **Strategy C: Design the facility as an architectural statement.**<br>- In some viewing situations a planned facility may be impossible to either screen or integrate or a community may wish to draw attention to the facility. Consideration could be given to designing an architecturally unique building to which attention would be drawn e.g. though use of bold architecture, or coloured night lighting etc. This approach is more commonly adopted and likely to be appropriate for urban settings rather than the rural landscape encountered within the project development area. | | | | | **X**<br>(mitigation applies to entire FCF, CGPF and IPF sites) | | | | | |
| **3) CONSTRUCTION: CONSIDER AND CONTROL IMPACTS ON LANDSCAPE AND VISUAL AMENITY DURING CONSTRUCTION** | | | | | | | | | | | |
| **3a) Landscape and Visual Issues Construction Management Plan** | | | | | | | | | | | |
| | | Gas well site preparation | Gas well drilling operations | Well site completion | Gathering infrastructure design and installation | **FCF, CGPF and IPF components** | | | | Water Storage Design and Installation |
| | | | | | | Sewage treatment plant design and installation | Facility design and installation | Power Generation Facility Design and Installation | IPF: Water Treatment Facility Design and Installation | |
| Construction Management Plan | Develop a construction management plan that seeks to control landscape and visual effects including:<br>- Conduct design review prior to ordering of materials specified for use to ensure that low-glare products and the correct colours have been specified.<br>- Control the movement and location of plant and materials during the construction period.<br>- Locate construction compounds within visually unobtrusive locations.<br>- Design construction methods and technology to limit the required construction area to reduce the amount of vegetation removed and the extent of change to landscape values and key features.<br>- Undertake construction in sensitive areas, such as road crossings and waterways, in dry weather where possible to minimise visual impacts that can result from sedimentation and erosion caused by heavy rain. | **X** | | | **X** | **X**<br>(mitigation applies to entire FCF, CGPF and IPF sites) | | | | **X** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Progressive rehabilitation | Instigate progressive rehabilitation of disturbed areas. Key aspects to note are that:<br>- Rehabilitation is to be undertaken by suitably qualified and experienced contractors, including bush regenerators where the aim is to reinstate pre-existing natural communities.<br>- Native vegetation that mimics the pre-disturbance conditions (i.e. close to the original ecosystem) is to be used wherever possible.<br>- Install fencing and other barriers to prevent disturbance to areas undergoing restoration.<br>- Remove temporary barriers, traffic management and signage when no longer required. | **X** | | | **X** | **X**<br>(mitigation applies to entire FCF, CGPF and IPF sites) | **X** |
| Site waste management plan | Preparation of a site waste management plan to improve materials resource efficiency and ensure waste is minimised and reduce impacts on landscape character, views and visual amenity. Any waste (including natural materials cleared during construction i.e. clear felling areas) should be re-used, recycled or recovered in other ways before disposal options are explored. The plan should be updated by the principal contractor/site manager as work progresses recovered (i.e. the plan should become a 'living' document to measure current progress against intended targets contained in the plan) and he/she should ensure that workers on the site are aware of the plan and co-operate with it (this should include provision of suitable site induction, information and training). | **X** | | | **X** | **X**<br>(mitigation applies to entire FCF, CGPF and IPF sites) | **X** |

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|---|---|---|---|---|---|---|---|---|---|---|
| Management of top soil | Topsoil and excavation should be carefully planned to maximise opportunities for re-use and minimise visual impacts:<br>- Where necessary, the topsoil at all construction sites and compounds should be carefully scraped from the site to a depth of 200-600mm (the actual depth of the topsoil) and stored in mounds no greater than 2m high at the perimeter of sites and along the edge of the pipeline route, in locations where they will aid visual screening.<br>- This soil should not be driven on by vehicles, in order to conserve soil condition.<br>- Where clearing native vegetation with low weed densities, seek opportunities to strip the top 100mm of the topsoil (with its associated soil native seed bank) and 'direct return' to previously prepared sites for natural regeneration of that community.<br>- Locate topsoil/excavation stockpiles in visually unobtrusive locations or alternatively, mound topsoil to screen construction activities from residents and motorists, where appropriate.<br>- In areas where the mounds are to be in place for long periods of time, they should be seeded with native grass seeds to help reduce erosion and prevent weed colonisation.<br>- Where FCFs, CGPFs and IPFs are proposed, geotextile (a strong woven synthetic material) should be laid where appropriate to protect the subsoil, and a temporary surface installed (usually gravel or crushed stone).<br>- Upon decommissioning, surfacing and geotextile should be removed, the subsoil ripped and topsoil re-spread, prior to seeding or planting.<br>- Where appropriate and practical, incorporate excess spoil from site excavations into bunding at the base of the proposed buffer planting (to increase the overall height of the screen planting, as discussed above). | **X** | | | **X** | **X**<br>(mitigation applies to entire FCF, CGPF and IPF sites) | | | | **X** |
| Vegetation clearing | No removal of vegetation should be undertaken outside of the approved scope of works, and should be in accordance with recommendations by the EIS team ecology consultant and a detailed tree clearing/removal schedule, to avoid unnecessary tree or shrub removal. If any removal which has not been anticipated (e.g. trees that may fall on the site and need to be removed for safety reasons), additional new planting should be undertaken to offset the loss. | **X** | | | **X** | **X**<br>(mitigation applies to entire FCF, CGPF and IPF sites) | | | | **X** |
| Fencing | The work site should be fenced at the outset, and all trees, shrubs and other vegetation which can be retained should be fenced and protected to the limit of their root zones (the canopy spread). No vehicular access, spoil, soil or equipment storage should be permitted within the fenced areas. | | | | | | | | | |

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| Site management | Materials and machinery are to be stored tidily during the installation works. On completion of construction, all remaining construction materials should be removed from the site and work compounds, and temporary hard standing access roads should be reinstated to match the existing ground flora, as soon as possible after works are complete. Topsoil should be re-spread, graded and seeded or planted, as appropriate to prevent weed colonisation. | X | X | X | X | X (mitigation applies to entire FCF, CGPF and IPF sites) | | | | X |
| | In field activity areas, drainage lines, irrigation channels and other rural features such as fences should be avoided where possible and reinstated if disturbed, in consultation with land owners. | | | X | X | | | | | |
| Access tracks design | Where possible, the existing roads and farm tracks should be used to limit the construction of new roads and access tracks during installation (and operation and decommissioning). Where new access tracks are required on private properties, these should be aligned and built in consultation with the respective landowner(s). They should be tidily maintained and designed to be visually similar to farm access tracks and include gates (where necessary) similar in style to those in the surrounding rural landscape. | X | | | X | X (mitigation applies to entire FCF, CGPF and IPF sites) | | | | X |
| Management of access tracks | Roads providing access to site compounds and installation works areas should be maintained free of dust and mud during construction. | X | X | X | X | X (mitigation applies to entire FCF, CGPF and IPF sites) | | | | X |

| **4) MONITOR AND MAINTAIN VISUAL MITIGATION MEASURES DURING THE OPERATIONAL LIFE OF THE INFRASTRUCTURE** | | | | | |
|---|---|---|---|---|---|
| **4a) Landscape and Visual Issues Management Plan** | | | | | |
| | | Gas Well Site | Gathering Infrastructure | FCF, CGPF and IPF Sites | Water Storage Facilities |
| Landscape Management Plan | Monitor and manage mitigation measures implemented to address potential landscape and visual impacts as detailed below: | X | X | X | X |
| | Ensure lighting is maintained at the lowest level practicable and monitor and respond appropriately to any complaints received from sensitive receptors on lighting impacts. . | X | X | X | X |
| | Maintain the exterior of the facility structures with non- or low-gloss finishes, and maintain the finish of buildings in non-glossy paints in colours and textures to blend with the surrounding landscape, as determined during the development of the Site-Specific, Context-specific, Landscape Integration Strategy. | X | X | X | X |

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|---|---|---|---|---|---|
| Vegetation management | Inspect effectiveness of screening vegetation to facilities resulting in the most significant impacts at least once a year for the duration of operation and undertake refurbishment planting if necessary. Screening vegetation must remain healthy and any breaks filled with suitable plants to ensure the visual barrier is maintained. Any trees and shrubs planted as part of the project should be maintained and replanted if there is any damage/death or loss of plants, within a 3 year maintenance period. Tree ties and guards (if any) should be adjusted annually, and are to be removed at the end of the maintenance period. | | | X | |
| Management of access tracks | Roads providing access to site compounds and installation works areas should be managed to minimise dust and mud during operation. | X | X | X | X |
| Site boundary and entrance Management | Road entrances, signage and boundary fencing to Arrow property should be maintained in good condition and tidy at all times to ensure they promote a legible and high quality responsible profile for Arrow. | X | X | X | X |
| Community | Respond to any comments or complaints made by the general public or interest groups in relation to the landscape or visual effects of the facilities. | X | X | X | X |

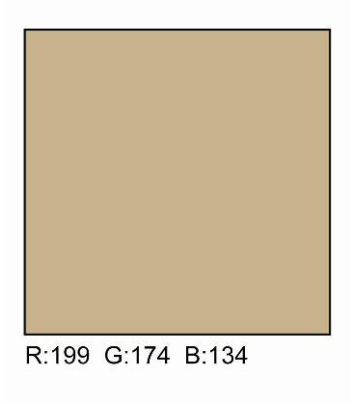
| **5. DECOMMISSIONING: UPON DECOMMISSIONING SEEK TO RETURN THE LANDSCAPE TO A CONDITION EQUAL TO OR BETTER THAN THE CONDITION PRIOR TO CSG ACTIVITIES** | | | | | |
|---|---|---|---|---|---|
| **5a) Landscape Restoration and Remediation Plan** | | | | | |
| | | Well Site | Gathering Infrastructure | FCF, CGPF and IPF Sites | Water Storage Facilities |
| Restoration | Infrastructure should be removed to the extent necessary to enable the ground surface condition and associated landscape character to be restored to its former use or as otherwise agreed with the regulator and landholder. i.e. consider the depth to which gas pipelines remaining in situ need to be capped to enable agricultural activities (such as ploughing) to occur unimpeded. | X | | X | |
| Restoration Surface re-instatement | Reinstatement of pre-existing (or enhanced) conditions: On completion of operation, all components, materials (e.g. hard standing) and access roads associated with the project should be removed from the site. Affected areas should be reinstated to their former or preferred land use in consultation with the land holder(s) and Government Authorities (e.g. in State Forest areas). Topsoil should be re-spread, graded and seeded with appropriate crops, native grasses, shrubs or plant species, in consultation with the land holder(s) or Government Authority. A portion of the remaining spoil should be used in landscaping and graded to match existing contours. | X | X | X | X |

| | | |
|---|---|---|
| Legacy projects | Consider community or environmental 'legacy projects' to compensate for disruption/change during the life of the project, for example:<br>- local use of treated water throughout project life e.g. crop irrigation<br>- creation of picnic areas<br>- improving visitor facilities at Lake Broadwater<br>- riparian zone regeneration<br>- creation of waterskiing facility in former water treatment dams<br><br>This could be achieved through specific instigation of projects or via the establishment of a community/environment fund, potentially in cooperation with other CSG operators in the Surat Basin. | **X**<br>(mitigation applies to entire project site and beyond) |

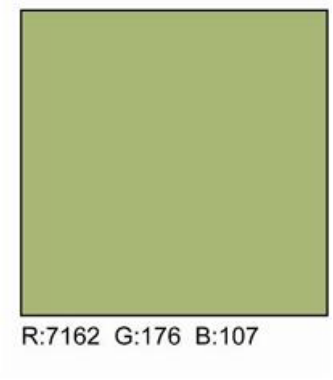
The following palette has been developed to provide an *indication* of the range of paint colours that could be explored to assist in the integration of CSG Facilities into the landscape. These are considered further in the Landscape Type specific mitigation section that follows:

**Figure 7 Illustrative Colour Palette**

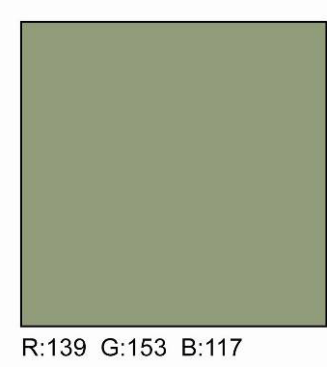
Suggested colour for arable landscapes:




Suggested colour for pastoral and forested landscapes:




Suggested colour if only one paint selection desired:



## 8.2 Landscape type-specific mitigations measures

The landscape type-specific mitigation measures described in this section explain and provide greater detail regarding how the mitigation measures described in **Table 18**.

above can be applied to the different landscape types present within the study area to achieve the greatest outcome of landscape and visual mitigation. Whilst they are relevant across all stages of the project, the measures detailed below are of greatest relevance with regard to Stage 2 (Preparation and Planning: Identify, Minimise and Address Landscape and Visual Impacts that Cannot be Eliminated) through the application of a Site Specific, Context Specific, Landscape Integration Strategy.

The particular landscape type-specific aspects addressed below in relation to the detailed siting or design of infrastructure are:

- Unique landscape features or distinctive scenery within the landscape type that should be avoided.
- Attractive man-made elements within the landscape type to avoid.
- Potential for skylining to minimise impact.
- Potential prominence from locally/regionally significant viewpoints;
- Impact on visual receptors (corridors, centres of habitation, private residences etc).
- Infrastructure design in relation to landscape colour, texture, line.
- Ability to capitalise on existing landform and vegetation.
- Potential cues for introducing screening.
- Opportunity for legacy projects (where appropriate).

Some of these issues are explored further in the visualisations (illustrating the mitigated and unmitigated project) and through the production of Zones of Theoretical Visibility (ZTVs), presented in **Figure 8** to **Figure 38** through the process described below.

### 8.2.1 Preparation of Zones of Theoretical Visibility (ZTV)

A ZTV maps the area within which a proposed development may have an influence or effect upon views and visual amenity; and is often used as a tool to select representative viewpoints for more detailed assessment. ESRI ArcGIS software has been used to model the ZTV.

Each visualisation is supported by a ZTV which indicates the approximate visibility of the production well and/or IPF in the relevant landscape. The ZTV has been created using ESRI ArcGIS software and 3D AutoCAD drawings issued by Arrow in conjunction with available digital terrain data. A Digital Elevation Model (DEM) was generated using the client GIS data of 20m Contours. This DEM generated had a cell size of 20m; meaning every 20m grid on the surface was populated with only one Z height value.

To indicate the role of vegetation within each landscape type, significant blocks of dense vegetation have been digitised (average vegetation height of 14m has been used) and incorporated into the ZTV model i.e. areas of the DEM where the vegetation layer sat, where artificially raised to 14m to reflect the height of the vegetation and its associated screening effect.

In interpreting the ZTV, the following important issues must be considered:

- The ZTV presented in this report was based on the ground surface elevation, and does not take account of all intervening vegetation (only significant blocks of dense vegetation have been digitised using aerial photos supplied for the project in conjunction with Google Earth imagery), buildings or minor changes in topography, such as road cuttings. Where such features intervene between the viewer and the proposed project (e.g. tree belts alongside roads), then this local visual screening will reduce the visibility of the project.
- A 10km radius study area for the ZTV of an IPF (largest proposed project facility, with maximum height of buildings is 12m, excluding the flare structure) has been used to capture all likely significant impacts associated with the operation of this project component.
- A 2km radius study area for the ZTV of a production well (maximum height of the tallest component at the production well sites is approximately 3.2m) has been used to capture all likely significant impacts associated with the operation of this project component.

### 8.2.2 TYPE A: WOODED RIVER VALLEY

In addition to the general mitigation measures presented in Section 8.1, the siting, scale and design of any project components in the *Wooded River Valley* landscape type will need to incorporate the following tailored mitigation measures:

| **Attribute** | **Landscape Type A: Tailored Mitigation Measure** |
|---|---|
| Unique landscape features or distinctive scenery within the type that should be avoided | The whole of Landscape Type A is considered a unique and distinctively scenic landscape. Location of project components should respond to the high level of naturalness, the 'organic' landscape pattern, the intimate scale and relatively narrow nature of this river valley landscape i.e. locating a FCF, CGPF, IPF and/or any water storage facility would be extremely challenging, due to the large footprint required and associated 'highly engineered' character of such facilities.<br>The siting of project components should minimise tree loss to maintain the intimate, 'well-treed' river valley character, which comprises a strong sense of visual continuity and presents a 'natural edge'. |
| Attractive man-made elements within the landscape type to avoid | None noted. |
| Potential for skylining to minimise impact | Through careful siting, wells could be viewed against a backdrop of existing vegetation that would assist in their visual integration into their landscape setting. |
| Potential prominence from locally/regionally significant viewpoints | No particularly significant regional/local viewpoints are noted in this landscape type. |
| Impact on Visual Receptors (corridors, centres of habitation, private residences etc) | Avoid locating any proposed facilities (including wells) close to significant road crossings over the river e.g. the crossing of Dalby-Cecil Plains Road over the Condamine River. Maintain the viewshed from these significant crossings free of infrastructure. This will depend on the local effects of screening but could extend to a distance of around 500m.<br>Avoid locating wells close (i.e. within 500m) to Cecil Plains and other settlements located close to the river valley.<br>Consider the relationship to farmsteads and houses in the adjoining landscape type in the detailed siting of wells. Seek to maximise the distance between wells and properties. Also seek to exploit the potential for any existing local vegetation to act as a visual screen. . |
| Infrastructure design in relation to landscape colour, texture, line | The design of project components should respond to characteristic colours and textures i.e. consider selecting recessive materials, colours and textures to increase compatibility with the landscape setting e.g. select a natural straw colour for gas well components and consider more rural fencing types in this landscape. |
| Ability to capitalise on existing landform and vegetation | The shelving valley landform provides some opportunities for localised siting of infrastructure in locations of lower visibility. The presence of existing vegetation provides opportunities for drawing on existing vegetation for screening as described below. |
| Potential cues for introducing screening | Existing informal large trees and shrubs provide a context against which any new planting should be planned. Any new planting should mimic the natural landscape in terms of species and structural composition i.e. scattered informal groupings, *not* straight lines or blocks. |

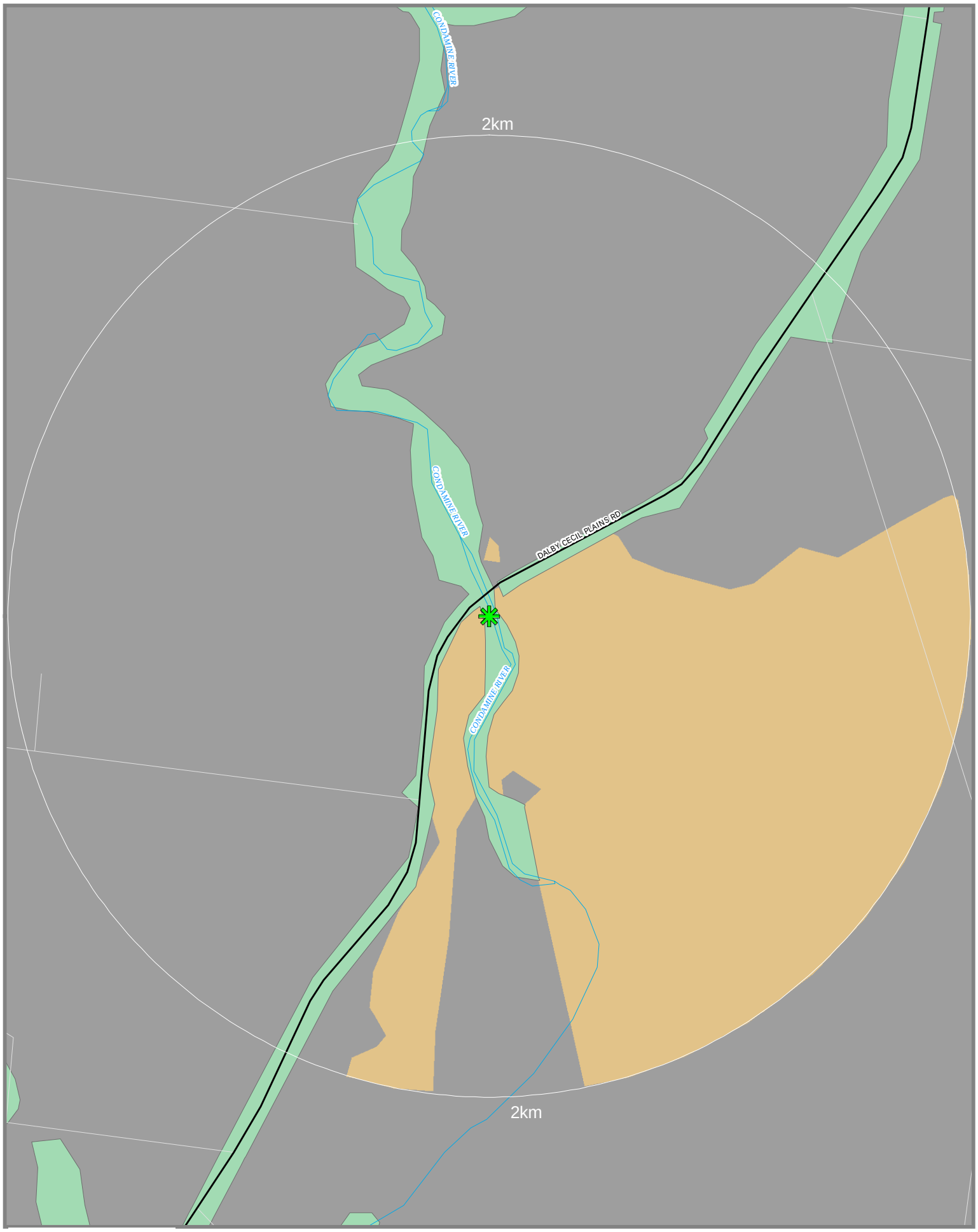
| | |
|---|---|
| Opportunity for legacy projects (if appropriate) | Enhancement of existing (or creation of new) picnic areas and facilities at key river crossings adjacent to road corridors, and riparian corridor restoration could be considered in consultation with the local community. |

**Figure 8 Landscape Type A: Production Well Visualisations (unmitigated scheme and mitigated)**

The visualisations illustrated in **Figure 8** have been created to assist in conceiving the introduction of a production well and surface facilities in the *Wooded River Valley* landscape type. Both the unmitigated and mitigated scheme have been illustrated to: i) ensure the scale and nature of the proposed infrastructure is fully understood, and ii) indicate the importance of integrating discrete tailored mitigation measures, as set out in the table above, into Arrow's standard operating procedures.

This riparian landscape is highly sensitive and incongruent to the introduction of FCFs, CGPFs, IPFs and large scale water storage facilities (as detailed in Section 7.0) and, consequently, the development of these types of facilities in this landscape type is not recommended. Therefore, visualisations and ZTVs have been created only for the production wells which may be accommodated in this landscape type. If development of FCFs, CGPFs, IPFs and/or water storage facilities does take place in this landscape (i.e. if landscape and visual sensitivities are surpassed by other demands), a separate detailed study on landscape and visual impact is strongly recommended.

The ZTV illustrated in **Figure 9** has been created to assist in conceiving the approximate visibility of the above production well and surface facilities (unmitigated project) in the *Wooded River Valley* landscape type up to 2km; taking into account the role of topography and some significant blocks of dense vegetation. From this representative viewpoint, trees and shrubs lining the Condamine River and Dalby-Cecil Plains Road provide visual enclosure to the well; however the well would be visible to the south east.

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**LEGEND**

- Production Well
- Vegetation

Zone of Theorectical Visibility

- Visible
- Not Visible

# LANDSCAPE TYPE A PRODUCTION WELL: INDICATIVE ZTV BASED ON PILOT LOCATION

**Arrow Energy**
**Surat Gas Project LVIA**

**Figure**
**F9**

| | |
|---|---|
| PROJECT ID | 09513140.01 |
| CREATED BY | GW |
| LAST MODIFIED | GW FEB 2010 |

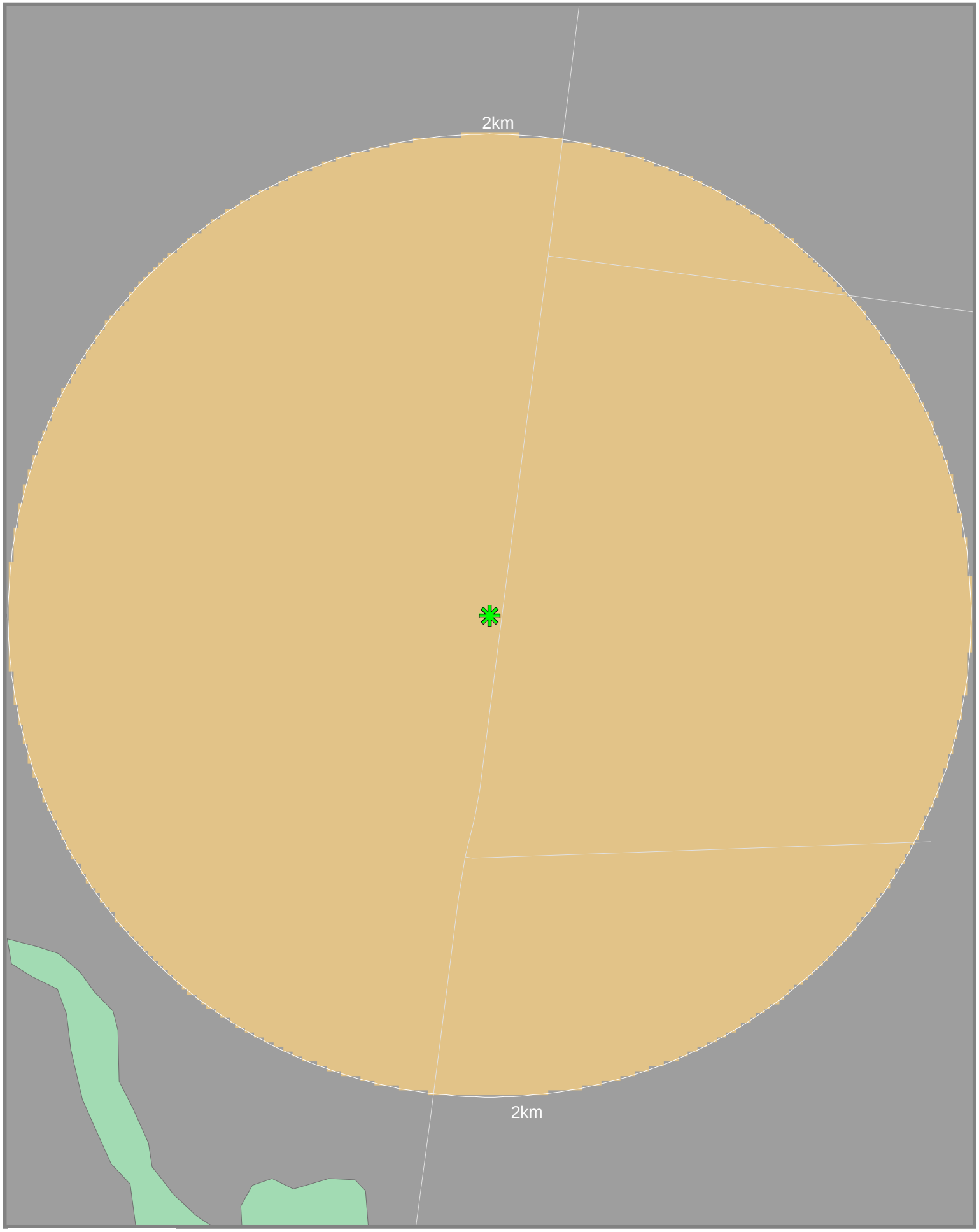
### 8.2.3 TYPE B: SETTLED ARABLE PLAINS

In addition to the general mitigation measures presented in Section 8.1, the siting, scale and design of project components in the *Settled Arable Plains* landscape type will need to incorporate the following tailored mitigation measures:

| **Attribute** | **Landscape Type B: Tailored Mitigation Measure** |
|---|---|
| Unique landscape features or distinctive scenery within the type that should be avoided | No areas or features of particular concern are noted. |
| Attractive man-made elements within the landscape type to avoid | None noted. |
| Potential for skylining to minimise impact | Seek to locate FCFs, CGPFs and/or IPFs on the edge of existing forested areas in adjoining landscape types or where there is a backdrop of existing screening shelterbelts or a substantial riparian corridor to the greatest extent possible, such that the facilities would be viewed against backdrop planting which can then be extended (as discussed below). Wells should also be sited where they would be screened by existing roadside shelterbelts to the greatest extent possible, albeit such shelterbelts are infrequent across the landscape type so is unlikely to be possible in most situations. |
| Potential prominence from locally/regionally significant viewpoints | Lake Broadwater occurs in this landscape type. There are potentially significant views obtained from within the reserve (particularly the camping and bird hide areas) and from the approach road to this important recreational area, which are sensitive to visual intrusion by infrastructure elements. These views and the character of the surrounding landscape are particularly important and will need to be given special consideration in the siting of any facilities close to this area i.e. through detailed siting of facilities to minimise impact on these key views and advance establishment of screen planting where visual impacts cannot be avoided . |
| Impact on Visual Receptors (corridors, centres of habitation, private residences etc) | This area contains significant regional centres including Chinchilla, Dalby and Cecil Plains. The presence of residences and community facilities within these towns and the fact that numerous people will be travelling on the roads connecting these towns increases the potential visual sensitivity. It is recommended that FCFs, CGPFs and IPFs be located a minimum of at least 1km from the edge of towns where screening can be effective or 5Km where no screening is appropriate/viable.<br><br>Significant road corridors traverse this area including parts of the Warrego Highway, Dalby-Jandawae Road and Dalby-Cecil Plains Road. It is recommended that FCFs, CGPFs and IPFs be located as far as possible from these view corridors, ideally 1km where screening is possible or 3Km otherwise.<br><br>This landscape has a high concentration of farmsteads and isolated properties. Wells and facilities should be sited to maintain the maximum distance between affected residential properties, whilst promoting use of existing tracks for access to facilities. |
| Infrastructure design in relation to landscape colour, texture, line | The colour of well facilities needs to take into account seasonal changes arising from cropping cycles. Beiges and mid browns may be considered appropriate, although in those locations where the facility is viewed against a vegetated backdrop olive greens may be a suitable alternative. |
| Ability to capitalise on existing | The landscape is fairly flat, providing few opportunities to use landform to |

| | |
|---|---|
| landform and vegetation | hide facilities. Vegetation areas are also fairly infrequent, comprising roadside planting belts, providing few opportunities to use existing vegetation in a screening capacity. |
| Potential cues for introducing screening | If any particularly sensitive views of wells would be experienced then consider roadside planting that mimics existing roadside shelterbelts. Otherwise retain the existing open character and use colour to integrate the well facilities, rather than seeking to screen them.<br><br>Seek to locate FCFs, CGPFs and IPFs on the edge of existing adjacent forested areas (adjoining landscape types) or, otherwise, screening shelterbelts to the greatest extent possible. These can then be extended through the creation of formal regular blocks of perimeter forest /planting that will assist in integrating the facility into its landscape setting. |
| Opportunity for legacy projects (if appropriate) | Potential for facilities in local towns (indirect benefits) in consultation with the community. |

**Figure 10 Landscape Type B: Production Well Visualisations (unmitigated scheme and mitigated)**

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**LEGEND**

- Production Well
- Vegetation

Zone of Theorectical Visibility

- Visible
- Not Visible

# LANDSCAPE TYPE B PRODUCTION WELL: INDICATIVE ZTV BASED ON PILOT LOCATION

**Arrow Energy**
**Surat Gas Project LVIA**

**Figure**

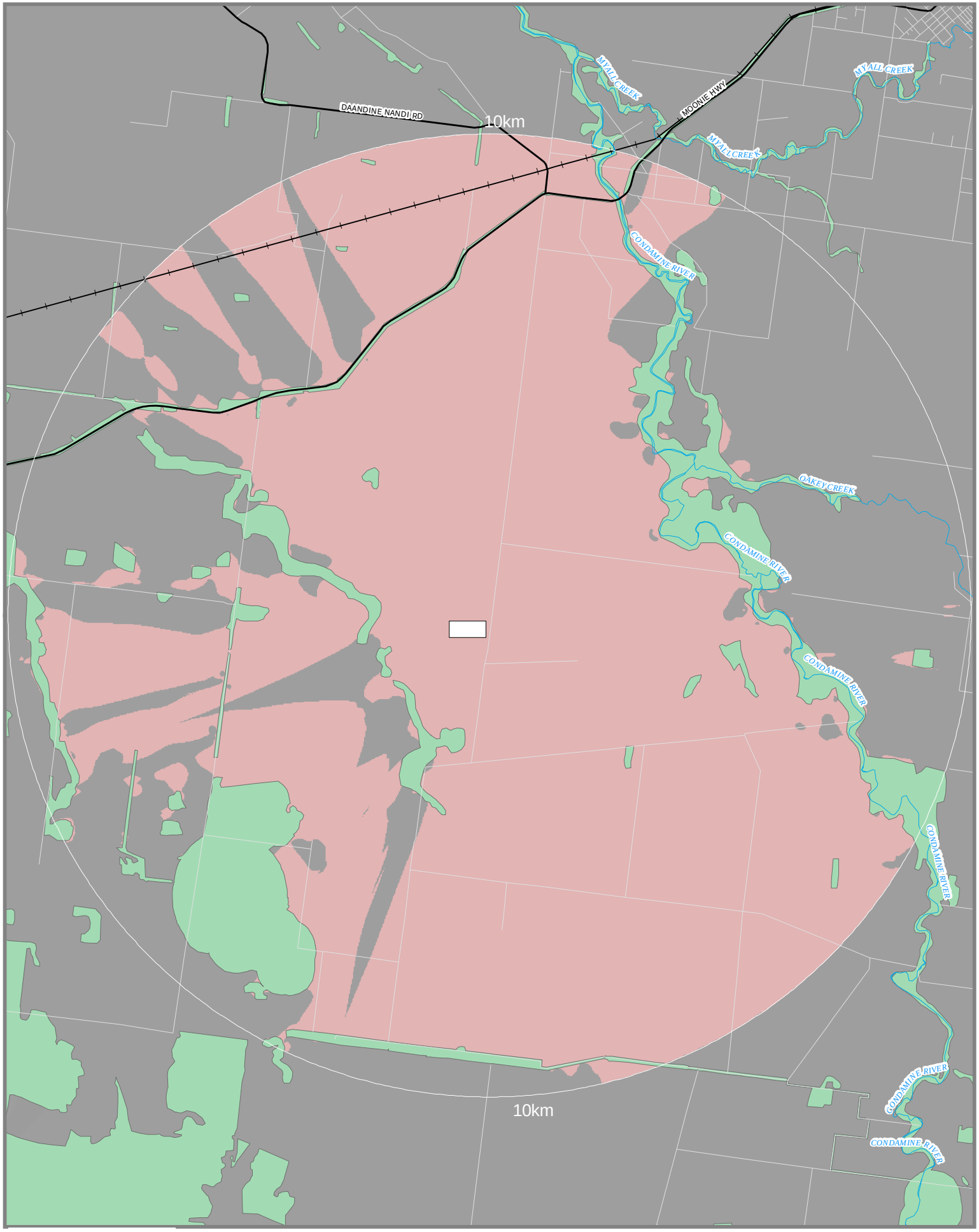
**F11**

| | |
|---|---|
| PROJECT ID | 09513140.01 |
| CREATED BY | GW |
| LAST MODIFIED | GW FEB 2010 |

**Figure 12 Landscape Type B: IPF Visualisations (unmitigated scheme and mitigated)**

The visualisations illustrated in **Figure 10** and **Figure 12** have been created to assist in conceiving the introduction of both IPFs and production wells in the *Settled Arable Plains* landscape type. Both the unmitigated and mitigated project have been illustrated to: i) ensure the scale and nature of the proposed infrastructure is fully understood, and ii) indicate the importance of integrating discrete mitigation measures into Arrow's standard operation procedures as described in the table above. This character landscape type is strongly affected by the changes in seasons and associated cycle of crop planting. The visualisation is based upon conditions at the time of site visit (i.e. without crops) and the potential situation with crops has also been considered in determining an appropriate mitigation response.

The ZTVs illustrated in **Figure 11**and **Figure 13** have been created to assist in conceiving the approximate visibility of the above production well and surface facilities (unmitigated project) and IPF (unmitigated project) in the *Settled Arable Plains* landscape type up to 2km and 10km respectively; taking into account the role of topography and some significant blocks of dense vegetation. Located to the west of the Condamine River, the open flat character of this landscape with little intervening vegetation, allows and clear views to both the well and IPF.

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**LEGEND**

- IPF
- Vegetation

Zone of Theoretical Visibility

- Visible
- Not Visible

# LANDSCAPE TYPE B IPF: INDICATIVE ZTV BASED ON PILOT LOCATION

**Arrow Energy**
**Surat Gas Project LVIA**

**Figure**
**F13**

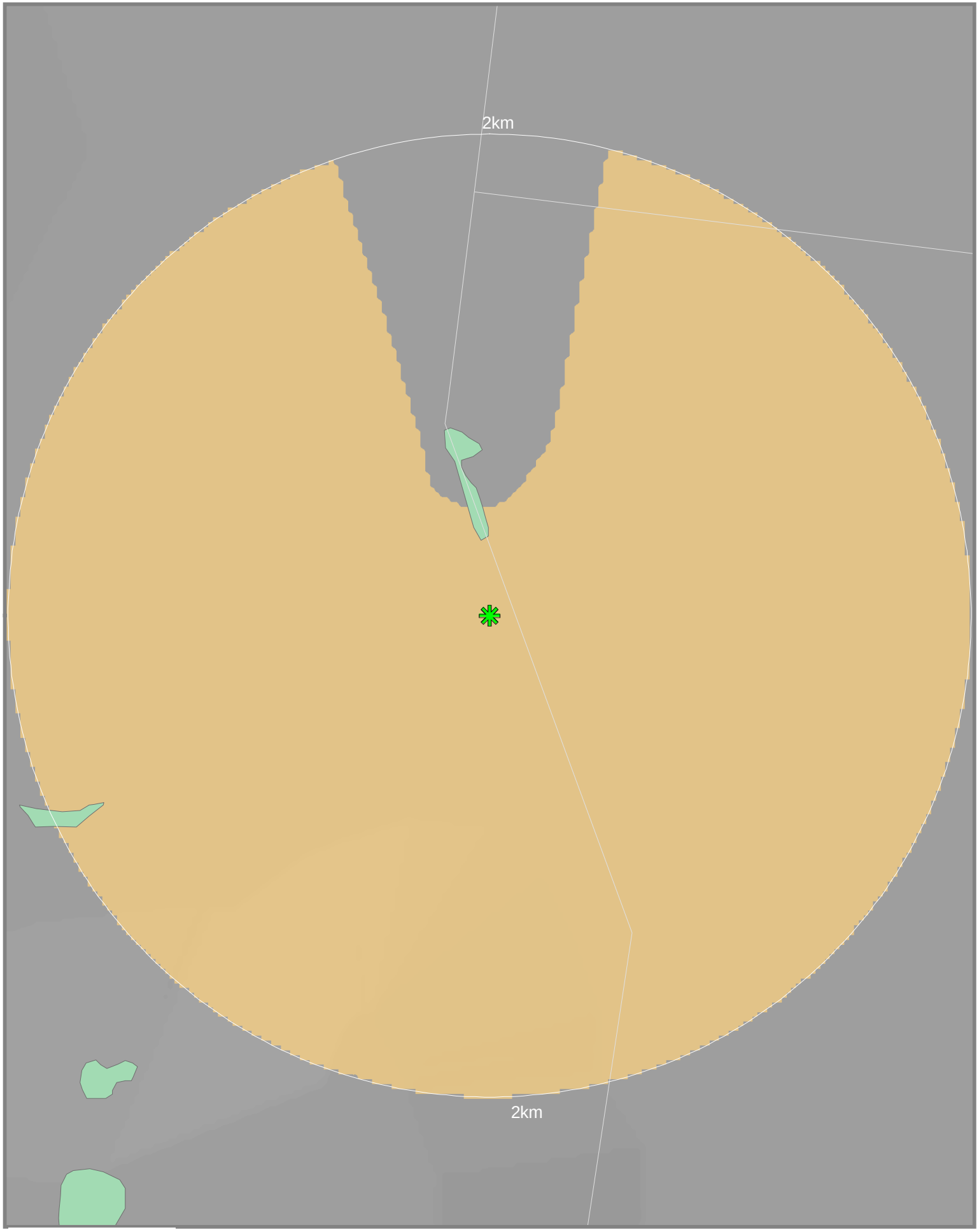
| | |
|---|---|
| PROJECT ID | 09513140.01 |
| CREATED BY | GW |
| LAST MODIFIED | GW FEB 2010 |

### 8.2.4 TYPE C: SODIC TRANSITIONAL PASTURES

In addition to the general mitigation measures presented in Section 8.1, the siting, scale and design of any project components in the *Sodic Transitional Pastures* landscape type will need to incorporate the following tailored mitigation measures:

| **Attribute** | **Landscape Type C: Tailored Mitigation Measures** |
|---|---|
| Unique landscape features or distinctive scenery within the type that should be avoided | No special features noted. |
| Attractive man-made elements within the landscape type to avoid | None noted. |
| Potential for skylining to minimise impact. | This landscape type appears in close proximity to the *Elevated Native Forest* and *Lowland Native Forest* landscape types, providing opportunities to site infrastructure against a forested (and sometimes slightly elevated) backdrop through some parts of this landscape type. Such opportunities should be taken where possible. |
| Potential prominence from locally/regionally significant viewpoints | No particularly sensitive vantage points are noted. |
| Impact on Visual Receptors (corridors, centres of habitation, private residences etc) | This area is sparsely settled, although consideration will need to be given to minimising the visibility of features from any of the scattered homesteads that are present, through maximising distance and using existing or addition planting screens. Most roads through this type are relatively minor with low levels of traffic but views from the Moonie Highway will need to be considered by siting facilities where they will be less visible / buffered from this view corridor. |
| Infrastructure design in relation to landscape colour, texture, line | Selective use of colour e.g. dark olive-green colour will assist in integrating the well facility into the local landscape and any existing backdrop of borrowed character from adjacent landscape types (D and E).<br><br>FCFs, CGPFs and IPFs to be of lighter colour e.g. straw-beige or grey-green that would minimise the appearance of bulk and enable the perception of greater screening. |
| Ability to capitalise on existing landform and vegetation | Local undulations provide an opportunity to use landform to assist in integrating the infrastructure into the landscape, through capitalising on existing screening qualities. There is also sufficient existing native vegetation within and in adjoining landscape types to provide a framework for the introduction of new screen planting (as described further below). |
| Potential cues for introducing screening | Existing vegetation in this landscape type comprises informal scrub and occasional shelterbelts. New planting associated with gas wells would need to follow this vegetation pattern to assist in integrating the facility, rather than seeking to provide full screening.<br><br>Extend or mimic the character of groves of Poplar Box/Grey Box roadside shelterbelt character around FCFs, CGPFs and IPFs to create the greatest level of screening possible. |
| Opportunity for legacy projects (if appropriate) | No obvious opportunities but would need to be considered in consultation with the local community. |

**Figure 14 Landscape Type C: Production Well Visualisations (unmitigated scheme and mitigated)**

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**LEGEND**

- Production Well
- Vegetation

Zone of Theorectical Visibility

- Visible
- Not Visible

# LANDSCAPE TYPE C PRODUCTION WELL: INDICATIVE ZTV BASED ON PILOT LOCATION

**Arrow Energy**
**Surat Gas Project LVIA**

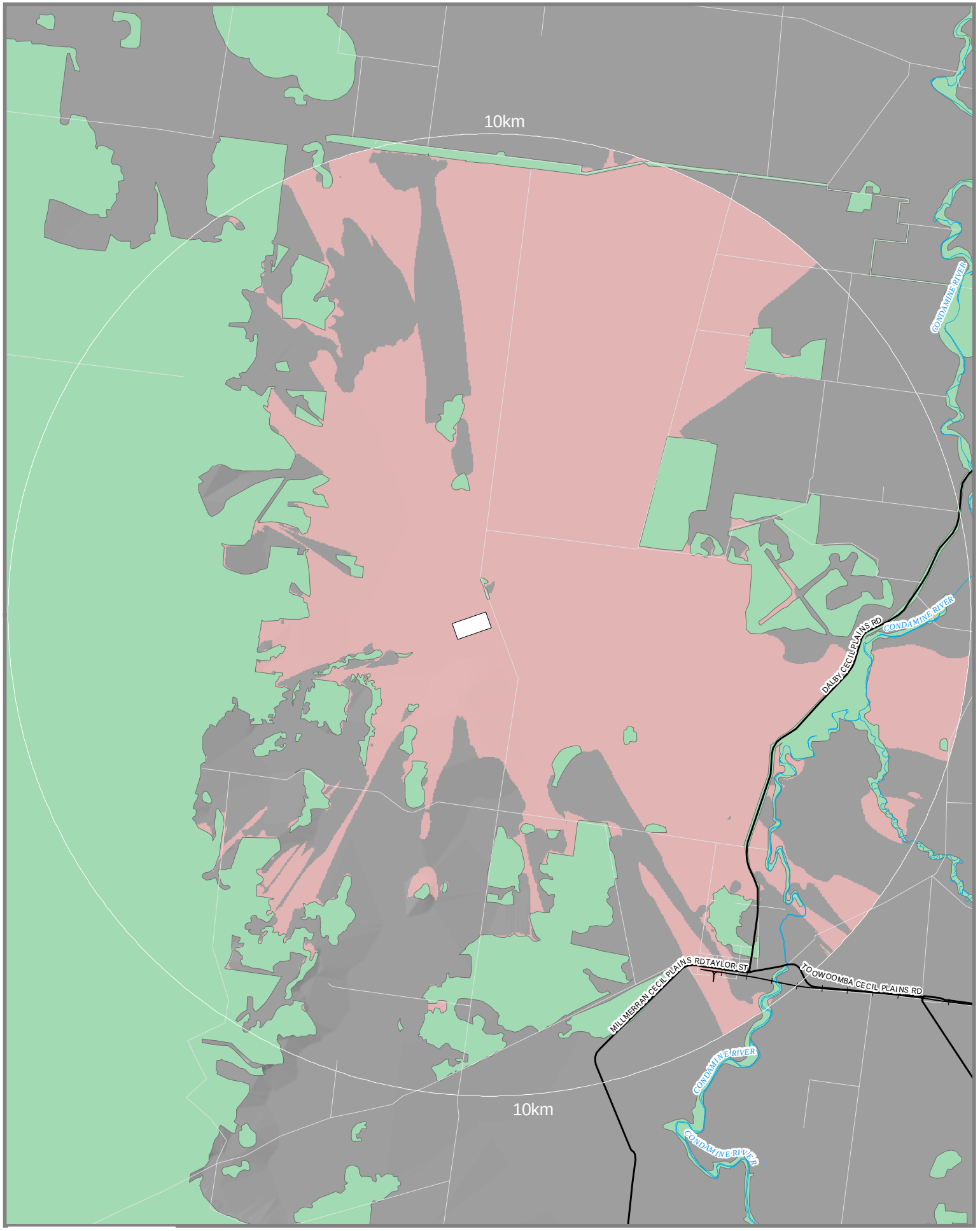
**Figure**
**F15**

| | |
|---|---|
| PROJECT ID | 09513140.01 |
| CREATED BY | GW |
| LAST MODIFIED | GW FEB 2010 |

**Figure 16 Landscape Type C: IPF Visualisations (unmitigated scheme and mitigated)**

The visualisations illustrated in **Figure 14** and **Figure 16** have been created to assist in conceiving the introduction of wells and IPFs in the *Sodic Transitional Pastures* landscape type. Both the unmitigated and mitigated project have been illustrated to: i) ensure the scale and nature of the proposed infrastructure is fully understood, and ii) indicate the importance of integrating discrete mitigation measures as described in the table above into Arrow's standard operation procedures.

The ZTVs illustrated in **Figure 15** and **Figure 17** have been created to assist in conceiving the approximate visibility of the above production well and surface facilities (unmitigated project) and IPF (unmitigated project) in the *Sodic Transitional Pastures* landscape type up to 2km and 10km respectively; taking into account the role of topography and some significant blocks of dense vegetation. Located between Kumbarilla State Forest and the Condamine River, the landscape comprises a fairly flat landform with little intervening vegetation, allowing some clear views to both the well and IPF, particularly from the north and east.

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**LEGEND**

- IPF
- Vegetation

Zone of Theoretical Visibility

- Visible
- Not Visible

# LANDSCAPE TYPE C
# IPF: INDICATIVE ZTV BASED ON PILOT LOCATION

**Arrow Energy**
**Surat Gas Project LVIA**

**Figure**
**F17**

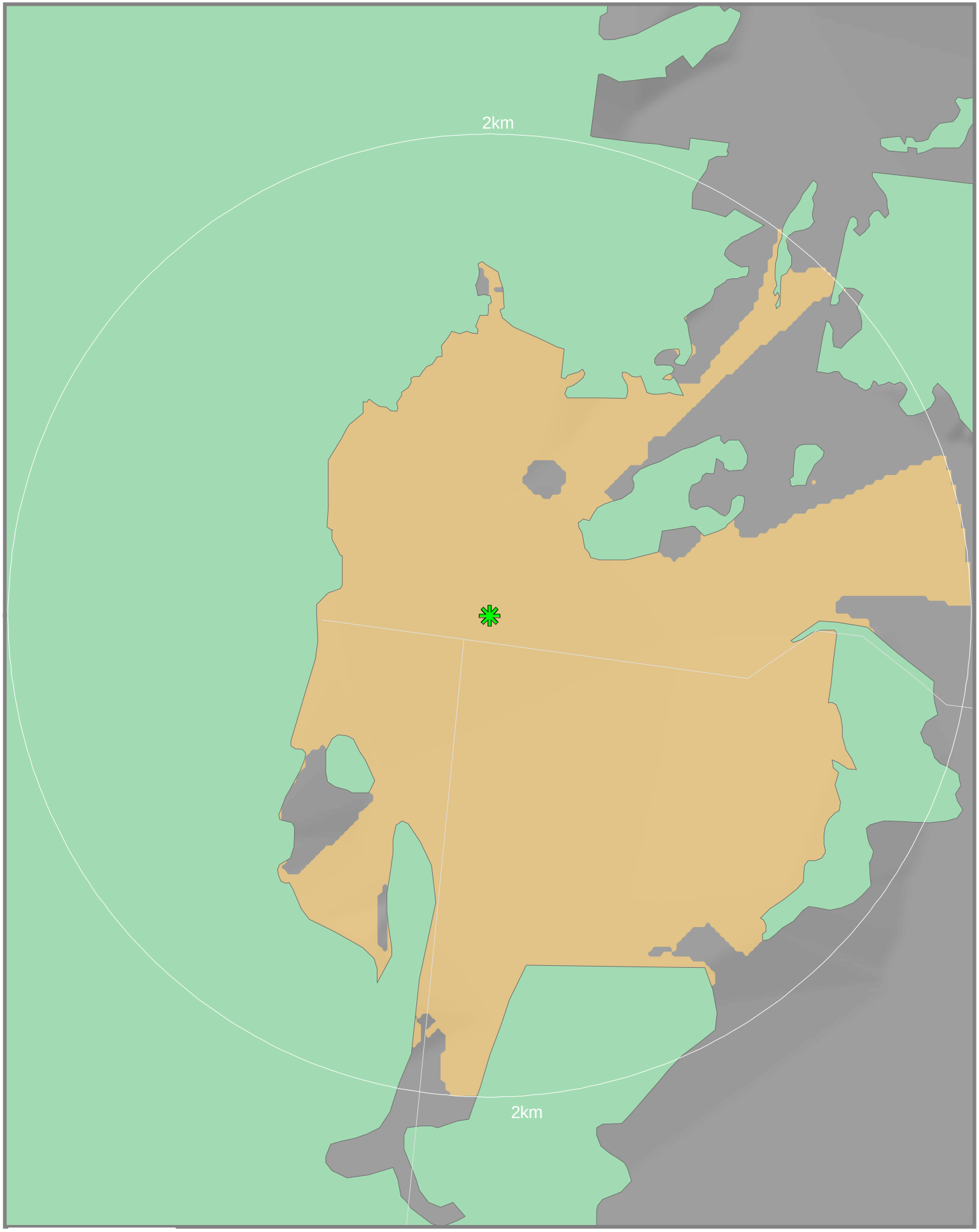
| | |
|---|---|
| PROJECT ID | 09513140.01 |
| CREATED BY | GW |
| LAST MODIFIED | GW FEB 2010 |

### 8.2.5 TYPE D: LOWLAND NATIVE FOREST

In addition to the general mitigation measures presented in Section 8.1, the siting, scale and design of any project components in the *Lowland Native Forest* landscape type will need to incorporate the following tailored mitigation measures:

| **Attribute** | **Landscape Type D: Tailored Mitigation Measure** |
|---|---|
| Unique landscape features or distinctive scenery within the type that should be avoided | This is a forested landscape, much of which is protected as State Forest. Within this landscape type there are locally attractive forested areas with tributaries, which should ideally be left in a pristine condition for the appreciation of recreational users that frequent the tracks through this zone. |
| Attractive man-made elements within the landscape type to avoid | None. |
| Potential for skylining to minimise impact; | There is a continuous backdrop of forest throughout this area that provides excellent opportunities for screening facilities in distant views and provides a wooded backdrop in closer views to facilities. |
| Potential prominence from locally/regionally significant viewpoints | There are no particularly important vantage points. However, there are numerous recreational 4WD/cycle trails through this zone, including a number of publicised 'bird trails'. Ideally FCFs, CGPFs, IPFs and wells should be located (or screening implemented) such that they are not visible from these trails e.g. Barakula Forest Drive. |
| Impact on Visual Receptors (corridors, centres of habitation, private residences etc) | This landscape is remote and sparsely settled so impacts on individual residences should be readily avoided through siting of facilities away from any homesteads that are present in this landscape type. Recreational trails through state forests also need careful consideration as discussed above. |
| Infrastructure design in relation to landscape colour, texture, line | Fencing and colour of well facilities and IPFs to match as closely as possible to grassland 'straw' colour (a couple of shades darker) or forested 'olive green' colour depending upon the specific context (i.e. if skylined against forest a deeper green colour would be most appropriate, whereas in a more open clearing of grassland the lighter shade may be more effective). Colour to be determined in situ based upon the standard palette that is to be developed. |
| Ability to capitalise on existing landform and vegetation | The forested and undulating character of the landscape provides significant opportunities for screening even the largest of project infrastructure. This is already recognised in the siting of existing power stations and project facilities within this landscape type. |
| Potential cues for introducing screening | Outside of well clear zones, consider introduction of Callitris/Wilga/Poplar Box vegetation that mimics the vegetation present around the selected site.<br><br>Introduce dense and thick forested planting of locally-occurring species in blocks of at least 30m deep (ideally more) around the edge of FCFs, CGPFs and IPFs to screen views to the greatest extent possible. |
| Opportunity for legacy projects (if appropriate) | Opportunities for establishment of recreation facilities and/or enhancements associated with the state forest tracks working in consultation with other agencies. |

**Figure 18 Landscape Type D: Production Well Visualisations (unmitigated scheme and mitigated)**

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**LEGEND**

- Production Well
- Vegetation

Zone of Theorectical Visibility

- Visible
- Not Visible

# LANDSCAPE TYPE D PRODUCTION WELL: INDICATIVE ZTV BASED ON PILOT LOCATION

**Arrow Energy**
**Surat Gas Project LVIA**

**Figure**

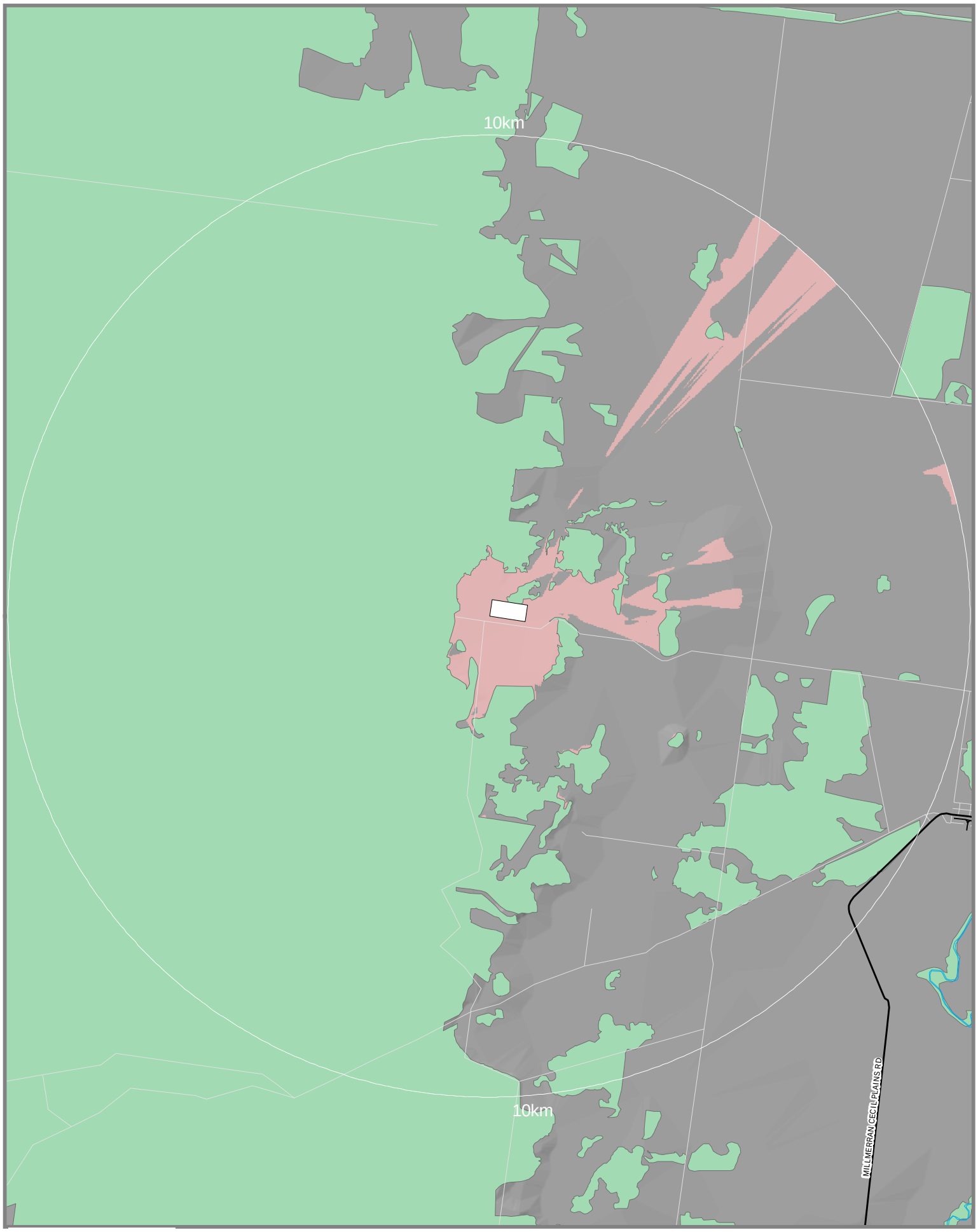
**F19**

| | |
|---|---|
| PROJECT ID | 09513140.01 |
| CREATED BY | GW |
| LAST MODIFIED | GW FEB 2010 |

**Figure 20 Landscape Type D: IPF Visualisations (unmitigated scheme and mitigated)**

The visualisations illustrated in **Figure 18** and **Figure 20** have been created to assist in conceiving the introduction of both wells and IPFs in the *Lowland Native Forest* landscape type. Both the unmitigated and mitigated project have been illustrated to: i) ensure the scale and nature of the proposed infrastructure is fully understood, and ii) indicate the importance of integrating discrete mitigation measures as outlined above into Arrow's standard operation procedures.

The ZTVs illustrated in **Figure 19** and **Figure 21** have been created to assist in conceiving the approximate visibility of the above production well and surface facilities (unmitigated project) and IPF (unmitigated project) in the *Lowland Native Forest* landscape type up to 2km and 10km respectively; taking into account the role of topography and some significant blocks of dense vegetation. From this point, views to the well and IPF would be largely obstructed by surround dense vegetation, including Kumbarilla State Forest.

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**LEGEND**

- IPF
- Vegetation

Zone of Theoretical Visibility

- Visible
- Not Visible

| | |
|---|---|
| PROJECT ID | 09513140.01 |
| CREATED BY | GW |
| LAST MODIFIED | GW FEB 2010 |

# LANDSCAPE TYPE D
# IPF: INDICATIVE ZTV BASED ON PILOT LOCATION

**Arrow Energy**
**Surat Gas Project LVIA**

**Figure**

**F21**

### 8.2.6 TYPE E: ELEVATED NATIVE FOREST

In addition to the general mitigation measures presented in Section 8.1, the siting, scale and design of any project components in the *Elevated Native Forest* landscape type will need to incorporate the following tailored mitigation measures:

| **Attribute** | **Landscape Type E: Tailored Mitigation Measure** |
|---|---|
| Unique landscape features or distinctive scenery within the type that should be avoided | As per Landscape Type D, this is a forested landscape, much of which is protected as State Forest. Within this landscape, there are locally attractive areas with tributaries that should be left in a pristine condition for the appreciation of recreational users, however these are less frequent in the upland location. |
| Attractive man-made elements within the landscape type to avoid; | None noted. |
| Potential for skylining to minimise impact; | There is a continuous backdrop of forest throughout this area that provides excellent opportunities for screening facilities in distant views and provides a wooded backdrop in closer views to facilities. |
| Potential prominence from locally/regionally significant viewpoints | There are no particularly important vantage points. However, there are numerous recreational 4WD trails through the State Forests e.g. Daandine. Ideally, FCFs, CGPFs, IPFs and wells should be located such that they are not visible and/or are screened from these trails. |
| Impact on Visual Receptors (corridors, centres of habitation, private residences etc) | The area is remote with little habitation and the roads are generally unsealed and sparsely used. Therefore, it should be possible to minimise impact on those few acreage properties that are present in the area through careful siting of proposed infrastructure. The Leichardt and Gore Highways are present through some sections of the landscape type and infrastructure siting should consider the potential for views from these roads and seek to site facilities to avoid or provide screening to any affected views. |
| Infrastructure design in relation to landscape colour, texture, line | Consider colours such as deep forest/olive greens for FCFs, CGPFs, IPFs and wells that will blend with the existing natural forested background colours. |
| Ability to capitalise on existing landform and vegetation | There is a high capacity to capitalise on the existing forested landscape and undulations to assist in integrating any proposed facilities into the landscape. |
| Potential cues for introducing screening | In most cases within this landscape type it is anticipated that vegetation clearing would need to occur to accommodate any proposed FCF, CGPF and IPF; in which case, at least 30m should be maintained around the perimeter and 50m from any sensitive receptor (e.g. road). Should existing vegetation not be present, dense and thick forested planting of locally-occurring species should be introduced in blocks of at least 30m deep (ideally more and of at least 50m deep close to existing sensitive receptors) around the edge of FCFs, CGPFs and IPFs in order to screen views to the greatest extent possible. For production wells, these distances may be reduced to 10m (general) and 20m (close to sensitive receptors) respectively. |
| Opportunity for legacy projects (if appropriate) | Opportunities for establishment of recreation facilities and/or enhancements associated with the State Forest tracks working in consultation with other agencies. |

**Figure 22 Landscape Type E: Production Well and IPF Visualisation (unmitigated scheme and mitigated)**

The visualisation illustrated in **Figure 22** has been created to assist in understanding the visual implications of the introduction of wells and IPFs in the *Elevated Native Forest* landscape type. As the location of the project facilities would be set-back from the roadside, within this densely forested landscape, only the signage defining the alignment of the gathering systems would be visible from this viewpoint. This visualisation has been illustrated to: i) ensure the scale and nature of the proposed infrastructure is fully understood, and ii) indicate the importance of integrating discrete mitigation measures into Arrow's standard operating procedures as discussed above.

### 8.2.7 TYPE F: FOOTHILL PLAINS AND VALLEYS

In addition to the general mitigation measures presented in Section 8.1, the siting, scale and design of any project components in the *Foothill Plains and Valleys* landscape type will need to incorporate the following tailored mitigation measures:

| Attribute | Landscape Type F: Tailored Mitigation Measure |
|---|---|
| Unique landscape features or distinctive scenery within the type that should be avoided | The Bunya Mountains provide a dramatic backdrop to this landscape and introduction of FCFs, CGPFs and/or IPFs has a strong potential to adversely impact on views. This needs to be considered in the detailed siting of facilities. The presence of distinctive vegetation, in particular the bottle tree that are a noted feature of this landscape type, should be avoided in the detailed siting of well and other project facilities. |
| Attractive man-made elements within the landscape type to avoid; | Jimbour House occurs just outside of the project development area but possesses panoramic views across this landscape type. Siting of a large facility such as a FCF, CGPF and/or IPF close to this historic feature would adversely affect its setting and should be avoided. Similar care will be needed in siting wells, where they would be visible from and affect the setting of Jimbour as detailed below. |
| Potential for skylining to minimise impact; | The backdrop of the Bunya Mountains provides some opportunity for siting facilities against a skyline, to lower their prominence in distant views. |
| Potential prominence from locally/regionally significant viewpoints | There are significant views obtained from Jimbour House across this landscape type. This is a significant landmark and local destination, also used for wedding receptions and other social functions. FCFs, CGPFs and/or IPFs placed within the viewshed of Jimbour would have adverse visual implications. Wells within the viewshed should also be located with extreme sensitivity as a 'grid like' effect would be likely to spoil the rural ambience of the setting. |
| Impact on Visual Receptors (corridors, centres of habitation, private residences etc) | There are small towns located along the edge of this landscape type such as Jimbour and Jandowae (located just outside of project development area) and a sparse scattering of homesteads. FCFs, CGPFs and/or IPFs would need to be sited at least 1km away from these towns (ideally, significantly more) due to the relatively open character of this landscape. Views from the larger roads that traverse this landscape type such as the Dalby-Jandowae Road would need to be considered in the detailed siting of infrastructure elements to minimise the potential visibility of features from these roads. |
| Infrastructure design in relation to landscape colour, texture, line | A deep straw colour that captures the essence of the dry grassland plains that characterises much of this landscape type would probably be most effective for the FCFs, CGPFs, IPFs and production wells. |
| Ability to capitalise on existing landform and vegetation | There are some opportunities to capitalise on the undulating landform in the detailed siting of facilities, particularly wells, which may be sited in natural dips, where they will be less visible in sweeping panoramic views across the type. The landscape is largely open and existing vegetation tends to be associated with tributaries and groups of characteristic bottle trees, which are sensitive to intrusion and provide limited opportunities to provide effective screening for mimicry through new planting, due to their sparse and informal character as discussed below. |
| Potential cues for introducing screening | The tributary and groups of bottle trees are not likely to form an effective cue to screen a FCF, CGPF or IPF; although may assist in the integration of wells into the local landscape. Poplar Box and Queensland Blue Gum shelter belts alongside roads could be used as a cue to introduce selective screening of any sensitive views, where possible. In more distant views, FCFs, CGPFs and IPFs are likely to need detailed site investigation to determine if linear shelterbelt planting on the perimeter of the facility or more scattered vegetation would be most appropriate to the particular site context. |

| | |
|---|---|
| Opportunity for legacy projects (if appropriate) | There may be potential to provide indirect benefits to local communities (e.g. Jandowae) through townscape enhancements and environmental projects, to be determined in consultation with the local community. |

**Figure 23 Landscape Type F: Production Well Visualisations (unmitigated scheme and mitigated)**


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**LEGEND**

- Production Well
- Vegetation

Zone of Theoretical Visibility

- Visible
- Not Visible

# LANDSCAPE TYPE F PRODUCTION WELL: INDICATIVE ZTV BASED ON PILOT LOCATION

**Arrow Energy**
**Surat Gas Project LVIA**

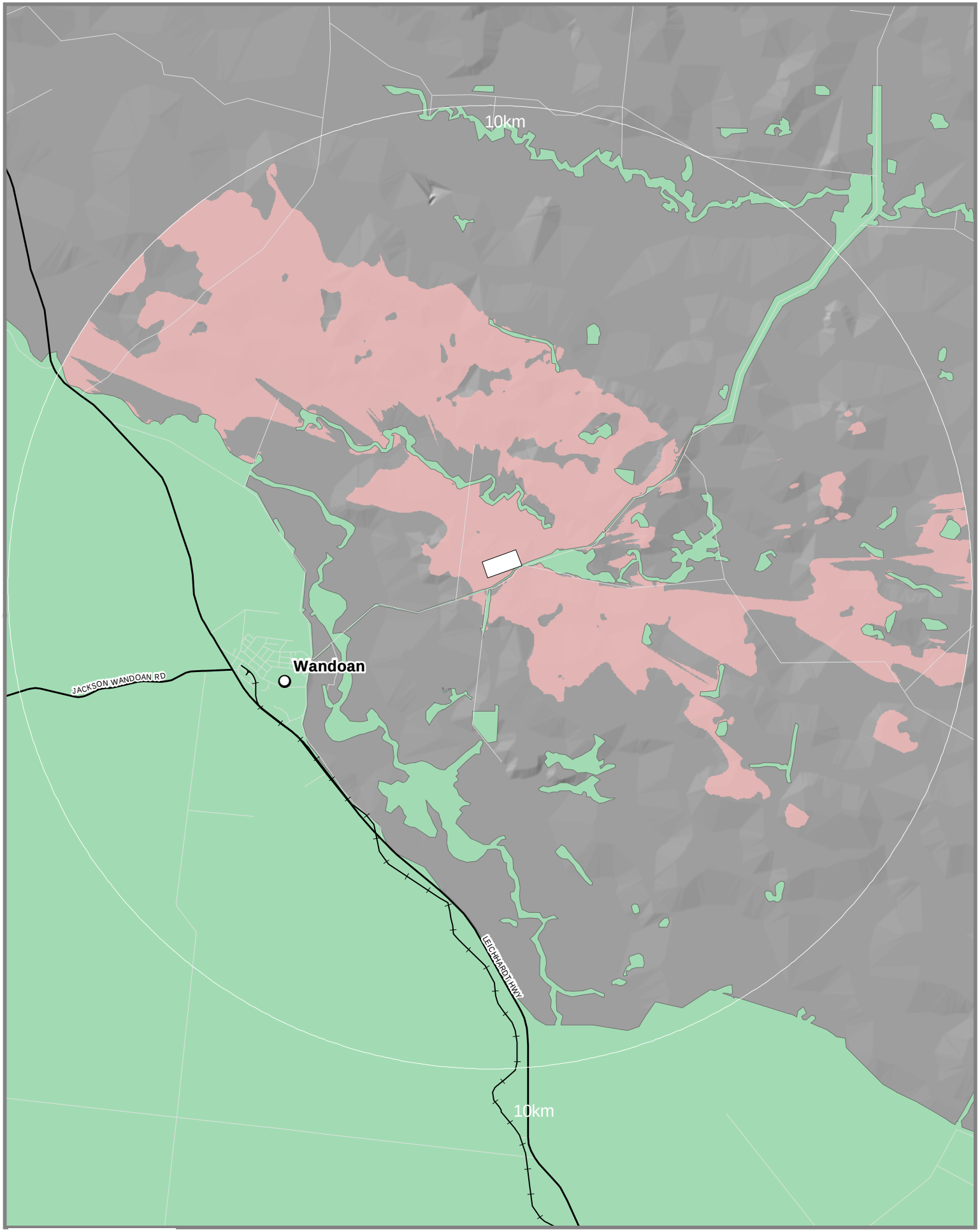
**Figure**
**F24**

| | |
|---|---|
| PROJECT ID | 09513140.01 |
| CREATED BY | GW |
| LAST MODIFIED | GW FEB 2010 |

**Figure 25 Landscape Type F: IPF Visualisations (unmitigated scheme and mitigated)**

The visualisations illustrated in **Figure 23** and **Figure 25** have been created to assist in conceiving the introduction of both IPFs and well facilities in the *Foothill Plains and Valleys* landscape type. Both the unmitigated and mitigated project have been illustrated to: i) ensure the scale and nature of the proposed infrastructure is fully understood, and ii) indicate the importance of integrating discrete mitigation measures into Arrow's standard operation procedures as noted above, albeit it is considered that there is a lower potential for mitigation to be effective than in some of the other landscape types due to the inherent openness and undulating character of the landscape.

The ZTVs illustrated in **Figure 24** and **Figure 26** have been created to assist in conceiving the approximate visibility of the above production well and surface facilities (unmitigated scheme) and IPF (unmitigated scheme) in the *Foothill Plains and Valleys* landscape type up to 2km and 10km respectively; taking into account the role of topography and some significant blocks of dense vegetation. From this point, views to the facilities are mostly dictated by the varied topography. The ZTV indicates filtered views to the well through low shrubs from a 2km radius. In addition, there would be clear views to the IPF from the north and east.

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PROJECT ID 09513140.01
CREATED BY GW
LAST MODIFIED GW FEB 2010

**LEGEND**

- IPF
- Vegetation

Zone of Theoretical Visibility

- Visible
- Not Visible

**LANDSCAPE TYPE F**
**IPF: INDICATIVE ZTV BASED ON PILOT LOCATION**

**Arrow Energy**
**Surat Gas Project LVIA**

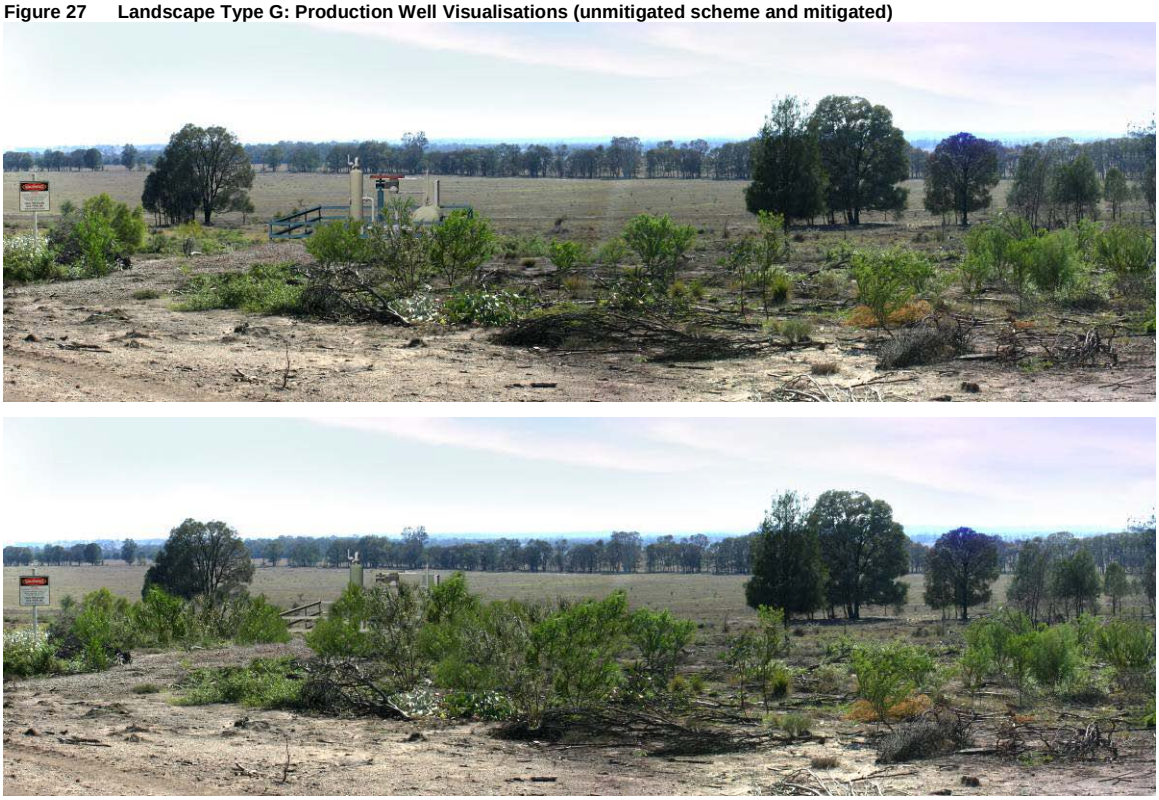
**Figure**
**F26**

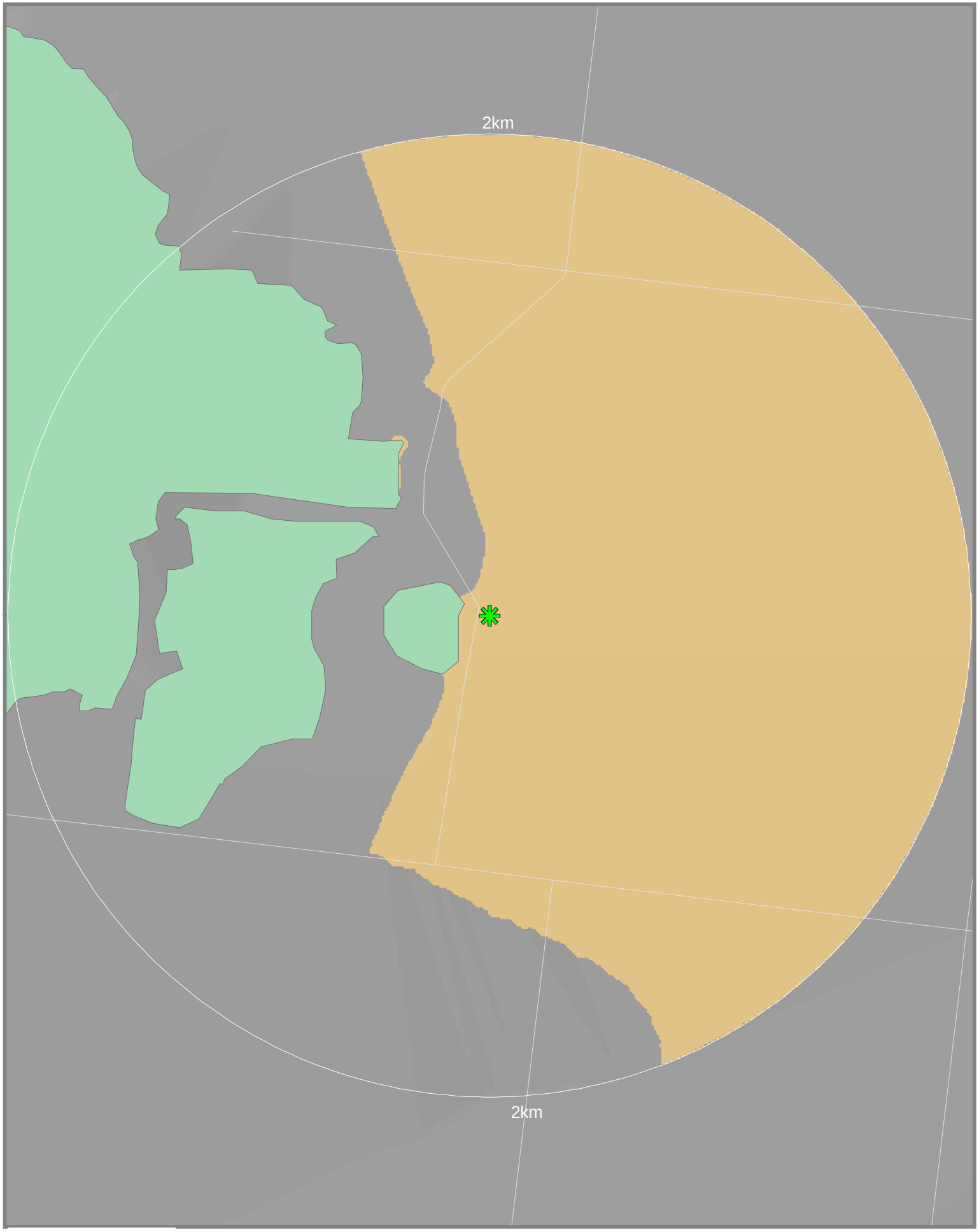
### 8.2.8 TYPE G: LOWLAND BRIGALOW PLAINS

In addition to the general mitigation measures presented in Section 8.1, the siting, scale and design of any project components in the *Lowland Brigalow Plains* landscape type will need to incorporate the following tailored mitigation measures:

| **Attribute** | **Landscape Type G: Tailored Mitigation Measure** |
|---|---|
| Unique landscape features or distinctive scenery within the type that should be avoided | No special features noted – key characteristics as per generic landscape type description to be respected. |
| Attractive man-made elements within the landscape type to avoid; | None noted. |
| Potential for skylining to minimise impact; | This landscape predominantly comprises an open character. However, adjoining landscape types have a high proportion of forests which provide opportunities to site facilities where they will be visible below the tree line. |
| Potential prominence from locally/regionally significant viewpoints | No particularly significant regional/local viewpoints are noted in this landscape type. |
| Impact on Visual Receptors (corridors, centres of habitation, private residences etc) | Due to the relative scarcity of habitation within this landscape type it should be possible to site major facilities to avoid impacts on small rural towns (Columboola and Goombi) and scattered homesteads and cottages. Site facilities to avoid views obtained from the Warrego Highway or implement detailed screening to address these impacts. |
| Infrastructure design in relation to landscape colour, texture, line | Facility colour will need to be determined in situ based upon the specific context within which the facility will be viewed. Where open scrubby grasslands predominate, the most effective colour is likely to be a muted beige colour. However, where facilities are sited against the backdrop of adjoining forested landscape types forest/dark olive greens may provide the most effective colour for integration. |
| Ability to capitalise on existing landform and vegetation | Largely flat to subtly undulating so there are few opportunities to capitalise on landform to effect visual screening through the detailed siting of facilities. The shrubby Brigalow character and shelterbelts and adjoining forested areas provide a cue for the introduction of new screening as discussed below. |
| Potential cues for introducing screening | Informal Brigalow planting could be used to assist in the integration of well facilities into the landscape. Such planting would need to follow an irregular informal character and be located alongside roads taking the form of roadside belts that would interrupt views close to the viewer (rather than necessarily around the immediate perimeter of the facility).<br><br>Remnant belts of Brigalow, Belah and Wilga would provide the context for the introduction of shelterbelts associated with the perimeter of any proposed FCF, CGPF and/or IPF. Semi-informal, scattered trees and roadside vegetation would assist in integrations. These could visually merge from a distance to effect integration but would not create a solid mass that may itself be perceived as 'artificial' in this open and scrubby landscape. Alternatively, ideally, FCFs, CGPFs and IPFs planned for this landscape type should adjoin the adjacent forested landscape types where the forested character could be logically extended out into this landscape type to provide effective screening whilst maintaining the character of open scrubland viewed against wooded backdrops. |
| Opportunity for legacy projects (if appropriate) | No particular opportunities noted, but could be determined in consultation with the affected community. |

**Figure 27 Landscape Type G: Production Well Visualisations (unmitigated scheme and mitigated)**



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**LEGEND**

- Production Well
- Vegetation

Zone of Theorectical Visibility

- Visible
- Not Visible

# LANDSCAPE TYPE G PRODUCTION WELL: INDICATIVE ZTV BASED ON PILOT LOCATION

**Arrow Energy**
**Surat Gas Project LVIA**

**Figure**

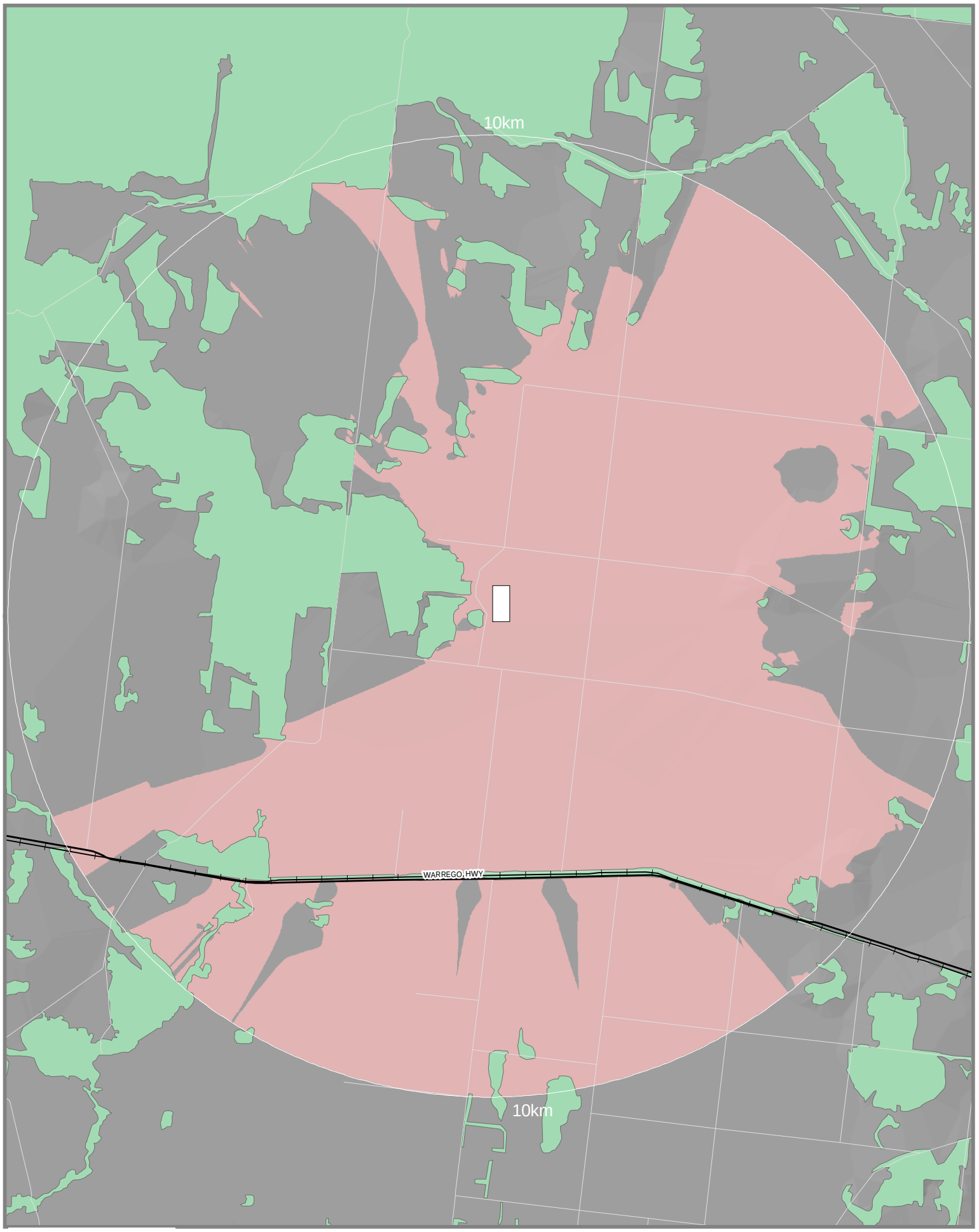
**F28**

| | |
|---|---|
| PROJECT ID | 09513140.01 |
| CREATED BY | GW |
| LAST MODIFIED | GW FEB 2010 |

**Figure 29 Landscape Type G: IPF Visualisations (unmitigated scheme and mitigated)**

The visualisations illustrated in **Figure 27** and **Figure 29** have been created to assist in conceiving the introduction of IPFs and well facilities in the *Lowland Brigalow Plains* landscape type. The visualisation represents both an unmitigated (above) and mitigated (below) project, to ensure i) the scale and nature of the proposed infrastructure is fully understood and ii) to realise the importance of adoption of appropriate mitigation measures as outlined above.

The ZTVs illustrated in **Figure 28** and **Figure 30** have been created to assist in conceiving the approximate visibility of the above production well and surface facilities (unmitigated project) and IPF (unmitigated project) in the *Lowland Brigalow Plains* landscape type up to 2km and 10km respectively; taking into account the role of topography and some significant blocks of dense vegetation. From this point, views to the facilities are mostly dictated by the varied topography and large blocks of dense vegetation. The ZTV indicates clear views to the well from the east. In addition, there would be clear views to the IPF from the north east, east and south.

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**LEGEND**

- IPF
- Vegetation

Zone of Theoretical Visibility

- Visible
- Not Visible

**LANDSCAPE TYPE G**
**IPF: INDICATIVE ZTV BASED ON PILOT LOCATION**

**Arrow Energy**
**Surat Gas Project LVIA**

**Figure**
**F30**

| | |
|---|---|
| PROJECT ID | 09513140.01 |
| CREATED BY | GW |
| LAST MODIFIED | GW FEB 2010 |

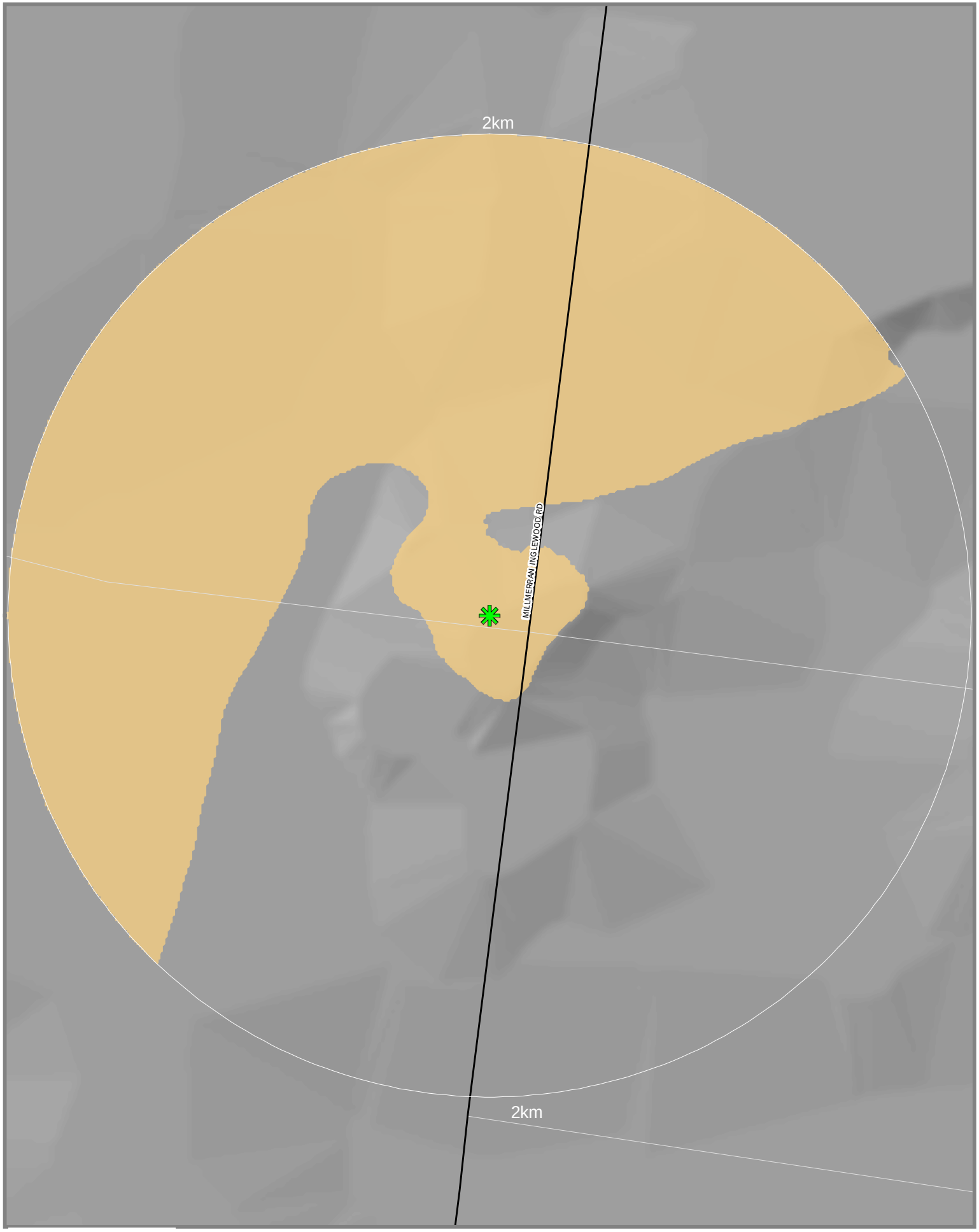
### 8.2.9 TYPE H: TERRACED BRIGALOW FARMLAND

In addition to the general mitigation measures presented in Section 8.1, the siting, scale and design of any project components in the *Terraced Brigalow Farmland* landscape type will need to incorporate the following tailored mitigation measures:

| **Attribute** | **Landscape Type H: Tailored Mitigation Measures** |
|---|---|
| Unique landscape features or distinctive scenery within the type that should be avoided | This landscape type is inherently scenic with a strong rural character and is viewed against the distinctive adjoining landscapes of *Type I: Forested Steep Hills* as described in the table for that landscape type below. Areas within this landscape that would be viewed against Type I should be avoided for the introduction of FCFs, CGPFs and IPFs. Wells and field development will need to avoid affecting the flowing and undulating quality of the terraces. |
| Attractive man-made elements within the landscape type to avoid | Nothing particularly noted. |
| Potential for skylining to minimise impact; | Whilst it would be possible to introduce facilities below the skyline of the adjacent Type I, this is not recommended due to the special character of these areas. However, the undulating character and presence of copses and some belts of trees along field boundaries would provide opportunities to site field development where they would not project above the horizon. |
| Potential prominence from locally/regionally significant viewpoints | No particularly important vantage points are noted in this landscape type. The 'Rural Getaway' scenic route passes along the Millmerran-Inglewood Road through this landscape type, and travellers along this route would have high expectations of a rural view (albeit this would already be influenced by views to the Millmerran power station). |
| Impact on Visual Receptors (corridors, centres of habitation, private residences etc) | This landscape is relatively well settled and is also visible from a relatively high concentration of roads and route-ways that are well used, including the Gore Highway and the Millmerran-Inglewood Road. Its visibility relates both to the presence of routes through the area and the potential for visual exposure due to the elevated character of much of this landscape. |
| Infrastructure design in relation to landscape colour, texture, line | Facility colour would need to be closely related to viewing context i.e. deep forest/olive greens when the facility can be implemented with a backdrop of vegetation but lighter straw-colours where cropland and grassland is likely to be the dominant viewing situation. This would need to be determined in situ using Arrow's standard colour palette that will be developed.<br><br>The smooth and sinuous line of this landscape type and the presence of contour-hugging terraces is a key characteristic. Facilities would need to respect this line, to avoid attention. For example, gathering lines should follow contours (to the greatest extent possible) particularly where contour banks/terraces have been created (in consultation with landowner, to avoid farming interruptions). Wells should be sited where they would be viewed against backdrop copses, where the horizontal flow has already been interrupted by natural vertical elements. |
| Ability to capitalise on existing landform and vegetation | Local undulations and vegetation provide some opportunities for detailed siting of field infrastructure to limit impact, although are unlikely to be effective in integrating larger infrastructure elements. |
| Potential cues for introducing screening | Extension of roadside planting provides some opportunities for integration of smaller facilities such as wells – this would need to comprise of loosely planted belts of shrubs and small trees, such as belts of Ironbark, Buloke, Cypress Pine and Poplar Box.<br><br>It would be very difficult to screen views of larger facilities (i.e. FCFs, CGPFs, IPFs) |

| | |
|---|---|
| | due to their large scale nature and sloping landform. Should these facilities need to be accommodated (i.e. for reasons that override landscape concerns) detailed consideration would be required of the specific landscape setting to create an effective planting and mitigation strategy. |
| Opportunity for legacy projects (if appropriate) | No specific opportunities have been identified, but these could be considered in consultation with the affected community. |

**Figure 31 Landscape Type H: Production Well Visualisations (unmitigated scheme and mitigated)**

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**LEGEND**

- Production Well
- Vegetation

Zone of Theoretical Visibility

- Visible
- Not Visible

# LANDSCAPE TYPE H PRODUCTION WELL: INDICATIVE ZTV BASED ON PILOT LOCATION

**Arrow Energy**
**Surat Gas Project LVIA**

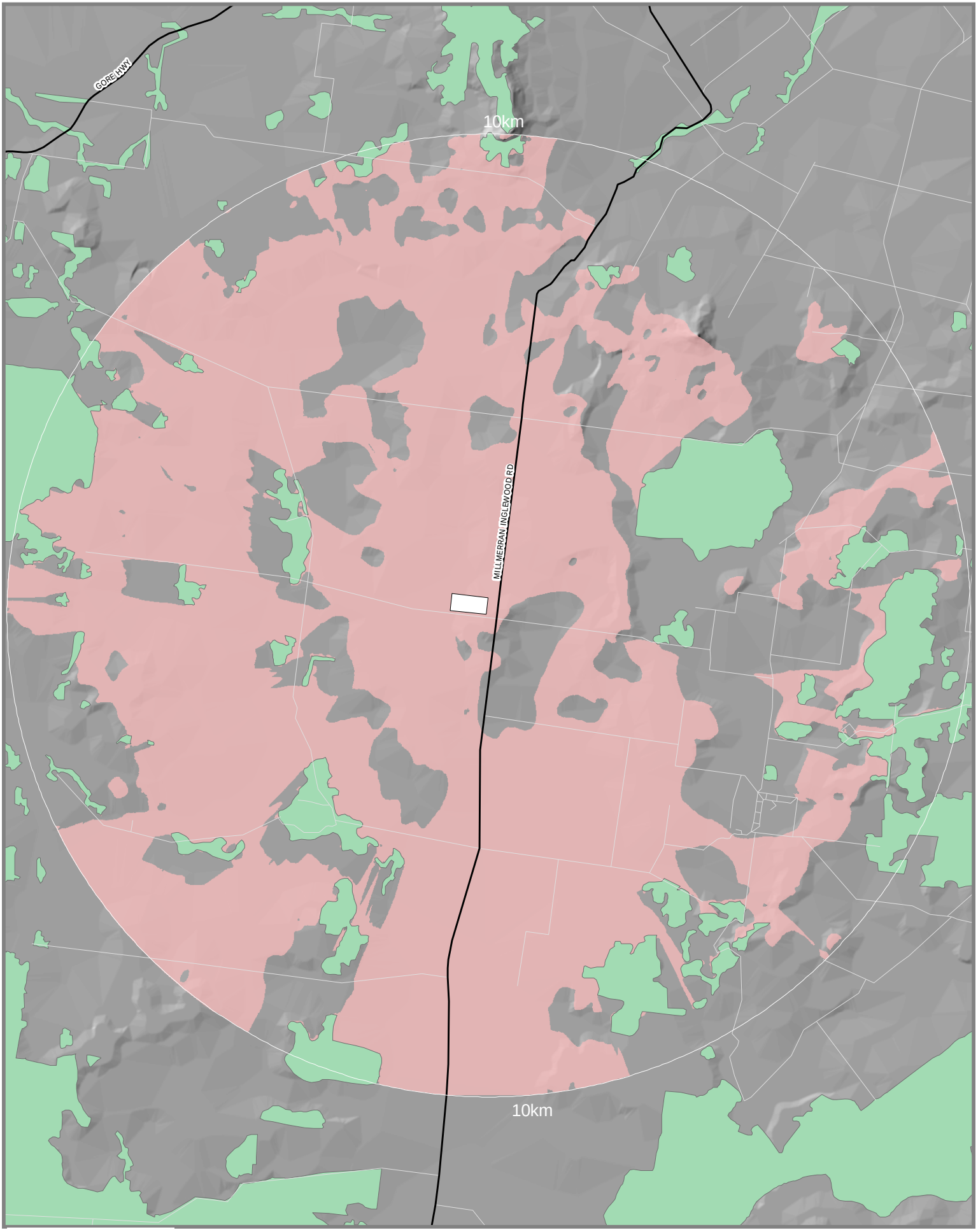
**Figure**
**F32**

| | |
|---|---|
| PROJECT ID | 09513140.01 |
| CREATED BY | GW |
| LAST MODIFIED | GW FEB 2010 |

**Figure 33 Landscape Type H: IPF Visualisations (unmitigated scheme and mitigated)**

The visualisations illustrated in **Figure 31** and **Figure 33** have been created to assist in conceiving the introduction of well facilities and in the *Terraced Brigalow Farmland* landscape type. The visualisation represents both a mitigated and unmitigated scheme, to ensure the project and nature of the proposed infrastructure is fully understood and to illustrate the potential offered by the mitigation measures considered above to assist in integrating the facility into the landscape.

The ZTVs illustrated in **Figure 32** and **Figure 34** have been created to assist in conceiving the approximate visibility of the above production well and surface facilities (unmitigated project) and IPF (unmitigated project) in the *Terraced Brigalow Farmland* landscape type up to 2km and 10km respectively; taking into account the role of topography and some significant blocks of dense vegetation. From this point, views to the facilities are mostly dictated by the varied topography, and to a lesser extent, small blocks of dense vegetation. The ZTV indicates clear views to the well from the north and west. In addition, the elevated nature of this site would allow clear views to the IPF all directions.

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**LEGEND**

- IPF
- Vegetation

Zone of Theoretical Visibility

- Visible
- Not Visible

**LANDSCAPE TYPE H**
**IPF: INDICATIVE ZTV BASED ON PILOT LOCATION**

**Arrow Energy**
**Surat Gas Project LVIA**

**Figure**
**34**

| | |
|---|---|
| PROJECT ID | 09513140.01 |
| CREATED BY | GW |
| LAST MODIFIED | GW FEB 2010 |

### 8.2.10 TYPE I: FORESTED STEEP HILLS

In addition to the general mitigation measures presented in Section 8.1, the siting, scale and design of any project components in the *Forested Steep Hills* landscape type will need to incorporate the following tailored mitigation measures:

| Attribute | Landscape Type I: Tailored Mitigation Measures |
|---|---|
| Unique landscape features or distinctive scenery within the type that should be avoided | The fundamental characteristics of this landscape type are its distinct elevated topography and forest. These are evident as a series of isolated peaks including Captains Mountain, Commodore Peak and Mount Domville, which are some of the most recognisable scenic landscape features in the study area, visually prominent from the surrounding low-lying landscape. Consequently the whole of this landscape type is considered to be of high sensitivity due to its unique landscape features and distinctive scenery. |
| Attractive man-made elements within the landscape type to avoid | None noted. |
| Potential for skylining to minimise impact | Any FCF, CGPF or IPF proposed in this landscape type would be visible on the skyline and would break the existing horizon. This is demonstrated by the presence of existing telecommunications towers on Mount Domville that have an adverse impact on rural character despite their relatively low mass and streamlined form (in contrast with a FCF, CGPF and/or IPF, which would be large and bulky). |
| Potential prominence from locally/regionally significant viewpoints | No particularly sensitive viewpoints within the landscape type are affected, although the prominence of the landscape type means that vantage points in adjacent areas are likely to be affected. |
| Impact on Visual Receptors (corridors, centres of habitation, private residences etc) | The main impact would be on views from the adjoining landscapes types e.g. Landscape Type H: Terraced Brigalow Farmland, as described above, including users of the Gore Highway. Farmsteads located in that landscape type are also likely to be affected. |
| Infrastructure design in relation to landscape colour, texture, line | Any facilities would need to recede against the forested backdrop, so dark forest/olive greens are likely to be the most effective colours. |
| Ability to capitalise on existing landform and vegetation | The steeply sloping and elevated landform in this location mean that it would be difficult to site any facility without it being visually prominent i.e. topography is a disadvantage in this context. Similarly, siting facilities within the forested landscape in this setting would create a visual scar and attract attention – whilst production wells may be capable of siting, with the forest providing some screening, although the clearing associated with the well pad and clearing zone and connecting gathering lines would be visually prominent. |
| Potential cues for introducing screening | Existing forest could provide a context within which facilities could be sited, but the clearing of vegetation to enable the facility to be constructed or, in the case of wells, to accommodate the subterranean pipelines, would leave a visual scar that could not be mitigated by planting at the periphery of the facility or on the lower slopes due to the effects of topography. Screen planting is therefore unlikely to be effective. |
| Opportunity for legacy projects | Could be determined in consultation with the local community. |

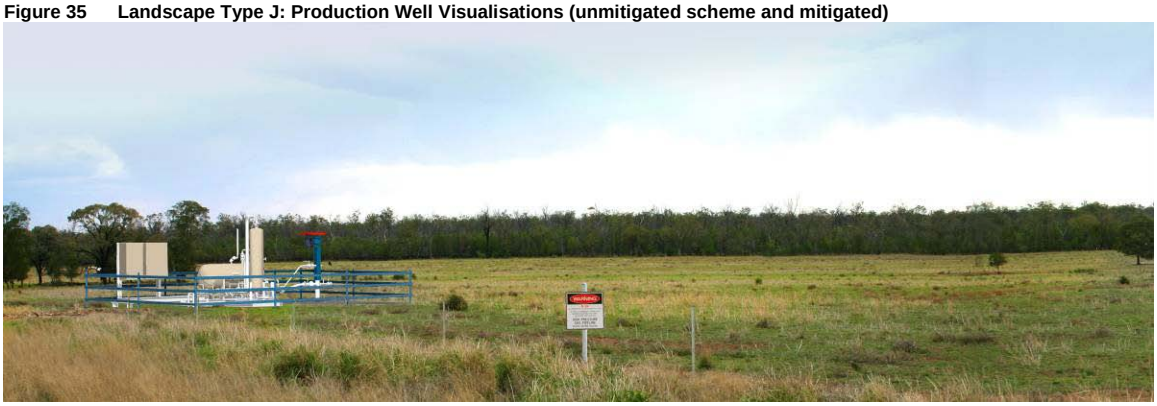
This natural steep-sided hilly landscape is highly sensitive and incongruent to the introduction of CSG infrastructure. Little or no access to this landscape for project activities is recommended; therefore, no visualisations or ZTVs have been created. If project activity must take place in this landscape (i.e. if landscape and visual sensitivities are surpassed by other demands), a separate detailed study on landscape and visual impact is strongly recommended.

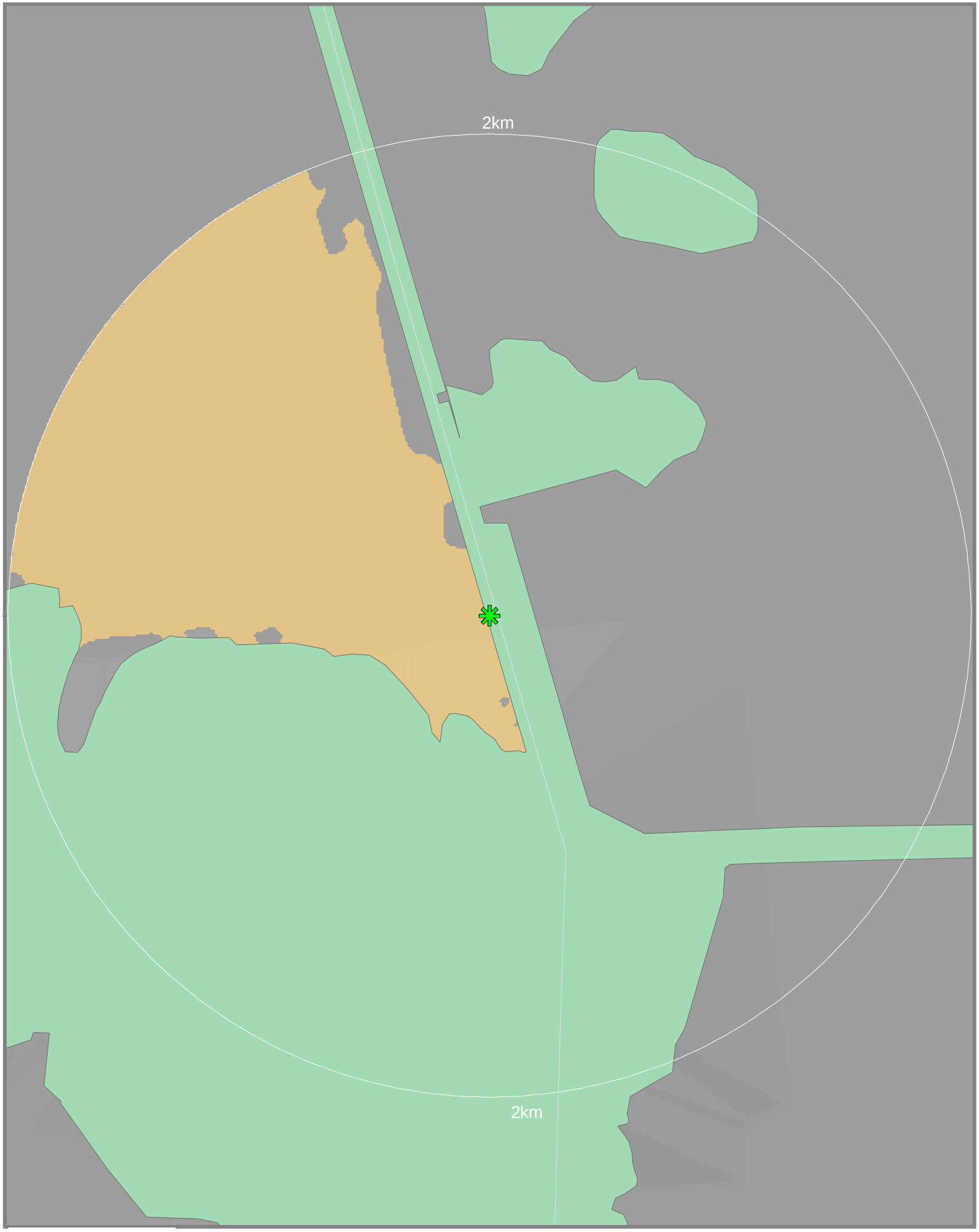
### 8.2.11 TYPE J: CHROMOSOL UNDULATING LOWLANDS

In addition to the general mitigation measures presented in Section 8.1, the siting, scale and design of any project components in the *Chromosol Undulating Lowlands* landscape type will need to incorporate the following tailored mitigation measures:

| **Attribute** | **Landscape Type J: Tailored Mitigation Measures** |
|---|---|
| Unique landscape features or distinctive scenery within the type that should be avoided | Nothing of particular concern. Local variety and interest is introduced through the shallow forested tributary streams and it would be beneficial if the character of these were maintained through the detailed facility siting process. In addition there are locally interesting patches of vegetation (grass trees) that are of visual interest and ought to be retained if practicable. |
| Attractive man-made elements within the landscape type to avoid | None noted. |
| Potential for skylining to minimise impact; | This is a low lying area, with few opportunities for skylining against an elevated backdrop. However, the adjoining landscapes comprise forest, which provide opportunities for siting facilities against. |
| Potential prominence from locally/regionally significant viewpoints | Fairly inaccessible landscape so no particularly significant vantage points have been noted. |
| Impact on Visual Receptors (corridors, centres of habitation, private residences etc) | Presence of Gore Highway and Cunningham Highways, with potential for views through a small section of this zone that will need to be considered. No towns and very few residences through this landscape type so it should be possible to undertake the detailed siting of facilities to minimise impact upon these. |
| Infrastructure design in relation to landscape colour, texture, line | Dark green or straw coloured paint would assist in the integration of facilities into their landscape context. The selection would need to be made in situ, depending on the most common viewing profile i.e. if generally against the forested backdrop, dark green would be more effective, but if against grassland a straw colour may be most effective. To be determined using Arrow's standard colour palette (to be developed). |
| Ability to capitalise on existing landform and vegetation | The flat landform provides no meaningful opportunity for detailed siting of facilities that will integrate them into the surrounding landform. The landscape is generally open. However, there are significant roadside shelterbelts and areas of Brigalow-Belah vegetation which create a context for the introduction of new vegetation areas in association with planned facilities. |
| Potential cues for introducing screening | Brigalow-Belah vegetation provides a cue for the establishment of new roadside shelterbelts etc. that could provide screening associated with the periphery of any FCF, CGPF, IPF and well compounds. Ideally, locate facilities close to the woodland edge where there is potential to establish dense blocks of new forest planting that will curtail views towards the facility. |
| Opportunity for legacy projects (if appropriate) | There may be opportunities for enhancement of recreational facilities within the state forests (working with other agencies). |

**Figure 35 Landscape Type J: Production Well Visualisations (unmitigated scheme and mitigated)**



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**LEGEND**

- Production Well
- Vegetation

Zone of Theorectical Visibility

- Visible
- Not Visible

# LANDSCAPE TYPE J PRODUCTION WELL: INDICATIVE ZTV BASED ON PILOT LOCATION

**Arrow Energy**
**Surat Gas Project LVIA**

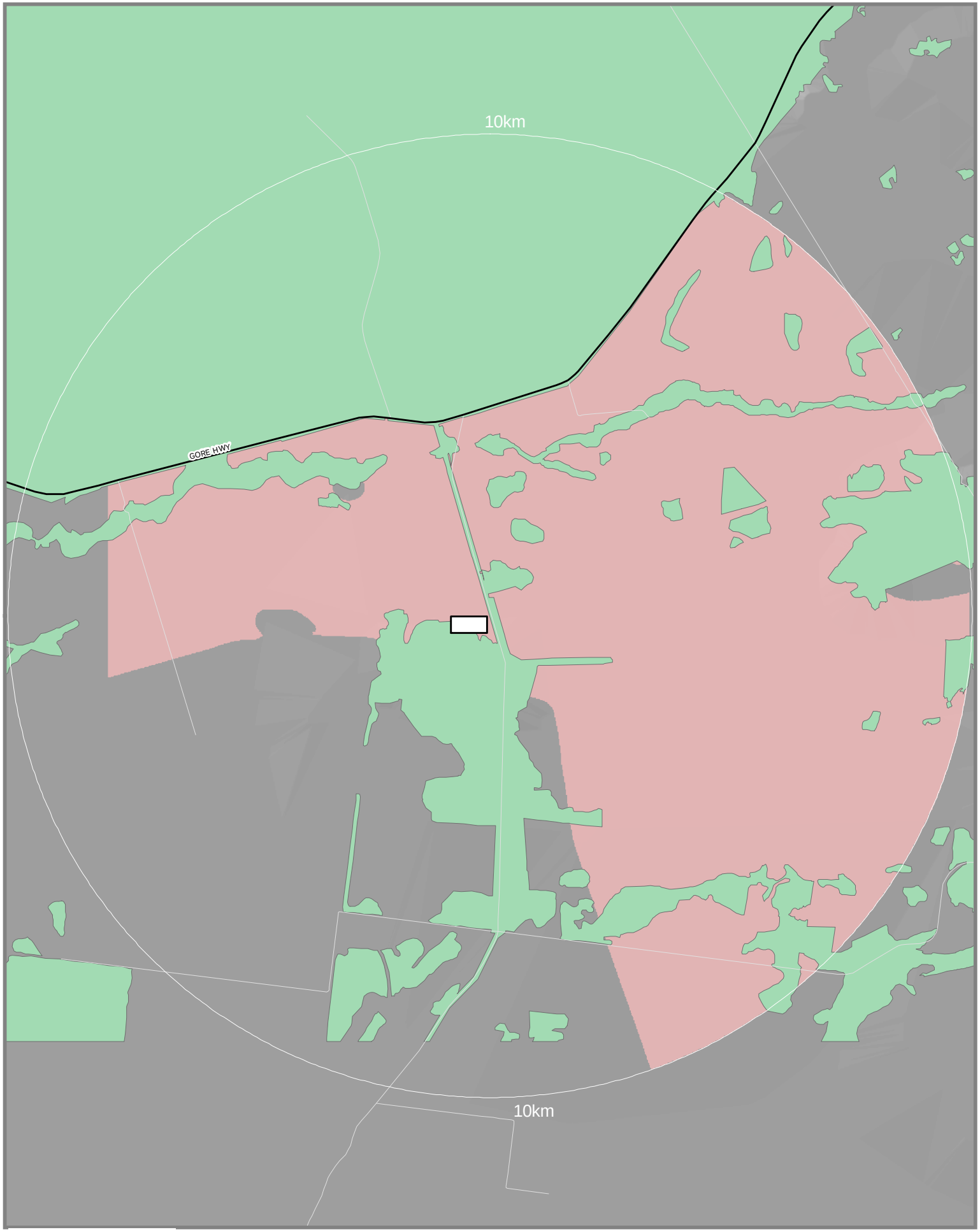
**Figure**
**F36**

| | |
|---|---|
| PROJECT ID | 09513140.01 |
| CREATED BY | GW |
| LAST MODIFIED | GW FEB 2010 |

**Figure 37 Landscape Type J: IPF Visualisations (unmitigated scheme and mitigated)**

The visualisations illustrated in **Figure 35** and **Figure 37** have been created to assist in conceiving the introduction of both field activities and IPFs in the *Chromosol Undulating Lowlands* landscape type. Both the unmitigated and mitigated project have been illustrated to: i) ensure the scale and nature of the proposed infrastructure is fully understood, and ii) indicate the viability and effectiveness of integrating the discrete mitigation measures outlined above into Arrow's standard operating procedures.

The ZTVs illustrated in **Figure 36** and **Figure 38** have been created to assist in conceiving the approximate visibility of the above production well and surface facilities (unmitigated project) and IPF (unmitigated project) in the *Chromosol Undulating Lowlands* landscape type up to 2km and 10km respectively; taking into account the role of topography and some significant blocks of dense vegetation. From this point, views to the facilities are mostly dictated by large blocks of dense vegetation, including Kerimbilla State Forest. The ZTV indicates clear views to the well from the north west. In addition, the views to the IPF would be limited to the north and east.

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**LEGEND**

- IPF
- Vegetation

Zone of Theoretical Visibility

- Visible
- Not Visible

**LANDSCAPE TYPE J**
**IPF: INDICATIVE ZTV BASED ON PILOT LOCATION**

**Arrow Energy**
**Surat Gas Project LVIA**

**Figure**
**F38**

| | |
|---|---|
| PROJECT ID | 09513140.01 |
| CREATED BY | GW |
| LAST MODIFIED | GW FEB 2010 |

# 9.0 Residual impacts

More conventional LVIAs assess the impact of a project in a fixed location during key sequential stages of construction, operation and (in some cases) decommissioning/rehabilitation. In contrast, the Surat Gas Project will involve ongoing gas exploration and progressive development of coal seam gas facilities across different geographic areas within the project development area over time. As a result, the residual impact assessment considers: i) the cumulative residual impact of the Surat Gas Project; as well as, ii) the residual impact of the project activities on each landscape character type during construction/installation, operation and maintenance, and decommissioning/rehabilitation.

## 9.1 Consideration of "whole of project" cumulative residual impact

The impact of the project will vary in intensity from location to location, depending on the availability of coal seam gas, and associated project phasing and focus of activity. There is likely to be a multitude of development activities experienced across the project development area in different stages of development (e.g. construction/installation; operation and maintenance; decommissioning and rehabilitation) over a number of years. For example, the construction/installation of each CGPF and IPF is likely to take approximately 9 to 15 months, which will occur concurrently with the development of production wells, gathering lines and FCF in the relevant development region. Construction/installation of the next planned development region will occur concurrently, or nearing the completion of the current development region. This process will continue over approximately 15 to 20 years.

The gas processing facilities (FCFs, CGPFs, IPFs) will be sized to met expected gas flows from the production wells within or nearby each development region. As the development regions reach their capacity, others will replace them. Each well will need to be "worked over" approximately every 3 years, requiring the drill-rig back on site. The project is likely to be experienced cumulatively, as the development regions will be developed concurrently over 15 to 20 years (as described in **Table 19**), rather than isolated stages of construction, operation, decommissioning activities uniform across the entire project development area. "Whole of project" impacts are particularly relevant to impacts on specific landscape character types and on kinetic view experiences i.e. those views experienced moving through a landscape, such as driving along a road.

**Table 19 Field and Facility Development Sequence**

| Year | Development Region | Facility | Total wells commissioned |
|---|---|---|---|
| **2013** | - | - | **-** |
| **2014** | Wandoan | Wandoan IPF1 | **-** |
| **2015** | Dalby/Wandoan | Dalby IPF2 | **119** |
| **2016** | Wandoan/Dalby | Wandoan CGPF1<br>Dalby IPF1 | **300** |
| | | Full length of Arrow Surat (high pressure) pipeline commissioned | |
| **2017** | Wandoan/Dalby | Wandoan CGPF2 | **490** |
| **2018** | Dalby / Wandoan / Millmerran | Dalby FCF1 | **676** |
| **2019** | Dalby/Millmerran | Dalby CGPF1<br>Millmerran FCF2 | **866** |
| **2020** | Millmerran / Wandoan / Chinchilla | Millmerran IPF1 | **970** |
| **2021** | Millmerran | Chinchilla IPF1 | **464** |
| **2022** | Chinchilla / Millmerran | Chinchilla CGPF1 | **382** |
| **2023** | Chinchilla | - | **166** |
| **2024** | Wandoan / Chinchilla / Kogan | - | **351** |
| **2025** | Millmerran | Millmerran FCF3 | **311** |
| **2026** | Millmerran | - | **305** |
| **2027** | Millmerran | - | **152** |
| **2028** | Millmerran | Millmerran CGPF1 | **440** |

| | | | |
|---|---|---|---|
| **2029** | Millmerran / Wandoan / Chinchilla | Millmerran FCF4 | **361** |
| **2030** | Chinchilla / Kogan | Millmerran FCF1 | **733** |
| **2031** | Goondiwindi | Goondiwindi IPF1 | **308** |
| **2032** | - | - | **-** |
| **2033** | Goondiwindi | Goondiwindi FCF1 | **-** |
| **2034** | - | - | **-** |
| **2035** | Goondiwindi | Goondiwindi CGPF1 | **-** |

## 9.2 Residual impact assessment on landscape character types

The nature of impacts on the landscape resource, views and visual amenity anticipated during the construction/installation phase are likely to be direct, short-term and adverse (negative). Similarly, the nature of impacts during the decommissioning and restoration phase is likely to be direct, short-term and adverse (negative). Some beneficial impacts are also anticipated (for example, regeneration of forest or pastures). Impacts during the operation and maintenance phase have been considered in the most detail, due to (i) the anticipated longevity of their impact (approximately 25 to 30 years), (ii) the greater potential to mitigate effects during this phase, and (iii) the consequential greater importance of these impacts in determining the development constraints framework. The residual impact assessment has been based on the project description (see Section 6.0) and assumes the suggested mitigation measures (see Section 8.0) have been integrated into the project; as follows:

### 9.2.1 Type A: Wooded River Valley

**Summary of anticipated impacts during construction / installation**

There is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and mobile camps (including transportation of the crew between project sites and nearby towns) and large scale machinery (and associated noise emissions) installing the project facilities in a tranquil riparian landscape. Construction activities (including excavation, trenching, drilling, earthmoving, vegetation clearance/trimming, temporary lighting) would be likely to disrupt the distinctive river valley landform, the sense of tranquillity and the high level of naturalness which comprises an intimate scale and 'organic' landscape pattern.

**Detailed summary of impacts during operation and maintenance**

Table 20 summarises the anticipated impacts on landscape character and views and visual amenity within the *Wooded River Valley* landscape.

**Table 20 Summary impact on landscape character, views and visual amenity within the *Wooded River Valley* landscape character type during operation and maintenance, and recommended development constraints framework**

| **Landscape Resource – summary impact** | | | | |
|---|---|---|---|---|
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Medium | The loss of landscape features (100m by 100m or 1ha clearing of grassland/ trees/shrubs for every production well and a 10m cleared corridor for the gathering lines and associated access tracks) and required earthworks (i.e. levelling) combined with the introduction of production wells (on an 800 m grid spacing), buried gathering systems (including frequent above ground signage) and required maintenance of project facilities (including "well workovers" every 3yrs) within this landscape would strongly contrast with its 'well-treed' character, its high level of | ***Moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |

| | | | | |
|---|---|---|---|---|
| | | naturalness and its 'organic' riparian pattern, resulting in a ***considerable*** change. The potential loss of large mature riparian trees is a particular concern. | | |
| CGPF and IPF | High | The large loss of landscape features (minimum 150,000m$^2$ clearing of grassland/ trees/shrubs per facility) and required earthworks (i.e. levelling) combined with introduction, operation and continued maintenance of a CGPF and/or IPF (requiring approximately 5 to 7 operational personnel per facility) within this riparian landscape would be highly incongruent with its intimate scale, distinctive landform, sense of tranquillity and high level of naturalness, resulting in a ***dominant*** change. | ***Major*** impact, due to the *high* degree of landscape sensitivity combined with the *dominant* change anticipated. | Development of any CGPF and/or IPF in this landscape character type triggers a ***High*** development constraints framework, due to the *major* impact anticipated. |
| FCF | High | Although the scale and massing of a FCF is substantially less than a CGPF or IPF, the introduction, operation and continued maintenance of a FCF(requiring periodic maintenance and checks from IPF or CGPF staff) would result in a moderate loss of landscape features (approximately 5,000m$^2$ clearing of grassland/ trees/shrubs) and require earthworks (i.e. levelling). This activity would be highly incongruent with the intimate scale, distinctive landform, sense of tranquillity, and high level of naturalness of this landscape, resulting in a ***considerable*** change. | ***Moderate to major*** impact, due to the *high* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Moderate*** development constraints framework, due to the *moderate to major impact* anticipated. |
| Water storage facilities | Medium | The large loss of landscape features (approximately 1-2km$^2$ of grassland/ trees/shrubs adjacent to an IPF) and required earthworks (i.e. re-grading and creation of embankments) combined with the introduction and continued maintenance of large-scale storage dams (requiring periodic maintenance from IPF staff) within this riparian landscape would be highly incongruent with its intimate scale, distinctive landform, sense of tranquillity and high level of naturalness, resulting in a ***dominant*** change. The presence of several existing engineered water storage facilities (i.e. weirs) creates some precedent, but since these are infrequent, it only reduces this type's sensitivity a small extent. | ***Moderate to major*** impact, due to the *medium* degree of landscape sensitivity combined with the *dominant* change anticipated. | ***Moderate*** development constraints framework, due to the *moderate to major impact* anticipated. |
| Depots | N/A | The proposed depots in Dalby, Miles and Millmerran would not directly affect this landscape character type. | ***N/A*** | ***N/A*** |
| **Visual Resource – summary impact** | | | | |
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Medium | Using the pilot viewpoints as an example; the proposed activities and likely affected features described above (under "landscape | ***Moderate*** impact, due to the *medium* | ***Low*** development constraints |

| | | | | |
|---|---|---|---|---|
| | | resource"), would result in a ***considerable*** change in these views, which currently contain a notable absence of human influences and scenic qualities (strong sense of naturalness and tranquillity). | degree of landscape sensitivity combined with the *considerable* change anticipated. | framework, due to the *moderate* impact anticipated. |
| CGPF and IPF | Medium | Using the pilot viewpoints as an example; the proposed activities and likely affected features described above (under "landscape resource"), would result in a ***dominant*** change in these views, which currently contain a notable absence of human influences and scenic qualities (strong sense of naturalness and tranquillity). | ***Moderate to major*** impact, due to the *medium* degree of landscape sensitivity combined with the *dominant* change anticipated. | ***Moderate*** development constraints framework, due to the *moderate to major* impact anticipated. |
| FCF | Medium | Using the pilot viewpoints as an example; the proposed activities and likely affected features described above (under "landscape resource"), would result in a ***considerable*** change in these views, which currently contain a notable absence of man-made features and scenic qualities (strong sense of naturalness and tranquillity). | ***Moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| Water storage facilities | Medium | Using the pilot viewpoints as an example; the proposed activities and likely affected features described above (under "landscape resource"), would result in a ***dominant*** change in these views, which currently contain a notable absence of man-made features and scenic qualities (strong sense of naturalness and tranquillity). | ***Moderate to major*** impact, due to the *medium* degree of landscape sensitivity combined with the *dominant* change anticipated. | ***Moderate*** development constraints framework, due to the *moderate to major* impact anticipated. |
| Depots | N/A | N/A | ***N/A*** | ***N/A*** |

**Summary of anticipated impacts during decommissioning and restoration**

At the end of the operational lifetime of each project component, the component will be decommissioned and the site will be rehabilitated; returning the landscape character, views and visual amenity within the *Wooded River Valley* largely to its pre-development surface level condition. Based on the project description (refer to Section 6.0) and assuming the suggested mitigation measures (refer to Section 8.0) are integrated into the scheme, there is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) removing the project facilities and rehabilitating sites (e.g. graded landform, spreading topsoil and seeds) in a tranquil riparian landscape. However, there are likely to be some long term positive impacts resulting from this phase, such as reinstatement of natural ecosystems. Sites affected will return to a more natural appearance over time, as the vegetation (grassland, trees and shrubs) matures, resulting in a negligible impact on the appearance of surface vegetation in the longer term. However, selected access tracks may remain in situ (as agreed) for use by the farmers/ landowners.

### 9.2.2 Type B: Settled Arable Plains

**Summary of anticipated impacts during construction / installation**

There is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual

amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) installing the project facilities in flat, open and exposed landscape. Construction activities (including excavation, trenching, drilling, earthmoving, vegetation clearance/trimming, temporary lighting) would be likely to disrupt the harmonious rural character.

**Detailed summary of impacts during operation and maintenance**

Table 21 summarises the anticipated impacts of the scheme on landscape character and views and visual amenity within the *Settled Arable Plains* landscape.

**Table 21 Summary impact on landscape character, views and visual amenity within the *Settled Arable Plains* landscape character type during operation and maintenance, and recommended development constraints framework**

| **Landscape Resource – summary impact** | | | | |
|---|---|---|---|---|
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Medium | The loss of arable farmland (100m by 100m or 1ha clearing for every production well and a 10m cleared corridor for the gathering lines and associated access tracks) combined with the introduction of production wells (on an 800 m grid spacing), buried gathering systems (including frequent above ground signage) and required maintenance of coal seam gas facilities (including "well workovers" every 3yrs) within this open exposed landscape would contrast with its harmonious rural character, resulting in a ***noticeable*** change. | ***Minor to moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| CGPF and IPF | Medium | Although the presence of large scale machinery sheds makes this landscape visually less sensitive to the introduction of similar scale buildings; the potential loss of arable farmland (minimum 150,000m$^2$ for each facility) and required earthworks (i.e. re-grading of land) combined with introduction, operation and continued maintenance of a CGPF and/or IPF (requiring approximately 5 to 7 operational personnel per facility) within this open exposed landscape would contrast with its harmonious rural character, resulting in a ***noticeable*** change. | ***Minor to moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| FCF | Medium | Although the scale and massing of a FCF is substantially less than a CGPF or IPF, the introduction, operation and continued maintenance of a FCF (requiring periodic maintenance and checks from IPF or CGPF staff) would result in a moderate loss of landscape features (approximately 5,000m$^2$ of grassland/ trees/shrubs) and require earthworks (i.e. levelling). This activity within this open exposed landscape would contrast with its harmonious rural character, resulting in a ***noticeable*** change. | ***Minor to moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| Water storage facilities | Low | Assuming the proposed dams take on a similar character (i.e. general size, shape, embankment height/slope) to existing 'ring tanks' in this landscape, the anticipated | ***Minor*** impact, due to the *medium* degree of landscape | ***Low*** development constraints framework, |

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| | | degree of change would be ***imperceptible***. | sensitivity combined with the *imperceptible* change anticipated. | due to the *minor* impact anticipated. |
| Depots | Low | Assuming the depots will be located in zoned industrial precincts in Dalby and Millmerran, the introduction of a new depot in Millmerran and the expansion of the existing Dalby Depot is anticipated to result in an ***imperceptible change*** | ***Minor to not significant*** impact, due to the *low* degree of landscape sensitivity combined with the *imperceptible* change anticipated. | ***Low*** development constraints framework, due to the *minor to not significant* impact anticipated. |
| **Visual Resource – summary impact** | | | | |
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Medium | Although the structured, regular landscape pattern and precedent infrastructure elements (including water extraction) makes it visually less sensitive to introduction of rigid linear elements such as field gas and water gathering systems; the proposed activities and likely affected features described above (under “landscape resource”) would result in a ***noticeable*** change in the pilot/representative viewpoints, which currently comprise a flat, open and exposed character. | ***Minor to moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| CGPF and IPF | Medium | Using the pilot viewpoints as an example; the proposed activities and likely affected features described above (under “landscape resource”) would result in a ***considerable*** change in these views, which currently contain a flat, open and exposed character with a notable absence of vertical intrusions. Of particular concern is the potential loss of productive arable land, access to the CGPF and/or IPF (notable increase of day to day traffic along rural roads) and associated detraction of the harmonious rural character, which is valued and celebrated by local communities and visitors. | ***Moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| FCF | Medium | Although the scale and massing of a FCF is substantially less than a CGPF or IPF, the introduction of a FCF in would result in a ***considerable*** change in these views, which currently contain a flat, open and exposed character with a notable absence of vertical intrusions. The above concerns (listed under the CGPF and IPF) also relate to the introduction of a FCF. | ***Moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |

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| Water storage facilities | Medium | Using the pilot viewpoints as an example; the proposed activities and likely affected features described above (under "landscape resource") would result in a ***noticeable*** change in these views, which currently contain a flat, open and exposed character albeit some precedent 'ring tanks'. | ***Minor to moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| Depots | Low | The introduction of a new depot in Millmerran and the expansion of the existing Dalby Depot will be in context with an area / precinct containing land use and buildings of similar scale and character; therefore result in an ***imperceptible change*** | ***Minor to not significant*** impact, due to the *low* degree of landscape sensitivity combined with the *imperceptible* change anticipated. | ***Low*** development constraints framework, due to the *minor to not significant* impact anticipated. |

**Summary of anticipated impacts during decommissioning and restoration**

At the end of the operational lifetime of each coal seam gas component, the component will be decommissioned and the site will be rehabilitated; returning the landscape character, views and visual amenity within the *Settled Arable Plains* largely to its pre-development surface level condition. Based on the project description and assuming the suggested mitigation measures are integrated into the scheme, there is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) removing the coal seam gas facilities and rehabilitating sites (e.g. graded landform, spreading topsoil and seeds) in a flat, open and exposed landscape. However, there are likely to be some long term positive impacts resulting from this phase, such as return of the arable landscape in a workable condition. Sites affected will return to a more rural appearance over time, as the vegetation (crops, grassland, trees and shrubs) matures, resulting in a negligible impact on the appearance of surface vegetation in the longer term. However, selected access tracks may remain in situ (as agreed) for use by the farmers/ landowners.

### 9.2.3 Type C: Sodic Transitional Pastures

**Summary of anticipated impacts during construction / installation**

There is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) installing the coal seam gas facilities in a tranquil riparian landscape. Construction activities (including excavation, trenching, drilling, earthmoving, vegetation clearance/trimming, temporary lighting) would be likely to disrupt the moderate sense of remoteness in this rural landscape.

### Detailed summary of impacts during operation and maintenance

**Table 22 Summary impact on landscape character, views and visual amenity within the *Sodic Transitional Pastures* landscape character type during operation and maintenance, and recommended development constraints framework**

| **Landscape Resource – summary impact** | | | | |
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| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Low | Although this landscape contains precedent coal seam gas facilities (production wells, access tracks and gathering lines); the additional introduction of field development and required maintenance (including "well workovers") combined with the further loss of landscape features (100m by 100m or 1h clearing of grassland/ trees/shrubs for every production well and a 10m cleared corridor for the gathering lines and associated access tracks) and required earthworks (i.e. levelling) within this landscape would influence its small-scale rural character with a moderate sense of remoteness, resulting in a ***noticeable*** change. | ***Minor*** impact, due to the *low* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor* impact anticipated. |
| CGPF and IPF | Low | Although this landscape contains precedent large-scale buildings (e.g. farm sheds); the introduction, operation and continued maintenance of a CGPF and/or IPF (requiring approximately 5 to 7 operational personnel per facility) combined with the large loss of landscape features (minimum 150,000$m^2$ clearing of grassland/ trees/shrubs for each facility) and required earthworks (i.e. levelling) within this rural landscape would contrast with its small-scale character and influence its moderate sense of remoteness, resulting in a ***considerable*** change overall. | ***Minor to moderate*** impact, due to the *low* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| FCF | Low | Although the scale and massing of a FCF is substantially less than a CGPF or IPF, the introduction, operation and continued maintenance of a FCF (requiring approximately 5,000$m^2$ of grassland/ trees/shrubs and periodic maintenance and checks from IPF or CGPF staff) would contrast with its small-scale rural character, resulting in a ***considerable*** change. | ***Minor to moderate*** impact, due to the *low* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| Water storage facilities | Medium | The large loss of landscape features (approximately 1-2$km^2$ of grassland/ trees/shrubs adjacent to an IPF) and required earthworks (i.e. re-grading and creation of embankments) combined with the introduction and continued maintenance of large-scale storage dams (requiring periodic maintenance from IPF staff) within this rural landscape would be contrast with its small scale character and high degree of variation of land cover and landform; resulting in a | ***Moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |

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| | | ***considerable*** change. | | |
| Depots | N/A | The proposed depots in Dalby, Miles and Millmerran will not directly affect this landscape character type. | ***N/A*** | ***N/A*** |
| **Visual Resource – summary impact** | | | | |
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Low | Using the pilot viewpoints as an example; the proposed activities and likely affected features described above (under "landscape resource") would result in a ***noticeable*** change in these views. The high degree of variation of land cover and landform (i.e. more opportunity for visual mitigation), as well as the precedent for coal seam gas facilities near Tipton (production wells, access tracks and signage) reduces this type's sensitivity. | ***Minor*** impact, due to the *low* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor* impact anticipated. |
| CGPF and IPF | Low | Using the pilot viewpoints as an example; the proposed CGPF and IPF components, activities and likely affected features described above (under "landscape resource") would result in a ***considerable*** change in these views, which currently comprise a rural character and a moderate strong sense of remoteness. The presence of large-scale large sheds (e.g. farm machinery sheds, Grassdale feedlot) creates some precedent, but since these are infrequent, it only reduces this type's sensitivity a small extent. | ***Minor to moderate*** impact, due to the *low* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| FCF | Low | Using the pilot viewpoints as an example; the proposed FCF components, activities and likely affected features described above (under "landscape resource") would result in a ***considerable*** change in these views, which currently comprise a rural character and a moderate strong sense of remoteness. | ***Minor to moderate*** impact, due to the *low* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| Water storage facilities | Low | Using the pilot viewpoints as an example; the proposed activities and likely affected features described above (under "landscape resource") would contrast with the high degree of variation of land cover and landform which contain a notable absence of precedent engineered water storage facilities (such as irrigation 'ring tanks'); resulting in a ***considerable*** change in these views. | ***Minor to moderate*** impact, due to the *low* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| Depots | N/A | N/A | ***N/A*** | ***N/A*** |

**Summary of anticipated impacts during decommissioning and restoration**

At the end of the operational lifetime of each coal seam gas component, the component will be decommissioned and the site will be rehabilitated; returning the landscape character, views and visual amenity within the *Sodic*

*Transitional Pastures* largely to its pre-development surface level condition. Based on the project description and assuming the suggested mitigation measures are integrated into the scheme, there is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) removing the coal seam gas facilities and rehabilitating sites (e.g. graded landform, spreading topsoil and seeds) in a rural landscape. However, there are likely to be some long term positive impacts resulting from this phase, such as creation of new vegetated areas. Sites affected will return to a more natural appearance over time, as the vegetation (grassland, trees and shrubs) matures, resulting in a negligible impact on the appearance of surface vegetation in the longer term. However, selected access tracks may remain in situ (as agreed) for use by the farmers/ landowners.

### 9.2.4 Type D: Lowland Native Forest

**Summary of anticipated impacts during construction / installation**

There is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) installing the coal seam gas facilities in this sparsely settled forested landscape. Construction activities (including excavation, trenching, drilling, earthmoving, vegetation clearance/trimming, temporary lighting) would be likely to disrupt the strong sense of remoteness and the high level of naturalness, as well as fragment the sense of visual continuity provided by the dense forest.

**Detailed summary of impacts during operation and maintenance**

Table 23 summarises the anticipated impacts of the scheme on landscape character and views and visual amenity within the *Lowland Native Forest* landscape.

**Table 23 Summary impact on landscape character, views and visual amenity within the *Lowland Native Forest* landscape character type during operation and maintenance, and recommended development constraints framework**

| **Landscape Resource – summary impact** | | | | |
|---|---|---|---|---|
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Low | Although this landscape contains precedent coal seam gas field development (i.e. production wells, gathering lines, access tracks, signage); the additional introduction of coal seam gas field development and required maintenance of coal seam gas facilities (including "well workovers" every 3yrs) combined with the additional loss of landscape features (100m by 100m or 1h clearing of native grasses/ trees/shrubs for every production well and a 10m cleared corridor for the gathering lines and associated access tracks) and required earthworks (i.e. levelling) within this forested landscape, would further impinge its perceived sense of naturalness and remoteness, resulting in a ***noticeable*** change. The fragmentation of forest habitat (including mature native trees and shrubs) is of particular concern. | ***Minor*** impact, due to the *medium* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor* impact anticipated. |
| CGPF and IPF | Medium | Although this landscape contains precedent coal seam gas facilities (including CGPF and/or IPF development), the additional introduction, operation and continued | ***Moderate*** impact, due to the *medium* degree of | ***Low*** development constraints framework, |

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| | | maintenance of a CGPF and/or IPF (requiring approximately 5 to 7 operational personnel per facility) combined with the large loss of landscape features (minimum 150,000m$^2$ clearing of grassland/ trees/shrubs for each facility) and required earthworks (i.e. levelling) within this forested landscape would further impinge its perceived sense of naturalness and remoteness, resulting in a ***considerable*** change. The large scale loss of forest habitat (including mature native trees and shrubs) is of particular concern. | landscape sensitivity combined with the *considerable* change anticipated. | due to the *moderate* impact anticipated. |
| FCF | Medium | Although the scale and massing of a FCF is substantially less than a CGPF or IPF, the introduction, operation and continued maintenance of a FCF (requiring periodic maintenance from IPF or CGPF staff) within this forested landscape would further impinge its perceived sense of naturalness and remoteness, resulting in a ***considerable*** change. | ***Moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| Water storage facilities | Medium | Although this landscape contains precedent coal seam gas water storage facilities, the additional introduction of and continued maintenance of large-scale storage dams (requiring periodic maintenance) combined with the large loss of landscape features (approximately 1-2km$^2$ of grassland/ trees/shrubs adjacent to an IPF) and required earthworks (i.e. re-grading and creation of embankments) within this forested landscape would further impinge its perceived sense of naturalness and remoteness, resulting in a ***considerable*** change. The large scale loss of forest habitat (including mature native trees and shrubs) is of particular concern. | ***Moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| Depots | Low | Assuming the new depot at Miles will be located in zoned industrial precinct containing land use and buildings of similar scale and character, the anticipated change will be ***imperceptible*** | ***Minor to not significant*** impact, due to the *low* degree of sensitivity combined with the *imperceptible* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| **Visual Resource – summary impact** | | | | |
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Medium | Although the further introduction of the proposed activities described above (under “landscape resource”) would result in the additional loss of landscape features also described above; the flat landform and the | ***Minor*** impact, due to the *medium* degree of landscape sensitivity | ***Low*** development constraints framework, due to the |

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| | | presence of forest makes it visually contained from the wider landscape; resulting in an ***imperceptible*** change in these views overall. | combined with the *imperceptible* change anticipated. | *minor* impact anticipated. |
| CGPF and IPF | Medium | Although the pilot viewpoints illustrate the sense of visual containment afforded in this landscape by its flat landform and dense forest; the scale and nature of the proposed activities described above (under "landscape resource") would result in further loss of landscape features also described above and contrast with the visual character of this landscape; resulting in a ***noticeable*** change in these views. The presence of existing coal seam gas facilities (i.e. at Daandine and Kogan North) creates some precedent, but since these are infrequent across the entire landscape character type, it only reduces this type's sensitivity a small extent. | ***Minor to moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| FCF | Medium | Although the scale and massing of a FCF is substantially less than a CGPF or IPF, the introduction of a FCF in would still result in a considerable loss of landscape features (described above) and contrast with the visual character of this landscape; resulting in a ***noticeable*** change in these views. | ***Minor to moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| Water storage facilities | Medium | Although the pilot viewpoints illustrate the sense of visual containment afforded in this landscape by its flat landform and dense forest; the scale and nature of the proposed activities described above (under "landscape resource") would result in further large loss of landscape features also described above and contrast with the visual character of this landscape; resulting in a ***noticeable*** change in these views. The presence of several existing engineered water storage facilities (i.e. existing dams associated with Daandine and Kogan North coal seam gas projects) creates some precedent, but since these are infrequent across the entire landscape character type, it only reduces this type's sensitivity a small extent. | ***Minor to moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| Depots | Low | The introduction of a new depot in Miles will be in context with an area / precinct containing land use and buildings of similar scale and character; therefore result in an ***imperceptible change*** | ***Minor to not significant*** impact, due to the *low* degree of sensitivity combined with the *imperceptible* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |

**Summary of anticipated impacts during decommissioning and restoration**

At the end of the operational lifetime of each coal seam gas component, the component will be decommissioned and the site will be rehabilitated; returning the landscape character, views and visual amenity within the *Lowland Native Forest* largely to its pre-development surface level condition, over time. Based on the project description and assuming the suggested mitigation measures are integrated into the scheme, there is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) removing the coal seam gas facilities and rehabilitating sites (e.g. graded landform, spreading topsoil and seeds) in a native forest landscape. However, there are likely to be some long term positive impacts resulting from this phase, such as management and restoration of natural ecosystems. Sites affected will return to a more natural appearance over time, as the vegetation (native grasses, trees and shrubs) matures, resulting in a negligible impact on the appearance of surface vegetation in the longer term. However, selected access tracks may remain in situ (as agreed) for use by the landowners.

### 9.2.5 Type E: Elevated Native Forest

**Summary of anticipated impacts during construction / installation**

There is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) installing the project facilities in this elevated sparsely settled forested landscape. Construction activities (including excavation, trenching, drilling, earthmoving, vegetation clearance/trimming, temporary lighting) would be likely to disrupt the strong sense of remoteness, the high level of naturalness and the sense of visual continuity provided by the dense forest, which provides a visual backdrop to the wider landscape.

**Detailed summary of impacts during operation and maintenance**

Table 24 summarises the anticipated impacts of the scheme on landscape character and views and visual amenity within the *Elevated Native Forest* landscape.

**Table 24 Summary impact on landscape character, views and visual amenity within the *Elevated Native Forest* landscape character type during operation and maintenance, and recommended development constraints framework**

| **Landscape Resource – summary impact** | | | | |
|---|---|---|---|---|
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Medium | The introduction of production wells, gathering systems (including frequent above ground signage) and required maintenance of coal seam gas facilities (including "well workovers" every 3yrs) combined with the loss of landscape features (requiring approximately 100m by 100m or 1h clearing of grassland/ trees/shrubs for each production well and a 10m cleared corridor the gathering lines and access tracks) and required earthworks (i.e. levelling) within this forested landscape would influence its perceived sense of naturalness, remoteness and visual continuity, resulting in a ***noticeable*** change. The fragmentation of forest habitat (including mature native trees and shrubs) is of particular concern. | ***Minor to moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| CGPF and IPF | Medium | The introduction, operation and continued maintenance of a CGPF and/or IPF (requiring approximately 5 to 7 operational personnel per facility) combined with the large loss of | ***Moderate*** impact, due to the *medium* degree of | ***Low*** development constraints framework, |

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| | | landscape features (minimum 150,000m$^2$ clearing of grassland/ trees/shrubs) and required earthworks (i.e. re-grading and levelling) within this elevated forest landscape would impinge its perceived sense of naturalness, remoteness and fragment its sense of visual continuity, resulting in a ***considerable*** change. The large scale loss of forest habitat (including mature native trees and shrubs) is of particular concern. | landscape sensitivity combined with the *considerable* change anticipated. | due to the *moderate* impact anticipated. |
| FCF | Medium | Although the scale and massing of a FCF is substantially less than a CGPF or IPF, the introduction, operation and continued maintenance of a FCF (requiring periodic maintenance from IPF or CGPF staff) within this forested landscape would further impinge its perceived sense of naturalness, remoteness and fragment its sense of visual continuity, resulting in a ***considerable*** change. | ***Moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| Water storage facilities | High | The substantial loss of landscape features (approximately 1-2km$^2$ clearing of grassland/ trees/shrubs) and earthworks (i.e. re-grading and creation of embankments) required for the introduction of large-scale storage dams (requiring periodic maintenance) within this elevated forested landscape, would result in a ***considerable*** change to the inherent character of this landscape (which comprises a high level of perceived naturalness, remoteness and visual continuity). The large scale loss of forest habitat (including mature native trees and shrubs) is of particular concern. | ***Moderate to major*** impact, due to the *high* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Moderate*** development constraints framework, due to the *moderate to major* impact anticipated. |
| Depots | N/A | The proposed depots in Dalby, Miles and Millmerran would not directly affect this landscape character type. | ***N/A*** | ***N/A*** |
| **Visual Resource – summary impact** | | | | |
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Medium | Although the scale of the proposed production wells are likely to be visually contained within this densely forested landscape; the introduction of access tracks and gathering systems (including frequent above ground signage and adjacent access tracks for required maintenance) would result in the loss of corridors of landscape features (i.e. 10m cleared corridor of grassland/ trees/shrubs); resulting in a ***noticeable*** change in views overall. | ***Minor to moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| CGPF and IPF | Medium | Using the pilot viewpoint as an example; the proposed activities and likely affected features described above (under “landscape resource”) would likely result in a ***noticeable*** change in views to and from this landscape (which | ***Minor to moderate*** impact, due to the *medium* degree of | ***Low*** development constraints framework, due to the |

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| | | provides a prominent forested backdrop to the wider landscape). The large scale loss of forest habitat (minimum 150,000m$^2$ block clearing of mature native trees and shrubs) is of particular concern, visually, as this may be clearly visible from extensive lowland areas. | landscape sensitivity combined with the *noticeable* change anticipated. | *minor to moderate* impact anticipated. |
| FCF | Medium | Although the scale and massing of a FCF is substantially less than a CGPF or IPF, the introduction of a FCF in would still result in a considerable loss of landscape features (described above) and contrast with the visual character of this landscape; resulting in a ***noticeable*** change in these views. | ***Minor to moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| Water storage facilities | Medium | The substantial loss of landscape features (described above) and earthworks (i.e. re-grading and creation of embankments) required for the introduction of large-scale storage dams (requiring frequent access for periodic checks), would likely result in a ***noticeable*** change in views to and from this landscape (which provides a prominent forested backdrop to the wider landscape). | ***Minor to moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| Depots | N/A | N/A | ***N/A*** | ***N/A*** |

**Summary of anticipated impacts during decommissioning and restoration**

At the end of the operational lifetime of each coal seam gas component, the component will be decommissioned and the site will be rehabilitated; returning the landscape character, views and visual amenity within the *Elevated Native Forest* largely to its pre-development surface level condition, over time. Based on the project description and assuming the suggested mitigation measures are integrated into the scheme, there is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) removing the coal seam gas facilities and rehabilitating sites (e.g. graded landform, spreading topsoil and seeds) in an elevated native forest landscape. However, there are likely to be some long term positive impacts resulting from this phase, such as restoration and reinstatement of natural ecosystems. Sites affected will return to a more natural appearance over time, as the vegetation (native grasses, trees and shrubs) matures, resulting in a negligible impact on the appearance of surface vegetation in the longer term. However, selected access tracks may remain in situ (as agreed) for use by the landowners.

### 9.2.6 Type F: Foothill Plains and Valleys

**Summary of anticipated impacts during construction / installation**

There is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) installing the coal seam gas facilities in this sparsely settled rural landscape. Construction activities (including excavation, trenching, drilling, earthmoving, vegetation clearance/trimming, temporary lighting) would be likely to disrupt the perceived rural character, the sense of tranquillity and remoteness, and the long distant views with strong skylines.

### Detailed summary of impacts during operation and maintenance

Table 25 summarises the anticipated impacts of the scheme on landscape character and views and visual amenity within the *Foothill Plains and Valleys* landscape.

**Table 25 Summary impact on landscape character, views and visual amenity within the *Foothill Plains and Valleys* landscape character type during operation and maintenance, and recommended development constraints framework**

| **Landscape Resource – summary impact** | | | | |
|---|---|---|---|---|
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Medium | The loss of landscape features (100m by 100m or 1h of grassland/ trees/shrubs for every production well and a 10m open corridor for the gathering lines and associated access tracks) and required earthworks (i.e. levelling) combined with the introduction of production wells (on an 800 m grid spacing), gathering systems (including frequent above ground signage) and required maintenance of coal seam gas facilities and "well workovers" every 3yrs within this landscape would strongly contrast with its sparsely settled character, and its high level of remoteness and tranquillity, resulting in a ***noticeable*** change. | ***Minor to moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| CGPF and IPF | High | The large loss of landscape features (minimum 150,000m$^2$ clearing of grassland/ trees/shrubs) and required earthworks (i.e. levelling) combined with introduction, operation and continued maintenance of a CGPF and/or IPF (requiring approximately 5 to 7 operational personnel per facility) within this fairly open, sparsely settled landscape would impinge some long distance views with notable 'un-built' skylines, and detract from the high level of remoteness and tranquillity, resulting in a ***considerable*** change overall. | ***Moderate to major*** impact, due to the *high* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Moderate*** development constraints framework, due to the *moderate to major* impact anticipated. |
| FCF | High | Although the scale and massing of a FCF is substantially less than a CGPF or IPF, the introduction (requiring approximately 5,000m$^2$ clearing of grassland/ trees/shrubs), operation and continued maintenance of a FCF (requiring periodic maintenance and checks from IPF or CGPF staff) within this fairly open, sparsely settled rural landscape would contrast with its remote and tranquil character, resulting in a ***noticeable*** change. | ***Moderate*** impact, due to the *high* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *moderate to major* impact anticipated. |
| Water storage facilities | High | The introduction and continued maintenance of large-scale storage dams (requiring periodic maintenance) combined with the required earthworks (i.e. creation of embankments) and associated substantial loss of landscape features (approximately 1-2km$^2$ clearing of grassland/ trees/shrubs) within this landscape, would be incongruent with its smoothly rolling landform (which has little precedence for such highly engineered water storage facilities); resulting in a | ***Moderate to major*** impact, due to the *high* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Moderate*** development constraints framework, due to the *moderate to major* impact anticipated. |

| | | | | |
|---|---|---|---|---|
| | | ***considerable*** change overall. | | |
| Depots | N/A | The proposed depots in Dalby, Miles and Millmerran would not directly affect this landscape character type. | ***N/A*** | ***N/A*** |
| **Visual Resource – summary impact** | | | | |
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Medium | Using the pilot viewpoints as an example; the proposed activities and likely affected features described above (under "landscape resource") would contrast with its smoothly rolling landform (which has little precedence for rigid linear man-made features); resulting in a ***noticeable*** change overall. | ***Minor to moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| CGPF and IPF | Medium | Using the pilot viewpoints as an example; the proposed activities and likely affected features described above (under "landscape resource") would result in a ***considerable*** change in views, which currently contain a notable 'un-built' skyline and scenic qualities (strong sense of remoteness and tranquillity). The potential disturbance of views from and to the Bunya mountains as well as intrusions to expansive southerly views from Jimbour House and front gardens (historic and cultural landmark), is of particular concern. | ***Moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| FCF | Medium | Although the scale and massing of a FCF is substantially less than a CGPF or IPF, the introduction of a FCF in would result in a ***considerable*** change in these views, which which currently contain a notable 'un-built' skyline and scenic qualities. The above concerns (listed under the CGPF and IPF) also relate to the introduction of a FCF. | ***Moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| Water storage facilities | Medium | Using the pilot viewpoints as an example; the proposed activities and likely affected features described above (under "landscape resource") would be incongruent with its smoothly rolling landform (which has little precedence for highly engineered water storage facilities); resulting in a ***considerable*** change overall. | ***Moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| Depots | N/A | N/A | ***N/A*** | ***N/A*** |

**Summary of anticipated impacts during decommissioning and restoration**

At the end of the operational lifetime of each coal seam gas component, the component will be decommissioned

and the site will be rehabilitated; returning the landscape character, views and visual amenity within the *Foothill Plains and Valleys* largely to its pre-development surface level condition. Based on the project description and assuming the suggested mitigation measures are integrated into the scheme, there is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) removing the coal seam gas facilities and rehabilitating sites (e.g. graded landform, spreading topsoil and seeds) in this tranquil rural landscape. However, there are likely to be some long term positive impacts resulting from this phase, including restoration of farmland. Sites affected will return to a more natural appearance over time, as the vegetation (grassland, trees and shrubs) matures, resulting in a negligible impact on the appearance of surface vegetation in the longer term. However, selected access tracks may remain in situ (as agreed) for use by the farmers/ landowners.

### 9.2.7 Type G: Lowland Brigalow Plains

**Summary of anticipated impacts during construction / installation**

There is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) installing the coal seam gas facilities within an open pastoral landscape. Construction activities (including excavation, trenching, drilling, earthmoving, vegetation clearance/trimming, temporary lighting) would be likely to disrupt the sparsely settled rural character, the sense of tranquillity and remoteness, and the long distant views with 'unbuilt' skylines.

**Detailed summary of impacts during operation and maintenance**

Based on the project description and assuming the suggested mitigation measures are integrated into the scheme, the following table summarises the anticipated impacts of the scheme on landscape character and views and visual amenity within the *Lowland Brigalow Plains* landscape.

**Table 26 Summary impact on landscape character, views and visual amenity within the *Lowland Brigalow Plains* landscape character type during operation and maintenance, and recommended development constraints framework**

| **Landscape Resource – summary impact** | | | | |
|---|---|---|---|---|
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Low | Although the presence of Brigalow and Wilga forest would help integrate field development into the landscape setting; the loss of landscape features (100m by 100m or 1h of grassland/ trees/shrubs for every production well and a 10m cleared corridor for the gathering lines and associated access tracks) and required earthworks (i.e. levelling) combined with the introduction of production wells (on an 800 m grid spacing), gathering systems (including frequent above ground signage), requiring periodic maintenance including "well workovers" every 3yrs within this open pastoral landscape would strongly contrast with its sparsely settled character with few rigid linear man-made features, and its sense of remoteness and tranquillity; resulting in a ***noticeable*** change overall. | ***Minor*** impact, due to the *low* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor* impact anticipated. |
| CGPF and IPF | Medium | Although the presence of Brigalow and Wilga forest and additional screen planting would help integrate a CGPF and/or IPF into the | ***Moderate*** impact, due to the *medium* | ***Low*** development constraints |

| | | | | |
|---|---|---|---|---|
| | | landscape setting; the large loss of landscape features (minimum 150,000m$^2$ clearing of grassland/ trees/shrubs per facility) and required earthworks (i.e. grading and levelling) combined with operation and continued maintenance of a CGPF and/or IPF (requiring approximately 5 to 7 operational personnel per facility) within this fairly open, sparsely settled landscape would impinge some long distance views with notable 'un-built' skylines, and detract from the sense of remoteness and tranquillity; resulting in a ***considerable*** change overall. | degree of landscape sensitivity combined with the *considerable* change anticipated. | framework, due to the *moderate* impact anticipated. |
| FCF | Medium | Although the scale and massing of a FCF is substantially less than a CGPF or IPF, the introduction, operation and continued maintenance of a FCF (requiring periodic maintenance and checks from IPF or CGPF staff) within this open pastoral landscape would contrast with its remote and tranquil character, resulting in a ***noticeable*** change. | ***Moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| Water storage facilities | Medium | The introduction and continued maintenance of large-scale storage dams (requiring periodic maintenance) combined with the required earthworks (i.e. creation of embankments) and associated substantial loss of landscape features (approximately 1-2km$^2$ clearing of grassland/ trees/shrubs) within this landscape, would be incongruent with its naturally rolling landform (which has little precedence for such highly engineered water storage facilities); resulting in a ***considerable*** change overall. | ***Moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| Depots | N/A | The proposed depots in Dalby, Miles and Millmerran would not directly affect this landscape character type. | ***N/A*** | ***N/A*** |
| **Visual Resource – summary impact** | | | | |
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Low | Using the pilot viewpoints as an example; the proposed activities and likely affected features described above (under "landscape resource") would contrast with the gently rolling landform (which has little precedence for rigid linear man-made features); resulting in a ***noticeable*** change overall. The presence of Brigalow and Wilga forest would help integrate Field Development into the landscape setting to a small extent (i.e. opportunity for additional planting, which may filter views to field development). | ***Minor*** impact, due to the *low* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor* impact anticipated. |
| Integrated production facility | Low | The large loss of landscape features and required earthworks (described above) combined with introduction, operation and | ***Minor to moderate*** impact, due to | ***Low*** development constraints |

| | | | | |
|---|---|---|---|---|
| | | continued maintenance of an IPF within this fairly open, sparsely settled landscape would impinge some long distance views with notable 'un-built' skylines, and detract from the sense of remoteness and tranquillity, resulting in a ***considerable*** change overall. | the *low* degree of landscape sensitivity combined with the *considerable* change anticipated. | framework, due to the *minor to moderate* impact anticipated. |
| FCF | Low | Although the scale and massing of a FCF is substantially less than a CGPF or IPF, the introduction of a FCF would result in a ***considerable*** change in these views, which currently contain a notable 'un-built' skyline and remote tranquil qualities. | ***Minor to moderate*** impact, due to the *low* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| Water storage facilities | Low | Using the pilot viewpoints as an example; the proposed activities and likely affected features described above (under "landscape resource") would result in a ***considerable*** change in views across this gently rolling open pastoral landscape which contains few precedent highly engineered water storage facilities. | ***Minor to moderate*** impact, due to the *low* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| Depots | N/A | N/A | ***N/A*** | ***N/A*** |

**Summary of anticipated impacts during decommissioning and restoration**

At the end of the operational lifetime of each coal seam gas component, the component will be decommissioned and the site will be rehabilitated; returning the landscape character, views and visual amenity within the *Lowland Brigalow Plains* largely to its pre-development surface level condition. Based on the project description and assuming the suggested mitigation measures are integrated into the scheme, there is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) removing the coal seam gas facilities and rehabilitating sites (e.g. graded landform, spreading topsoil and seeds) in an open pastoral landscape. However, there are likely to be some long term positive impacts resulting from this phase, such as restoration of natural ecosystems. Sites affected will return to a more natural appearance over time, as the vegetation (grassland, trees and shrubs) matures, resulting in a negligible impact on the appearance of surface vegetation in the longer term. However, selected access tracks may remain in situ (as agreed) for use by the farmers/ landowners.

### 9.2.8 Type H: Terraced Brigalow Farmland

**Summary of anticipated impacts during construction / installation**

There is likely to be significant adverse, albeit short term, impacts are likely on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) installing the project facilities in a sparsely settled rural landscape. Construction activities (including excavation, trenching, drilling, earthmoving, vegetation clearance/trimming, temporary lighting) are likely to disrupt the perceived rural character, the sense of tranquillity and remoteness, and the long distant views with strong skylines.

**Detailed summary of impacts during operation and maintenance**

Table 27 summarises the anticipated impacts of the project on landscape character and views and visual amenity within the *Foothill Plains and Valleys* landscape.

**Table 27 Summary impact on landscape character, views and visual amenity within the *Foothill Plains and Valleys* landscape character type during operation and maintenance, and recommended development constraints framework**

| **Landscape Resource – summary impact** | | | | |
|---|---|---|---|---|
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Medium | Although the presence of Brigalow forest and changes in landform would help integrate field development into the landscape setting; the loss of landscape features (100m by 100m or 1h of grassland/ trees/shrubs for every production well and a 10m cleared corridor for the gathering lines and associated access tracks) and required earthworks (i.e. levelling of gently sloping hills and plains) combined with the introduction of production wells (on an 800 m grid spacing), gathering systems (including frequent above ground signage) and periodic maintenance of coal seam gas facilities and "well workovers" every 3yrs within this open pastoral would detract from the strong rural character, expansive views, memorable scenic qualities; resulting in a ***considerable*** change overall. | ***Moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| CGPF and IPF | High | Although the presence of Brigalow forest and changes in landform would help integrate large scale features such as a CGPF and/or IPF; the large loss of landscape features (minimum 150,000m$^2$ clearing of grassland/ trees/shrubs) and required earthworks (i.e. grading and levelling of levelling of gently sloping hills and plains) combined with introduction, operation and continued maintenance of a CGPF and/or IPF (requiring approximately 5 to 7 operational personnel per facility) within this open pastoral landscape would detract from the strong rural character, expansive views, memorable scenic qualities; resulting in a ***dominant*** change overall. | ***Major*** impact, due to the *high* degree of landscape sensitivity combined with the *dominant* change anticipated. | Development of any CGPF and/or IPF in this landscape character type triggers a ***High*** development constraints framework, due to the *major* impact anticipated. |
| FCF | High | Although the scale and massing of a FCF is substantially less than a CGPF or IPF, the introduction, operation and continued maintenance of a FCF(requiring periodic maintenance and checks from IPF or CGPF staff) would result in a moderate loss of landscape features (approximately 5,000m$^2$ of grassland/ trees/shrubs) and require earthworks (i.e. levelling). This activity would be highly incongruent with the strong rural character and memorable scenic qualities, resulting in a ***dominant*** change. | ***Major*** impact, due to the *high* degree of landscape sensitivity combined with the *dominant* change anticipated. | Development of any CGPF and/or IPF in this landscape character type triggers a ***High*** development constraints framework, due to the *major* impact anticipated. |

| | | | | |
|---|---|---|---|---|
| Water storage facilities | High | The large loss of landscape features (approximately 1-2km$^2$ clearing of grassland/ trees/shrubs) and required earthworks (i.e. creation of embankments) combined with the introduction and continued maintenance of large-scale storage dams (requiring periodic maintenance) within this pastoral landscape would be incongruent with its smoothly undulating landform and distinctive landscape pattern, which contains little precedent for highly engineered water storage facilities; resulting in a ***considerable*** change overall. | ***Moderate to major*** impact, due to the *high* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Moderate*** development constraints framework, due to the *moderate to major* impact anticipated. |
| Depots | N/A | The proposed depots in Dalby, Miles and Millmerran would not directly affect this landscape character type. | ***N/A*** | ***N/A*** |
| **Visual Resource – summary impact** | | | | |
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Medium | Using the pilot viewpoints as an example; the proposed activities and likely affected features described above (under "landscape resource") would result in a ***noticeable*** change in these views, which comprises a scenic and memorable smoothly undulating landscape with few rigid linear man-made features. | ***Minor to moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| CGPF and IPF | Medium | Using the pilot viewpoints as an example; the proposed activities and likely affected features described above (under "landscape resource") would result in a ***dominant*** change in views, which currently comprise memorable scenic qualities and a general absence of large-scale infrastructure. | ***Moderate to major*** impact, due to the *medium* degree of landscape sensitivity combined with the *dominant* change anticipated. | ***Moderate*** development constraints framework, due to the *moderate to major* impact anticipated. |
| FCF | Medium | Although the scale and massing of a FCF is substantially less than a CGPF or IPF, the introduction of a FCF in would still result in a ***dominant*** change in these views, which currently comprise memorable scenic qualities and a general absence of large-scale infrastructure | ***Moderate to major*** impact, due to the *medium* degree of landscape sensitivity combined with the *dominant* change anticipated. | ***Moderate*** development constraints framework, due to the *moderate to major* impact anticipated. |
| Water storage facilities | Medium | Using the pilot viewpoints as an example; the proposed activities and likely affected features described above (under "landscape resource") would result in a ***dominant*** change in views across this distinctive landscape of rolling terraced arable plains, which contains few precedent highly engineered water storage | ***Moderate to major*** impact, due to the *medium* degree of landscape sensitivity combined with | ***Moderate*** development constraints framework, due to the *moderate to major* impact |

| | | | | |
|---|---|---|---|---|
| | | facilities. | the *dominant* change anticipated. | anticipated. |
| Depots | N/A | N/A | ***N/A*** | ***N/A*** |

**Summary of anticipated impacts during decommissioning and restoration**

At the end of the operational lifetime of each coal seam gas component, the component will be decommissioned and the site will be rehabilitated; returning the landscape character, views and visual amenity within the *Foothill Plains and Valleys* largely to its pre-development surface level condition. Based on the project description and assuming the suggested mitigation measures are integrated into the scheme, there is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) removing the coal seam gas facilities and rehabilitating sites (e.g. graded landform, spreading topsoil and seeds) in a tranquil rural landscape. However, there are likely to be some long term positive impacts resulting from this phase, associated with restoration of the farmland landscape and copses/natural ecosystems. Sites affected will return to a more natural appearance over time, as the vegetation (grassland, trees and shrubs) matures, resulting in a negligible impact on the appearance of surface vegetation in the longer term. However, selected access tracks may remain in situ (as agreed) for use by the farmers/ landowners.

### 9.2.9 Type I: Forested Steep Hills

**Summary of anticipated impacts during construction / installation**

There is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) installing the coal seam gas facilities in a steep hilly landscape. Construction activities (e.g. excavation, trenching, drilling, earthmoving, vegetation clearance/trimming, temporary lighting) would be likely to disrupt the distinctive steep-sided hilly landform, which is highly prominent from the wider landscape.

**Detailed summary of impacts during operation and maintenance**

Table 28 summarises the anticipated impacts of the scheme on landscape character and views and visual amenity within the *Forested Steep Hills* landscape.

**Table 28 Summary impact on landscape character, views and visual amenity within the *Forested Steep Hills* landscape character type during operation and maintenance, and recommended development constraints framework**

| **Landscape Resource – summary impact** | | | | |
|---|---|---|---|---|
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | High | The introduction of production wells (on an 800 m grid spacing), buried gathering systems and access tracks (requiring a 10m cleared corridor and frequent above ground signage) and periodic maintenance of coal seam gas facilities (including “well workovers” every 3 years within this landscape would strongly contrast with its natural steep-sided hilly landform, and its sense of naturalness and tranquillity, which has little precedent for rigid linear man-made features, resulting in a ***noticeable*** change to its character overall. | ***Moderate*** impact, due to the *high* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| CGPF and IPF | High | The siting and required earthworks (i.e. levelling) to install a CGPF and/or IPF (including access tracks and continued maintenance by approximately 5 to 7 operational personnel per facility) combined | ***Major*** impact, due to the *high* degree of landscape sensitivity | Development of any CGPF and/or IPF in this landscape character type |

| | | | | |
|---|---|---|---|---|
| | | with the large loss of landscape features (minimum 150,000 $m^2$ clearing of grassland/ trees/shrubs) within this steep hilly landscape would be highly incongruent this prominent, elevated landscape which contains no precedence for large-scale buildings; resulting in a ***dominant*** change. | combined with the *dominant* change anticipated. | triggers a **High** development constraints framework, due to the *major* impact anticipated. |
| FCF | High | Although the scale and massing of a FCF is substantially less than a CGPF or IPF (requiring a footprint of approximately 5,000$m^2$); the introduction of a FCF in would still result in a ***dominant*** change within this steep hilly landscape. | ***Major*** impact, due to the *high* degree of landscape sensitivity combined with the *dominant* change anticipated. | Development of any FCF in this landscape character type triggers a **High** development constraints framework, due to the *major* impact anticipated. |
| Water storage facilities | High | The siting and required earthworks (i.e. levelling and creation of embankments) to install large-scale storage dams (and access tracks and continued maintenance) combined with the large loss of landscape features (approximately 1-2$km^2$ clearing of grassland/ trees/shrubs) within this steep hilly landscape would be highly incongruent this prominent, elevated landscape which contains no precedence for highly engineered water storage facilities; resulting in a ***dominant*** change. | ***Major*** impact, due to the *high* degree of landscape sensitivity combined with the *dominant* change anticipated. | Development of water storage facilities in this landscape character type triggers a **High** development constraints framework, due to the *major* impact anticipated. |
| Depots | N/A | The proposed depots in Dalby, Miles and Millmerran would not directly affect this landscape character type. | ***N/A*** | ***N/A*** |
| **Visual Resource – summary impact*** | | | | |
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | High | Due to the visual prominence of this elevated landscape, the introduction of production wells and associated access tracks and gathering systems (including frequent above ground signage and adjacent access tracks for required maintenance) would be clearly visible from the surrounding low-lying landscape, resulting in a ***considerable*** change in views overall. | ***Moderate to major*** impact, due to the *high* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Moderate*** development constraints framework, due to the *moderate to major* impact anticipated. |
| CGPF and IPF | High | The proposed activities associated with the installation of a CGPF and/or IPF and the likely affected features described above (under “landscape resource”) would likely result in a ***dominant*** change in views to and from this landscape, which currently provides | ***Major*** impact, due to the *high* degree of landscape sensitivity combined with | ***High*** development constraints framework, due to the *major* impact |

| | | | | |
|---|---|---|---|---|
| | | a prominent and scenic backdrop to the wider landscape. | the *dominant* change anticipated. | anticipated. |
| FCF | High | Although the scale and massing of a FCF is substantially less than a CGPF or IPF, the introduction of a FCF in would result in a ***dominant*** change in views to and from this landscape. | ***Major*** impact, due to the *high* degree of landscape sensitivity combined with the *dominant* change anticipated. | ***High*** development constraints framework, due to the *major* impact anticipated. |
| Water storage facilities | High | The siting and required earthworks to install large-scale storage dams (and access tracks and continued maintenance) combined with approximately 1-2km$^2$ clearing of grassland/ trees/shrubs within this steep hilly landscape would be highly prominent and strongly contrast with the visual character of this elevated landscape; resulting in a ***dominant*** change. | ***Major*** impact, due to the *high* degree of landscape sensitivity combined with the *dominant* change anticipated. | ***High*** development constraints framework, due to the *major* impact anticipated. |
| Depots | N/A | N/A | ***N/A*** | ***N/A*** |

***** Although no viewpoints were recorded from this landscape character type (due to restricted vehicular access to this steep hilly landscape), the likely visual impacts of installing coal seam gas facilities in this landscape have been estimated based on field work in the surrounding low-lying landscape (i.e. views to the *Forested Steep Hills* landscape character type).

**Summary of anticipated impacts during decommissioning and restoration**

At the end of the operational lifetime of each coal seam gas component (if installed), the component will be decommissioned and the site will be rehabilitated; returning the landscape character, views and visual amenity within the *Forested Steep Hills* largely to its pre-development surface level condition. Based on the project description and assuming the suggested mitigation measures are integrated into the scheme, there is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) removing the coal seam gas facilities and rehabilitating sites (e.g. graded landform, spreading topsoil and seeds) in a steep hilly landscape. Sites affected will return to a more natural appearance over time, as the vegetation (grassland, trees and shrubs) matures, resulting in a negligible impact on the appearance of surface vegetation in the longer term. However, selected access tracks may remain in situ (as agreed) for use by the farmers/ landowners.

### 9.2.10 Type J: Chromosol Undulating Lowlands

**Summary of anticipated impacts during construction / installation**

There is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) installing the coal seam gas facilities within an open pastoral landscape. Construction activities (including excavation, trenching, drilling, earthmoving, vegetation clearance/trimming, temporary lighting) would be likely to disrupt the sparsely settled rural character, the sense of remoteness and naturalness (including remnant stands of native Eucalypt woodland, sclerophyll forests and Brigalow and Belah forest), as well as impinge on the current 'unbuilt' horizon views.

**Detailed summary of impacts during operation and maintenance**

Table 29 summarises the anticipated impacts of the scheme on landscape character and views and visual amenity within the *Chromosol Undulating Lowlands* landscape.

**Table 29 Summary impact on landscape character, views and visual amenity within the *Chromosol Undulating Lowlands* landscape character type during operation and maintenance, and recommended development constraints framework**

| **Landscape Resource – summary impact** | | | | |
|---|---|---|---|---|
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Low | Although the presence of Eucalypt woodland and dry sclerophyll forests would help integrate field development into the landscape setting; the loss of landscape features (100m by 100m or 1h clearing of grassland/ trees/shrubs for every production well and a 10m cleared corridor for the gathering lines and associated access tracks) and required earthworks (i.e. levelling) combined with the introduction of frequently occurring production wells (on an 800 m grid spacing), gathering systems (including frequent above ground signage) and required maintenance of coal seam gas facilities (including "well workovers" every 3yrs within this open pastoral landscape would influence its sparsely settled character with few rigid linear man-made features, and its sense of remoteness; resulting in a ***noticeable*** change overall. | ***Minor*** impact, due to the *low* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor* impact anticipated. |
| CGPF and IPF | Medium | Although the presence of Eucalypt woodland and sclerophyll forests and additional screen planting would help integrate any proposed CGPF and/or IPF into the landscape setting; the large loss of landscape features (minimum 150,000m$^2$ clearing of grassland/ trees/shrubs) and required earthworks (i.e. grading and levelling) combined with introduction, operation and continued maintenance of a CGPF and/or IPF (requiring approximately 5 to 7 operational personnel per facility) within this fairly open, sparsely settled landscape would detract from the sense of remoteness and provide new significant built elements; resulting in a ***considerable*** change overall. | ***Moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| FCF | Medium | Although the scale and massing of a FCF is substantially less than a CGPF or IPF, the introduction of a FCF (requiring a footprint of 5,000m$^2$) in would still result in a ***dominant*** change within this fairly open, sparsely settled rural landscape. | ***Moderate*** impact, due to the *medium* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *moderate* impact anticipated. |
| Water storage | Medium | The introduction and continued maintenance of large-scale storage dams (requiring | ***Moderate*** impact, due to | ***Low*** development |

| **Landscape Resource – summary impact** | | | | |
|---|---|---|---|---|
| facilities | | periodic maintenance from IPF staff) combined with the required earthworks (i.e. creation of embankments) and associated substantial loss of landscape features (approximately 1-2km$^2$ clearing of grassland/ trees/shrubs) within this landscape, would influence its gently undulating landform (with little precedence for such highly engineered water storage facilities); resulting in a ***considerable*** change overall. | the *medium* degree of landscape sensitivity combined with the *considerable* change anticipated. | constraints framework, due to the *moderate* impact anticipated. |
| Depots | N/A | The proposed depots in Dalby, Miles and Millmerran would not directly affect this landscape character type. | ***N/A*** | ***N/A*** |
| **Visual Resource – summary impact** | | | | |
| **Proposed development** | **Overall sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| Field Development | Low | Using the pilot viewpoint as an example; the proposed activities and likely affected features described above (under "landscape resource") would result in a ***noticeable*** change in these views, which comprises a gently undulating landform with few rigid linear man-made features. | ***Minor*** impact, due to the *low* degree of landscape sensitivity combined with the *noticeable* change anticipated. | ***Low*** development constraints framework, due to the *minor* impact anticipated. |
| CGPF and IPF | Low | The proposed activities described above (under "landscape resource") combined with introduction, operation and continued maintenance of a CGPF and/or IPF (as described above) within this fairly open, sparsely settled landscape would impinge some long distance views with notable 'un-built' skylines and provide new significant built elements; resulting in a ***considerable*** change overall. | ***Minor to moderate*** impact, due to the *low* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| FCF | Low | Although the scale and massing of a FCF is substantially less than a CGPF or IPF, the introduction of a FCF in would result in a ***considerable*** change in these views, which currently contain a notable 'un-built' skyline. | ***Minor to moderate*** impact, due to the *low* degree of landscape sensitivity combined with the *considerable* change anticipated. | ***Low*** development constraints framework, due to the *minor to moderate* impact anticipated. |
| Water storage facilities | Low | Using the pilot viewpoints as an example; the proposed activities and likely affected features described above (under "landscape resource") would result in a ***considerable*** change in views across this gently undulating open pastoral landscape which contains few precedent highly engineered water storage facilities. | ***Minor to moderate*** impact, due to the *low* degree of landscape sensitivity combined with the *considerable* change | ***Moderate*** development constraints framework, due to the *minor to moderate* impact anticipated. |

| Landscape Resource – summary impact | | | | |
|---|---|---|---|---|
| | | | anticipated. | |
| Depots | N/A | N/A | ***N/A*** | ***N/A*** |

**Summary of anticipated impacts during decommissioning and restoration**

At the end of the operational lifetime of each coal seam gas component, the component will be decommissioned and the site will be rehabilitated; returning the landscape character, views and visual amenity within the *Chromosol Undulating Lowlands* largely to its pre-development surface level condition. Based on the project description and assuming the suggested mitigation measures are integrated into the scheme, there is likely to be significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and large scale machinery (and associated noise emissions) removing the coal seam gas facilities and rehabilitating sites (e.g. graded landform, spreading topsoil and seeds) in an open lowland pastoral landscape. However, there are likely to be some long term positive impacts resulting from this phase, such as reinstatement and restoration of ecosystems. Sites affected will return to a more natural appearance over time, as the vegetation (grassland, trees and shrubs) matures, resulting in a negligible impact on the appearance of surface vegetation in the longer term. However, selected access tracks may remain in situ (as agreed) for use by the farmers/ landowners.

# 10.0 Conclusions

This section presents a summary of the results of the residual impact assessment on the landscape resource, views and visual amenity within the study area.

The landscape and visual impact assessment has divided the study area into ten different "types" of landscapes, broadly comprising similar character. As the location of the development regions and associated project components (i.e. production wells, gathering lines, CGPFs, IPFs, FCFs, water holding systems, depots etc.) are not fixed, these landscape character types have provided a framework to assess the likely impact of each type of project component in different landscape "scenarios", using pilot viewpoint locations with corresponding visualisations and ZTVs. To assess the magnitude of change anticipated in each landscape character type, key components (and associated development activities) have been grouped into broadly similar scales and/or types of development, to identify and communicate the significance of impact i.e. field activities, CGPFs and IPFs, FCFs, water storage facilities and depots.

A detailed landscape and visual mitigation framework has been developed (see Section 8.0), which directly responds to the landscape and visual sensitivity of the landscape character types occurring within the study area. It is assumed that these measures will be integrated into Arrow's environmental management strategy and have, therefore, been considered as "part of the project" in determining its residual impact. In addition, a number of "beneficial" mitigation measures for long-term legacy have been identified; such as establishment of community facilities or ecological restoration, which could be considered as a value-add or "offset" for unavoidable landscape and visual (or other) impacts.

The scale and nature of the proposed Surat Gas Project is likely to result in several impacts on the landscape resource, views and visual amenity (see Section 9.0). The outcomes of this LVIA are summarised in **Table 30**; and are also illustrated in plan form in **Figure 39** and **Figure 40**. In summary, the greatest issues of concern identified by the assessment include:

- Significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and construction activities including excavation, trenching, drilling, earthmoving, vegetation clearance/trimming, temporary lighting (and associated noise emissions) installing and removing the project facilities in a largely rural landscape.
- Impact on sensitive visual receptors i.e. people living in proximity to the project facilities, and residents that may experience the facilities on a daily basis (including night time impacts associated with lighting).
- Ongoing and progressive nature of gas construction and development in the study area, which is intended to extend over 25 to 30 years, resulting in "whole of project" impacts on local residents (on properties and in towns such as Dalby), visitors and travellers/motorists who would have kinetic view experiences i.e. views to gas development in differing stages of development/construction, experienced when moving through a landscape, such as driving along roads.
- Potential impact on 'un-built' skylines; and associated detraction from the sense of remoteness and tranquillity in many rural landscapes e.g. Landscape Type H: *Terraced Brigalow Farmland*.
- The potential residual loss of landscape features required as a result of installing the project components within the development areas (e.g. installing the CGPF and IPFs, requiring a minimum 150,000m$^2$ cleared footprint and water holding facilities) as well as the production wells (up to 7,500 wells, requiring a 100m by 100m or 1ha cleared footprint per well) and gathering lines and associated access tracks (requiring a 10m cleared corridor), which may fundamentally change the character of the landscape.
- Modifications to the landform and drainage required as a result of installing the project components within the development regions e.g. levelling on land for the IPFs (approximately 200,000m$^2$) and an increase in permeable surfaces in a rural landscape.
- Increase in traffic on rural roads e.g. due to required construction, ongoing maintenance of the project facilities over 25-30 years and eventual decommissioning and transportation of the facilities.
- The presence of workforce construction camps adjacent to each IPF for up to 15 months, housing an average of 350 to 500 personnel between year 2016 to 2021, which have the potential to result in adverse impacts to landscape visual values (as well as other impacts e.g. ecological, hydrological,

social, transport).

- Changing perception of the character of the landscapes i.e. changing from a landscape defined by farming and grazing, to a landscape strongly characterised by gas development and other infrastructure, such as coal mining, underground coal gasification, large-scale power generation and distribution.
- Changing character of the rural towns i.e. changing from towns that have historically been focused on supporting farming and grazing families, to towns which service large-scale gas developments during construction and operation.

## 10.1 Recommendations

A range of essential mitigation measures are proposed that seek to integrate the project into the landscape and minimise the landscape and visual impact to the greatest extent possible. It is recommended that these measures be given further consideration (e.g. through the preparation and implementation of a Landscape Management Plan, as part of an overall Environmental Management Strategy for the Surat Gas Project) to ensure they are adopted as early as possible (i.e. during construction planning phase) and monitored during the operational phase of the project

As part of this mitigation, it is recommended that the detailed siting of the project facilities (including the IPFs and associated construction camps) involve a landscape planner / landscape architect, to minimise adverse impacts on the landscape and visual resource.

It is also recommended that the landscape and visual impact of the project is reviewed once it has been constructed and, where appropriate, further measures explored for minimising adverse impacts.

**Table 30 Summary impact on landscape character, views and visual amenity and recommended development constraints framework for all landscape character types**

| **Landscape Resource – summary impact** | | | | |
|---|---|---|---|---|
| **DEVELOPMENT TYPE** | **LANDSCAPE BASELINE** | **LANDSCAPE IMPACT** | | **DEVELOPMENT CONSTRAINTS FRAMEWORK** |
| | **Sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| **Type A: Wooded River Valley** | | | | |
| Field Development | Medium | Considerable | Moderate | Low |
| CGPF and IPF | High | Dominant | Major | High |
| FCF | High | Considerable | Moderate to major | Moderate |
| Water storage facilities | Medium | Dominant | Moderate to major | Moderate |
| Depots | N/A | N/A | N/A | N/A |
| **Type B: Settled Arable Plains** | | | | |
| Field Development | Medium | Noticeable | Minor to moderate | Low |
| CGPF and IPF | Medium | Noticeable | Minor to moderate | Low |
| FCF | Medium | Noticeable | Minor to Moderate | Low |
| Water storage facilities | Low | Imperceptible | Minor | Low |
| Depots | Low | Imperceptible | Minor to not significant | Low |
| **Type C: Sodic Transitional Pastures** | | | | |
| Field Development | Low | Noticeable | Minor | Low |
| CGPF and IPF | Low | Considerable | Minor to moderate | Low |
| FCF | Low | Considerable | Minor to moderate | Low |
| Water storage facilities | Medium | Considerable | Moderate | Low |
| Depots | N/A | N/A | N/A | N/A |

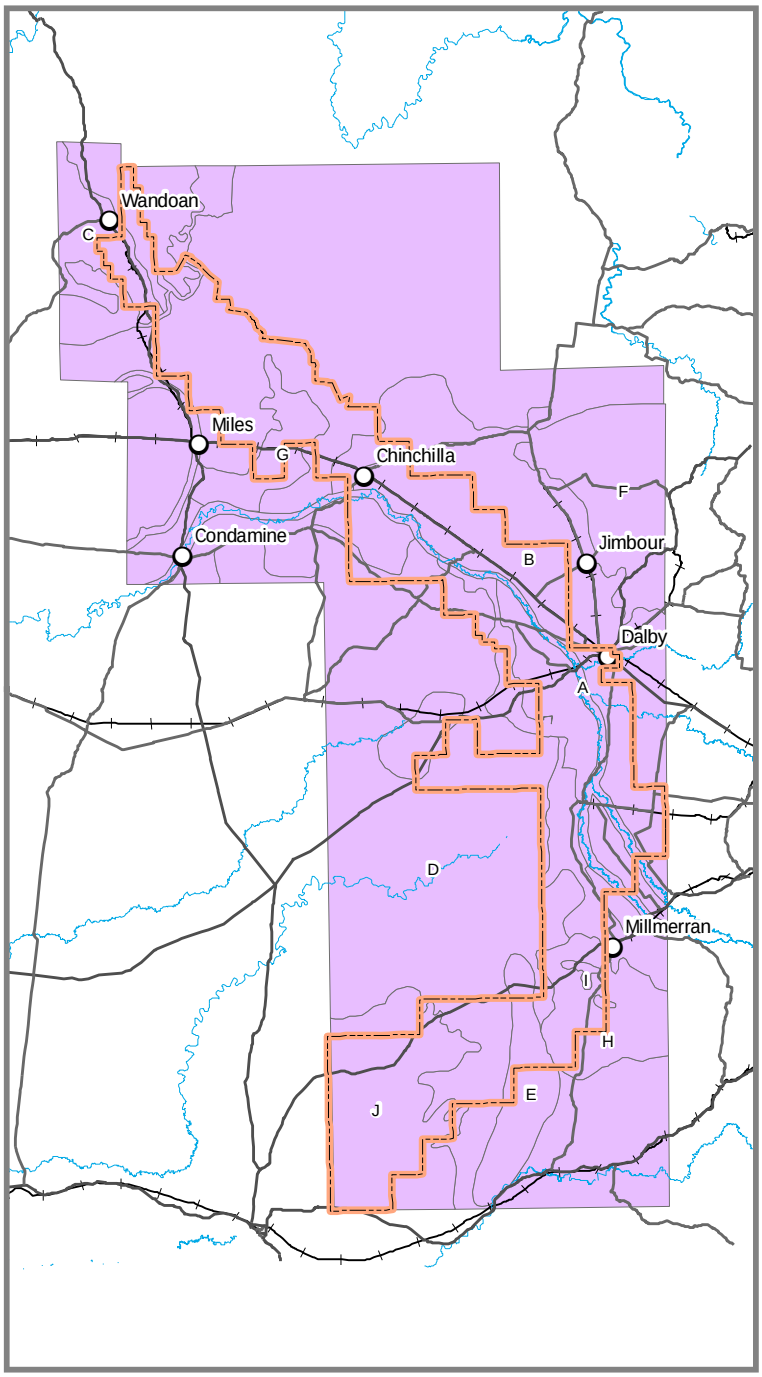
| | | | | |
|---|---|---|---|---|
| **Type D: Lowland Native Forest** | | | | |
| Field Development | Low | Noticeable | Minor | Low |
| CGPF and IPF | Medium | Considerable | Moderate | Low |
| FCF | Medium | Considerable | Moderate | Low |
| Water storage facilities | Medium | Considerable | Moderate | Low |
| Depots | Low | Imperceptible | Minor to not significant | Low |
| **Type E: Elevated Native Forest** | | | | |
| Field Development | Medium | Noticeable | Minor to moderate | Low |
| CGPF and IPF | Medium | Considerable | Moderate | Low |
| FCF | Medium | Considerable | Moderate | Low |
| Water storage facilities | High | Considerable | Moderate to major | Moderate |
| Depots | N/A | N/A | N/A | N/A |
| **Type F: Foothill Plains and Valleys** | | | | |
| Field Development | Medium | Noticeable | Minor to moderate | Low |
| CGPF and IPF | High | Considerable | Moderate to major | Moderate |
| FCF | High | Noticeable | Moderate | Low |
| Water storage facilities | High | Noticeable | Moderate to major | Moderate |
| Depots | N/A | N/A | N/A | N/A |
| **Type G: Lowland Brigalow Plains** | | | | |
| Field Development | Low | Noticeable | Minor | Low |
| CGPF and IPF | Medium | Considerable | Moderate | Low |
| FCF | Medium | Noticeable | Moderate | Low |
| Water storage facilities | Medium | Considerable | Moderate | Low |

| | | | | |
|---|---|---|---|---|
| Depots | N/A | N/A | N/A | N/A |
| **Type H: Terraced Brigalow Farmland** | | | | |
| Field Development | Medium | Considerable | Moderate | Low |
| CGPF and IPF | High | Dominant | Major | High |
| FCF | High | Dominant | Major | High |
| Water storage facilities | High | Considerable | Moderate to major | Moderate |
| Depots | N/A | N/A | N/A | N/A |
| **Type I: Forested Steep Hills** | | | | |
| Field Development | High | Noticeable | Moderate | Low |
| CGPF and IPF | High | Dominant | Major | High |
| FCF | High | Dominant | Major | High |
| Water storage facilities | High | Dominant | Major | High |
| Depots | N/A | N/A | N/A | N/A |
| **Type J: Chromosol Undulating Lowlands** | | | | |
| Field Development | Low | Noticeable | Minor | Low |
| CGPF and IPF | Medium | Considerable | Moderate | Low |
| FCF | Medium | Considerable | Moderate | Low |
| Water storage facilities | Medium | Considerable | Moderate | Low |
| Depots | N/A | N/A | N/A | N/A |

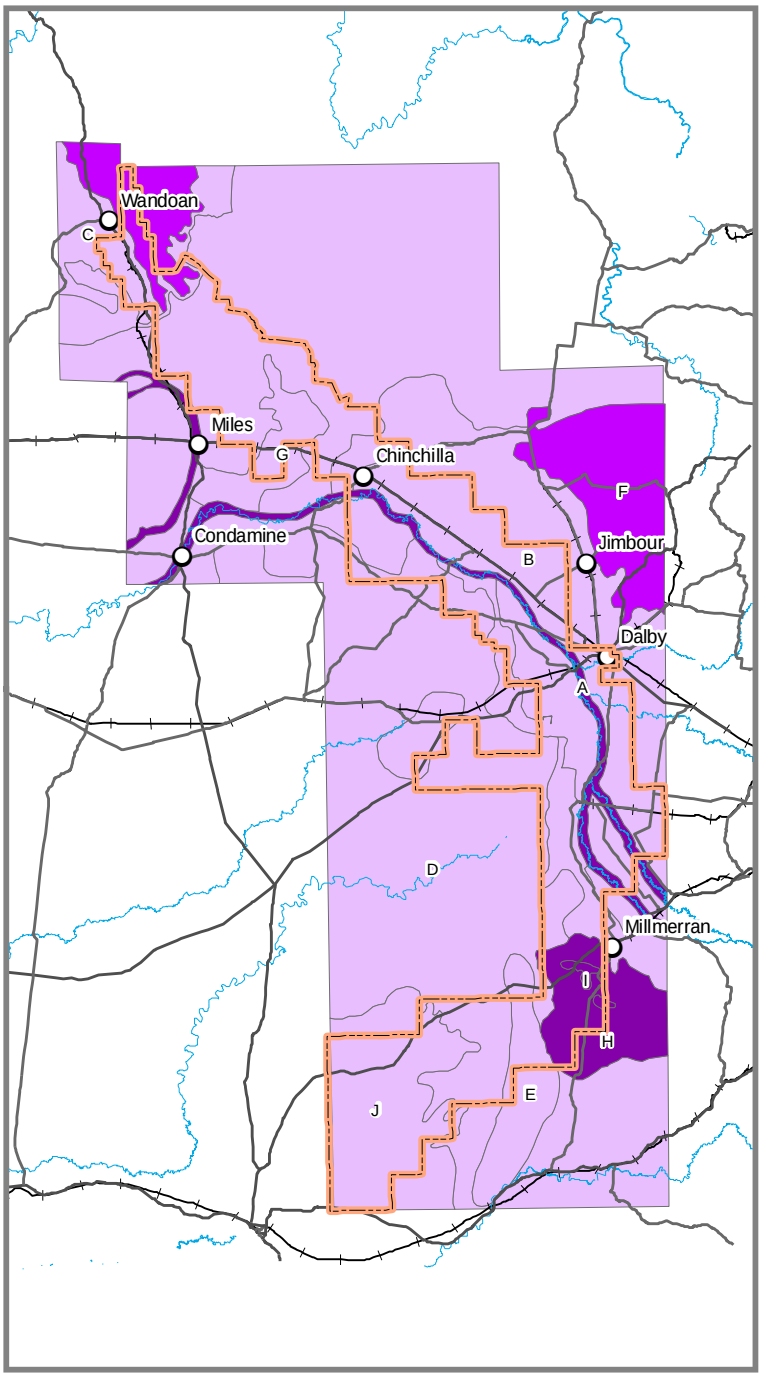
| **Visual Resource – summary impact** | | | | |
|---|---|---|---|---|
| **DEVELOPMENT TYPE** | **VISUAL BASELINE** | **VISUAL IMPACT** | | **DEVELOPMENT CONSTRAINTS FRAMEWORK** |
| | **Sensitivity** | **Judgement of magnitude of change** | **Judgement of significance of impact** | **Applicable development constraints framework** |
| **Type A: Wooded River Valley** | | | | |
| Field Development | Medium | Considerable | Moderate | Low |
| CGPF and IPF | Medium | Dominant | Moderate to major | Moderate |
| FCF | Medium | Considerable | Moderate | Low |
| Water storage facilities | Medium | Dominant | Moderate to major | Moderate |
| Depots | N/A | N/A | N/A | N/A |
| **Type B: Settled Arable Plains** | | | | |
| Field Development | Medium | Noticeable | Minor to moderate | Low |
| CGPF and IPF | Medium | Considerable | Moderate | Low |
| FCF | Medium | Considerable | Moderate | Low |
| Water storage facilities | Medium | Noticeable | Minor to moderate | Low |
| Depots | Low | Imperceptible | Minor to nor significant | Low |
| **Type C: Sodic Transitional Pastures** | | | | |
| Field Development | Low | Noticeable | Minor | Low |
| CGPF and IPF | Low | Considerable | Minor to moderate | Low |
| FCF | Low | Considerable | Minor to moderate | Low |
| Water storage facilities | Low | Considerable | Minor to moderate | Low |
| Depots | N/A | N/A | N/A | N/A |
| **Type D: Lowland Native Forest** | | | | |

| | | | | |
|---|---|---|---|---|
| **Visual Resource – summary impact** | | | | |
| Field Development | Medium | Imperceptible | Minor | Low |
| CGPF and IPF | Medium | Noticeable | Minor to moderate | Low |
| FCF | Medium | Noticeable | Minor to moderate | Low |
| Water storage facilities | Medium | Noticeable | Minor to moderate | Low |
| Depots | Low | Imperceptible | Minor to not significant | Low |
| **Type E: Elevated Native Forest** | | | | |
| Field Development | Medium | Noticeable | Minor to moderate | Low |
| CGPF and IPF | Medium | Considerable | Moderate | Low |
| FCF | Medium | Considerable | Moderate | Low |
| Water storage facilities | High | Considerable | Moderate to major | Moderate |
| Depots | N/A | N/A | N/A | N/A |
| **Type F: Foothill Plains and Valleys** | | | | |
| Field Development | Medium | Noticeable | Minor to moderate | Low |
| CGPF and IPF | Medium | Considerable | Moderate | Low |
| FCF | Medium | Considerable | Moderate | Low |
| Water storage facilities | Medium | Considerable | Moderate | Low |
| Depots | N/A | N/A | N/A | N/A |
| **Type G: Lowland Brigalow Plains** | | | | |
| Field Development | Low | Noticeable | Minor | Low |
| CGPF and IPF | Low | Considerable | Minor to moderate | Low |
| FCF | Low | Considerable | Minor to moderate | Low |
| Water storage facilities | Low | Considerable | Minor to moderate | Low |
| Depots | N/A | N/A | N/A | N/A |

| Visual Resource – summary impact | | | | |
|---|---|---|---|---|
| **Type H: Terraced Brigalow Farmland** | | | | |
| Field Development | Medium | Noticeable | Minor to moderate | Low |
| CGPF and IPF | Medium | Dominant | Moderate to major | Moderate |
| FCF | Medium | Dominant | Moderate to major | Moderate |
| Water storage facilities | Medium | Dominant | Moderate to major | Moderate |
| Depots | N/A | N/A | N/A | N/A |
| **Type I: Forested Steep Hills** | | | | |
| Field Development | High | Considerable | Moderate to major | Moderate |
| CGPF and IPF | High | Dominant | Major | High |
| FCF | High | Dominant | Major | High |
| Water storage facilities | High | Dominant | Major | High |
| Depots | N/A | N/A | N/A | N/A |
| **Type J: Chromosol Undulating Lowlands** | | | | |
| Field Development | Low | Noticeable | Minor | Low |
| CGPF and IPF | Low | Considerable | Minor to moderate | Low |
| FCF | Low | Considerable | Minor to moderate | Low |
| Water storage facilities | Low | Considerable | Minor to moderate | Moderate |
| Depots | N/A | N/A | N/A | N/A |




FIELD ACTIVITIES




CGPF and IPF

AECOM

0 5 10 20 30 40
Kilometres
DATUM GDA 1994, PROJECTION MGA ZONE 56

1:2,000,000 when printed at A4

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**LEGEND**

EIS study Area

Constraints Framework Level - Landscape

LOW

MODERATE

HIGH

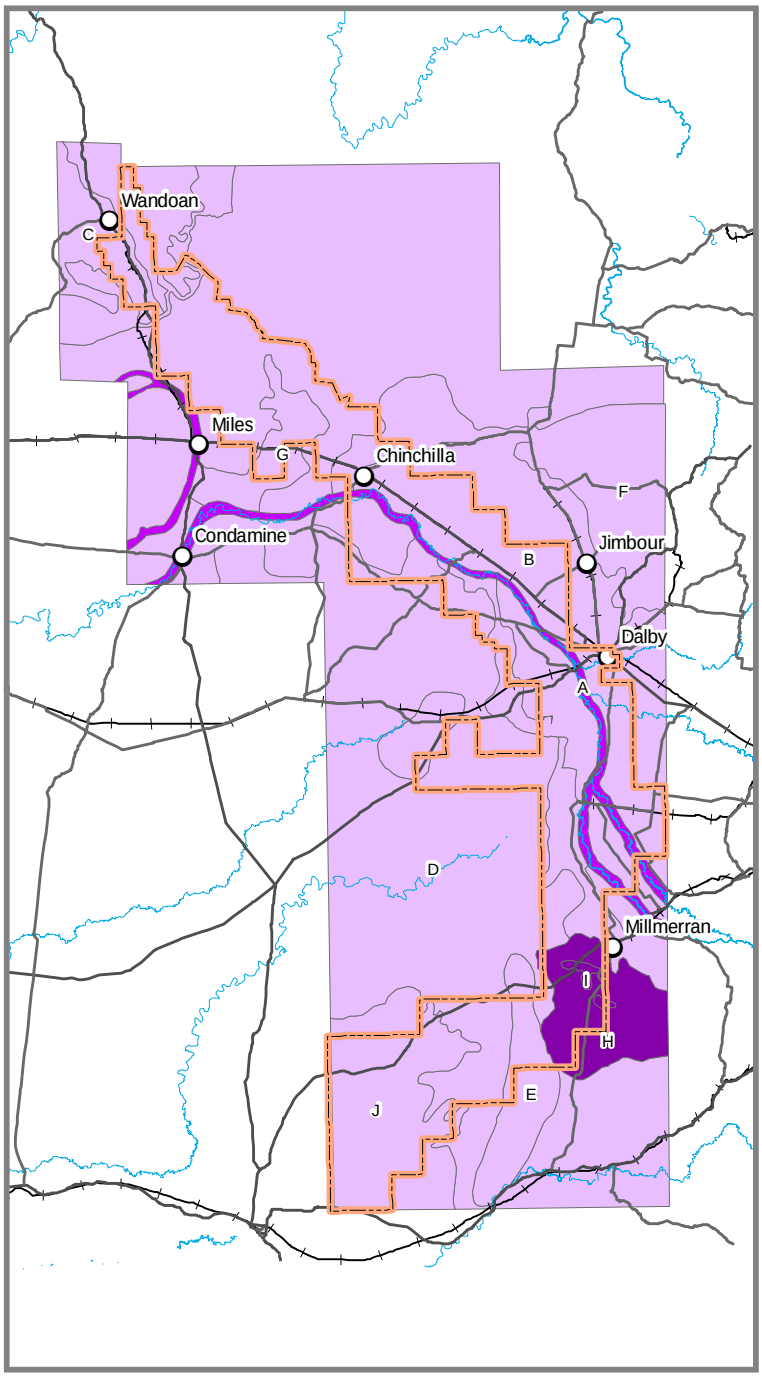
| | |
|---|---|
| PROJECT ID | 09513140.01 |
| CREATED BY | GW |
| LAST MODIFIED | GW JUL 2011 |

**DEVELOPMENT CONSTRAINTS FRAMEWORK - LANDSCAPE**

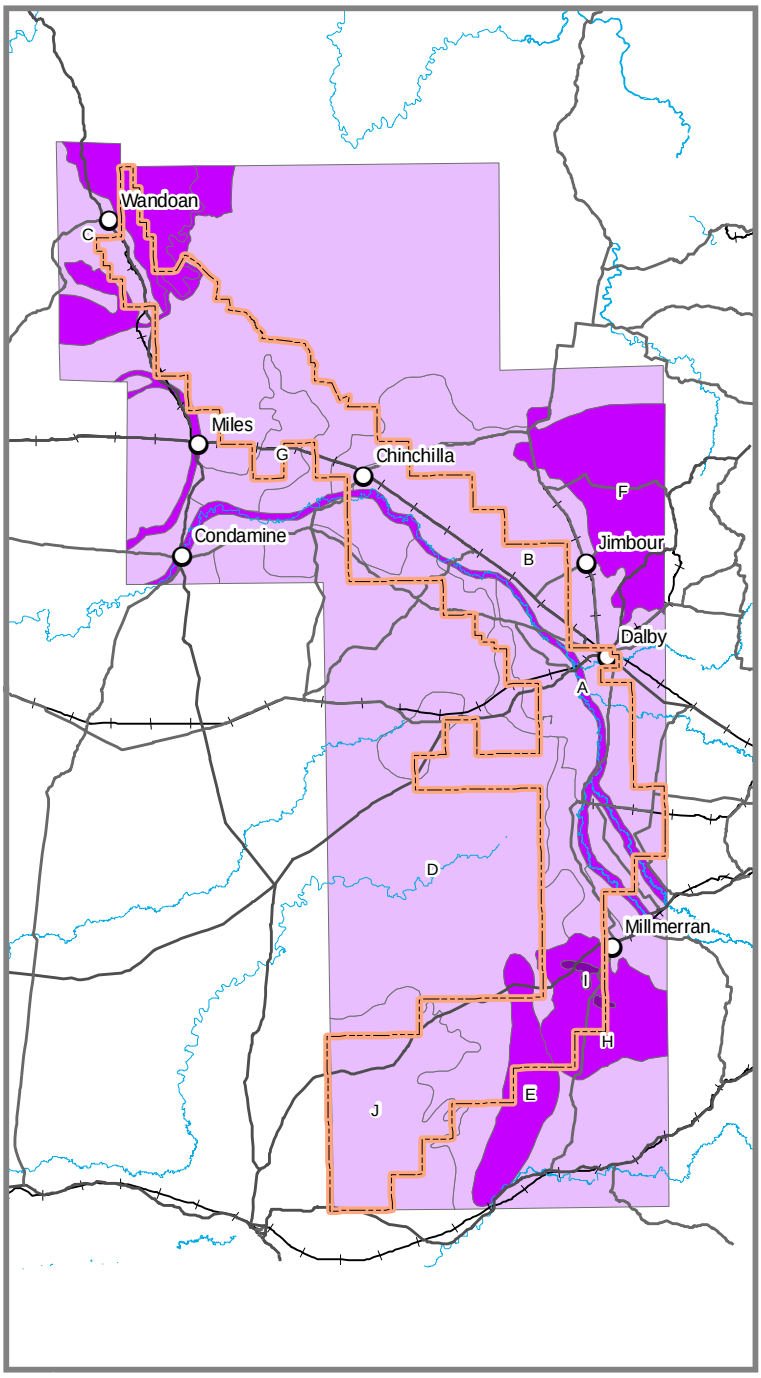
**Arrow Energy**
**Surat Gas Project LVIA**

**Figure**

# 39a




FCF




WATER STORAGE FACILITIES

AECOM

0 5 10 20 30 40
Kilometres
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**LEGEND**

EIS study Area

Constraints Framework Level - Landscape

LOW
MODERATE
HIGH

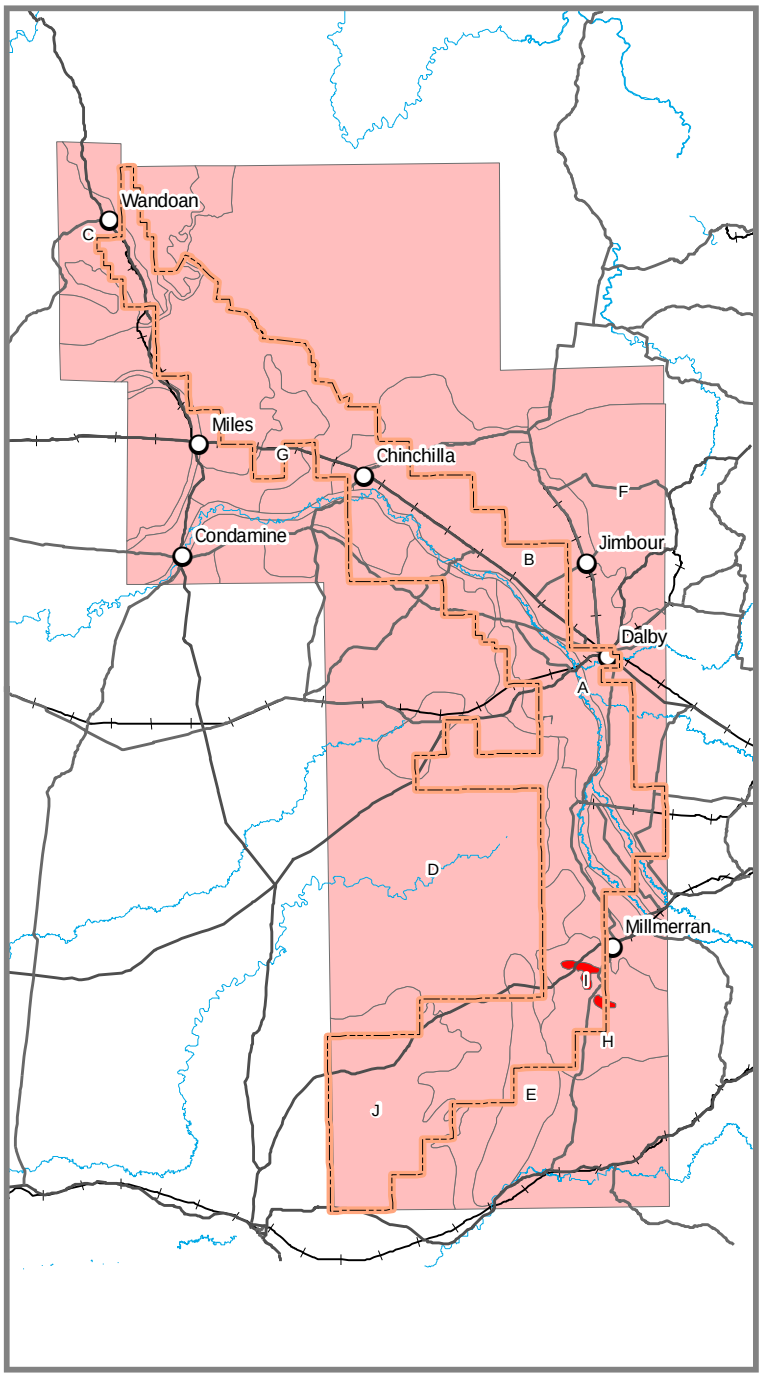
**DEVELOPMENT CONSTRAINTS FRAMEWORK - LANDSCAPE**

**Arrow Energy**
**Surat Gas Project LVIA**

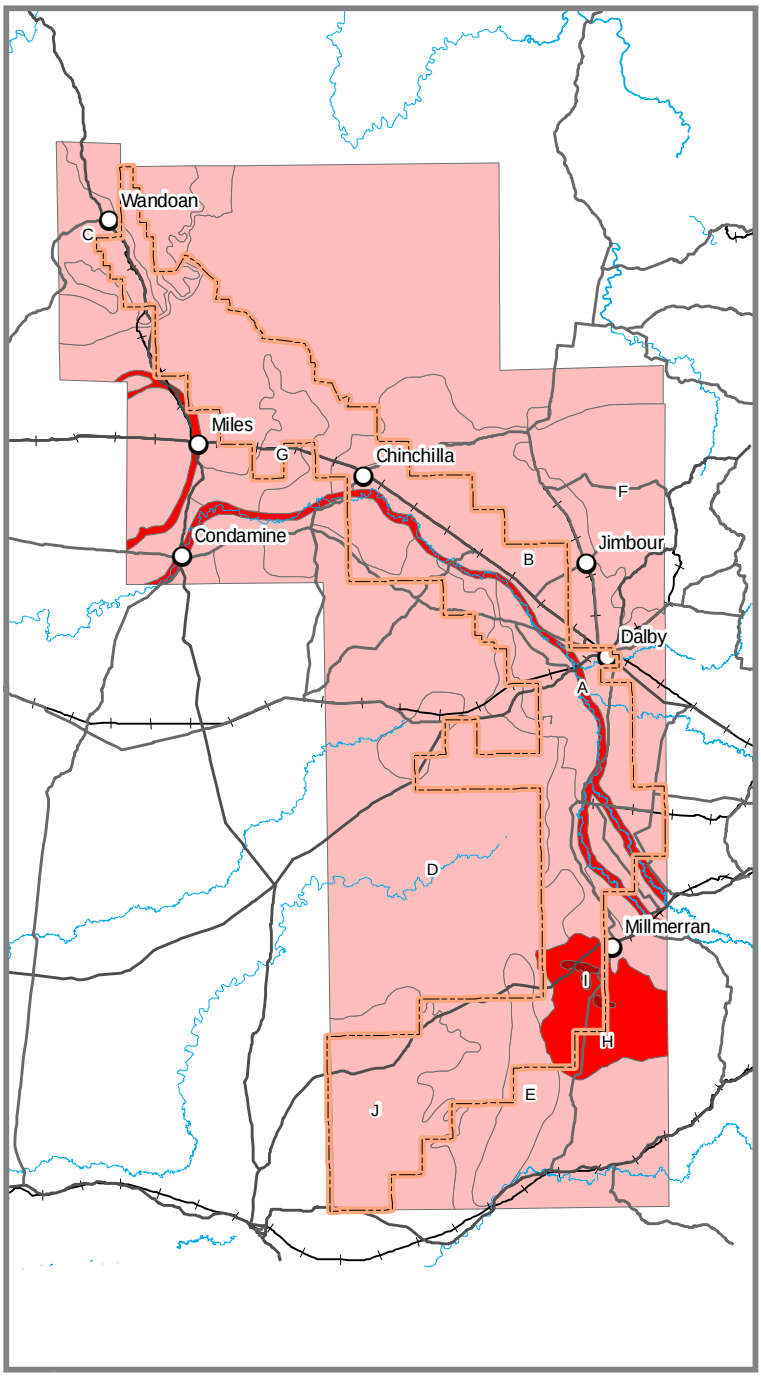
**Figure**

# 39b

| | |
|---|---|
| PROJECT ID | 09513140.01 |
| CREATED BY | GW |
| LAST MODIFIED | GW JUL 2011 |




FIELD ACTIVITIES




CGPF and IPF

AECOM

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Kilometres
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**LEGEND**

EIS study Area

Constraints Framework Level - Visual

LOW
MODERATE
HIGH

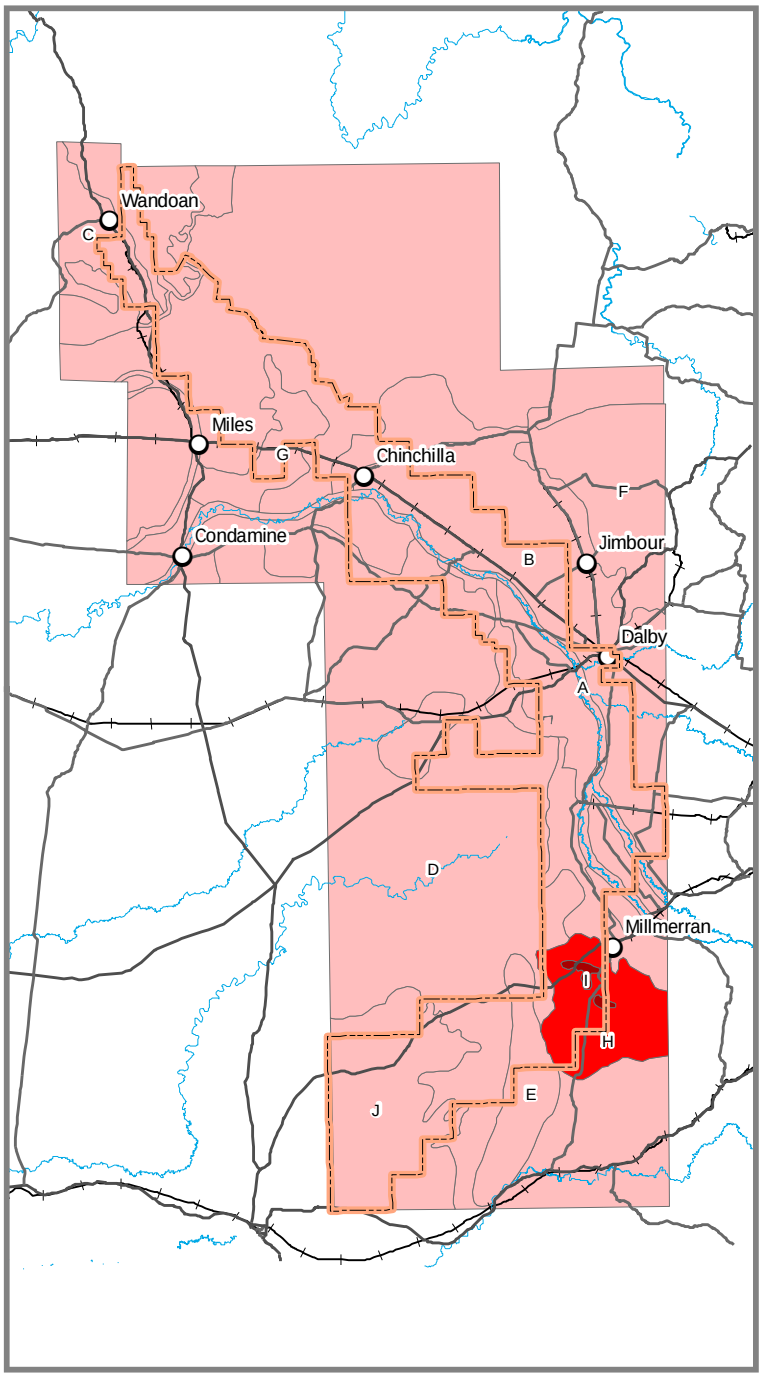
PROJECT ID 09513140.01
CREATED BY GW
LAST MODIFIED GW JUL 2011

**DEVELOPMENT CONSTRAINTS FRAMEWORK - VISUAL**

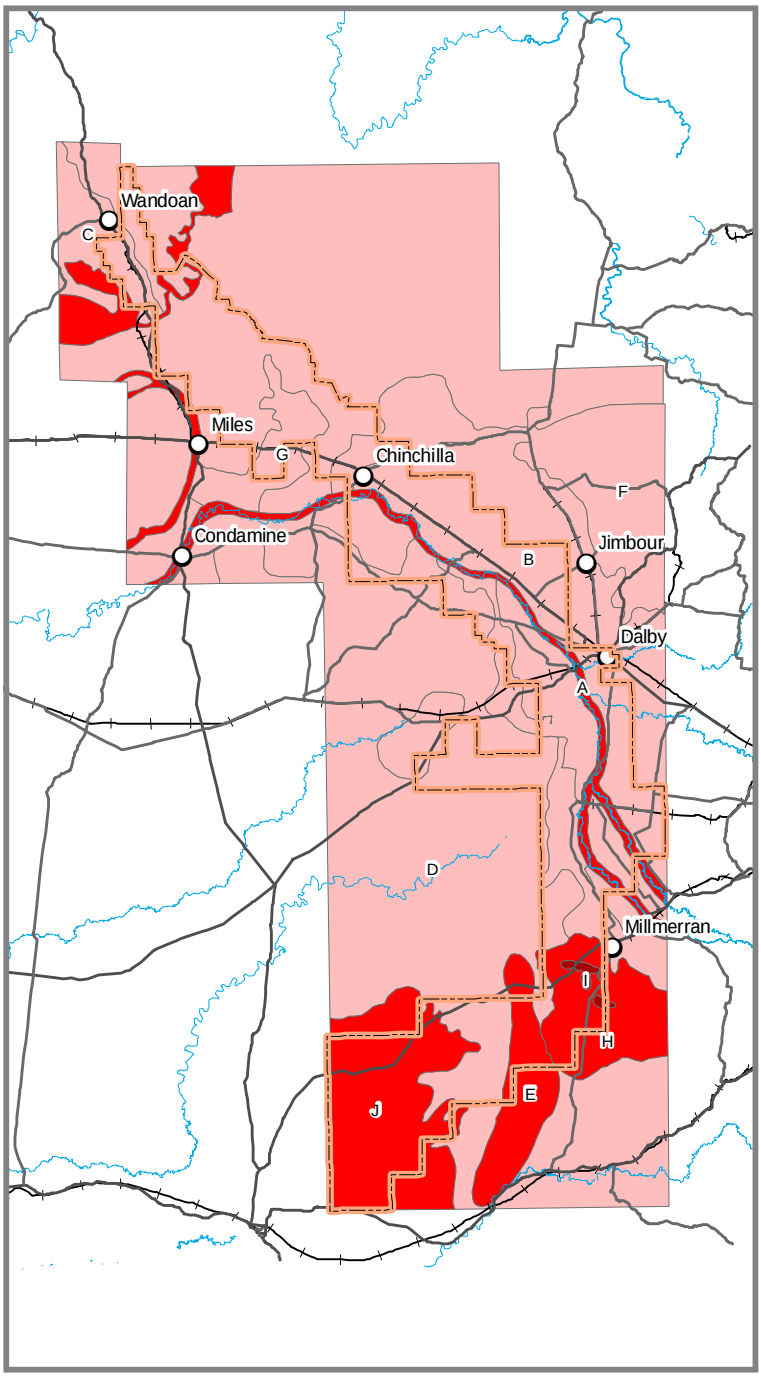
**Arrow Energy**
**Surat Gas Project LVIA**

**Figure**

**40a**




FCF




WATER STORAGE FACILITIES

AECOM

0 5 10 20 30 40
Kilometres
DATUM GDA 1994, PROJECTION MGA ZONE 56

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**LEGEND**

EIS study Area

Constraints Framework Level - Visual

LOW
MODERATE
HIGH

PROJECT ID 09513140.01
CREATED BY GW
LAST MODIFIED GW JUL 2011

**DEVELOPMENT CONSTRAINTS FRAMEWORK - VISUAL**

**Arrow Energy**
**Surat Gas Project LVIA**

**Figure**

# 40b

# 11.0 Cumulative impact assessment

## 11.1 Introduction

As the exploration and development of the mining and petroleum industry (particularly the coal seam gas industry) expands in this part of southern Queensland, together with the continuation of other large-scale infrastructure such as new railway links; it is becoming increasingly necessary to consider their cumulative landscape and visual impacts. A key concern is their visibility, but also their ancillary development such as access tracks, mobile camps, increased traffic on rural roads, potential interruption to farming and grazing operations, and their effect on the landscape. Of particular importance is:

- How these developments relate to each other in the design and relationship to their settings (e.g. massing, height, scale, form, style);
- Their frequency as one moves through the landscape i.e. as seen sequentially from main transport and recreational routes; and
- Their visual separation to allow experience of the character of the landscape in-between.

The following projects (including significant developments currently in construction, consented developments, or developments currently undertaking or have recently submitted an EIS) have been considered in the cumulative landscape and visual assessment:

**Table 31 Summary impact on landscape character, views and visual amenity and recommended development constraints framework for all landscape character types**

| Proposed Project | Proponent(s) | Stage | Components | Location, distance and direction from project development area boundary | Timing | Consideration in the cumulative LVIA |
|---|---|---|---|---|---|---|
| 1. Arrow Surat Pipeline (formerly Surat-Gladstone Pipeline) | Arrow | EIS approved January 2010. | 467 km long buried gas pipeline between the Surat Basin gas fields and Gladstone. | The pipeline will start adjacent to the Kogan North Central Gas Processing Facility in the Surat Basin gas fields, about 20 km east of the township of Kogan. | Construction anticipated to commence in 2015/16, with LNG production 3 years after that. The pipeline has a technical design life of 40 years. | Yes cumulative impacts are likely. The pipeline will extend through the project development area in a north-westerly direction from near Kogan North Central Gas Processing Facility; therefore the impact of this development in addition to the proposed Arrow Surat Gas Project would be experienced cumulatively. |
| 2. Australia Pacific LNG Project | Origin Energy, Conoco Phillips and Sinopec | Project approved with conditions by the Queensland CG in November 2010. Project approved with conditions by DSEWPC in February 2011. | Further development of APLNG's coal seam gas fields in the Bowen and Surat Basins, the construction of a 450km gas transmission pipeline, together with the construction of a LNG plant and associated port infrastructure on Curtis Island to export LNG to international markets. | Adjacent to the northern and western boundaries of the project development area near Wandoan Miles, Kogan and Millmerran. | LNG export (first train) 2015. Train two is scheduled for 2016. Trains three and four are scheduled for post 2016. Pipeline construction 18 months. Project life of approximately 30 years. | Yes cumulative impacts are likely. The impact of this development in addition to the proposed Arrow Surat Gas Project would be experienced cumulatively, due to the close proximity between gas field project development areas. |
| 3. Bloodwood Creek Queensland – Stage 2 (Commercial Gas Production) | Carbon Energy (Operations) Pty Ltd. | IAS issued December 2009. Stage 2 TOR issued May 2010. The Proponent is currently preparing a draft EIS. | Large-scale syngas production facility using underground coal gasification (UCG) at the Bloodwood Creek project site, consuming approximately two million tonnes of coal a year over an expected 30 year period. The proposal intends to utilise UCG technology for power generation, gas production, liquid fuel production and fetilizer production including carbon | Bloodwood Creek, ~40km west of Dalby. | Initial UCG demonstration trial (Stage 1) at Bloodwood Creek is operational. The scoping study for Stage 2 will be progressed in 2011 and construction | Yes cumulative impacts are likely. The impact of this development in addition to the proposed Arrow Surat Gas Project would be experienced cumulatively, due to the potentially small distance between components of each scheme, as well as an increase in traffic along rural roads such |

| Proposed Project | Proponent(s) | Stage | Components | Location, distance and direction from project development area boundary | Timing | Consideration in the cumulative LVIA |
|---|---|---|---|---|---|---|
| | | | capture and storage. | | works are due to commence in 2014 | as Dalby-Kogan Road. |
| 4. Cameby Downs Coal Mine expansion project | Syntech Resources Pty Ltd | Final TOR issued. EIS in preparation – have until January 2013 to submit to DERM. | The Cameby Downs Expansion Project proposes to increase the rate of mining of run of mine (ROM) coal from 1.8 million tonnes a year (Mt/y) to 25Mt/y to produce 15Mt/y to 20Mt/y of product coal for export. The mine life is estimated at around 40 years, comprising a two year construction period and 35 to 40 years of production. The project site has an area of approximately 13,370ha. | Located ~3km to the west of the central-northern part of the project development area. | Construction of Stage 1 environmental approval has already been granted and overburden removal works have commenced. Stage 2 environmental investigations are currently underway. Works are due to commence in 2014 with a mine life of 30+ years. | Yes cumulative impacts are likely. The impact of this development in addition to the proposed Arrow Surat Gas Project would be experienced cumulatively, due to the potentially small distance between components of each scheme, as well as an increase in traffic along rural roads such as the Warrego Highway and Chinchilla-Tara Road. |
| 5. Kogan Creek Solar Boost Project | CS Energy Qld AREVA Solar | Project approved by the Commonwealth Government and Queensland Government in April 2011. | The Kogan Creek Solar Boost Project will involve the installation of a solar thermal addition to CS Energy's 750 megawatt coal-fired Kogan Creek Power Station. The project will augment the Kogan Creek Power Station's steam generation system to increase the station's electricity output and fuel efficiency. Funding for the project includes a $70 million contribution from CS Energy and a contribution of more than $34 million from the Australian Government's Renewable Energy Demonstration | Kogan Creek Power Station | Construction due to commence in 2011; and anticipated to be operational by 2013. | Yes cumulative impacts are likely as the Kogan Creek Solar Boost Project is located within the project development area. |

| Proposed Project | Proponent(s) | Stage | Components | Location, distance and direction from project development area boundary | Timing | Consideration in the cumulative LVIA |
|---|---|---|---|---|---|---|
| | | | Program. | | | |
| 6. Elimatta Coal Project | Taroom Coal Pty Ltd. | Initial advice statement lodged October 2009. Final TOR issued – EIS in process (Proponent has until April 2012 to submit to DERM). | Open cut coal mine (over approximately 2,500 hectares), with approximately 42 km of rail line to connect the project to the Surat Basin Rail (north of Wandoan), and 12 MW power supply connection. | ~35 km west of Wandoan and project development area. | Commencement date for production is mid 2013. The mine will operate for approximately 25 years. | No. The impact of this development and the proposed Arrow Surat Gas Project would be experienced separately, due to the large distance between; therefore cumulative impacts are not likely. |
| 7. Emu Swap Dam Project | Southern Downs Regional Council (SDRC) previously Stanthorpe Shire Council. | EIS lodged January 2008. Supplementary EIS being prepared. SDRC currently investigating water supply options – research nearing completion with options identified and presented to Council for decision in April 2010. The Emu Swamp Dam EIS process is on hold until this process concludes. | Either a 5,000 ML urban water supply dam or a 10,500 ML urban and irrigation water supply dam; urban pipeline linking the dam to the Mt Marlay Water Treatment Plant, and a combined urban and irrigation dam connected to a number of irrigators in Stanthorpe Shire. | 15 km southwest of Stanthorpe. Located ~100km southeast of the project development area. | Upon approval, construction of the Emu Swamp dam and pipeline will take 15 to 18 months. | No. The impact of this development and the proposed Arrow Surat Gas Project would be experienced separately, due to the large distance between; therefore cumulative impacts are not likely. |
| 8. Felton Clean Coal Demonstration | Ambre Energy (Felton) Pty LtdProject | IAS lodged March 2009. Final TOR issued June 2009. Currently | The project will convert local coal to unleaded petrol and LPG, which will be available for domestic use. It will involve the construction of a coal-to- | A 2,000 hectare mining lease near between Pittsworth and Felton, ~30km south-west of Toowoomba. | Unspecified at this stage. | No. The impact of this development and the proposed Arrow Surat Gas Project would be experienced separately, due |

| Proposed Project | Proponent(s) | Stage | Components | Location, distance and direction from project development area boundary | Timing | Consideration in the cumulative LVIA |
|---|---|---|---|---|---|---|
| | | preparing a draft EIS. | liquids facility, adjoining open-cut coal mine, dames, coal stockpile, conveyor systems and a power generation plant. | Located ~35km to the east-southeast of the project development area. | | to the large distance between; therefore cumulative impacts are not likely. |
| 9. Santos Gladstone Liquefied Natural Gas (GLNG) Project | Santos Ltd, PETRONAS, Total and KOGAS | The Coordinator-General's report (approved on 28 May 2010) decided that the project can proceed subject to certain conditions. | The LNG facility will be located in the south-west section of Curtis Island and will liquefy the gas collected from Santos's resources in the Bowen and Surat Basins to enable it to be transferred to ships for export. | Curtis Island, Gladstone. ~272km to the north-east of the project development area. | Construction is due to commence in 2011, with the first cargoes scheduled to be exported from 2015. | No. The operational impact of this development and the proposed Arrow Surat Gas Project would be experienced separately, due to the large distance between; therefore cumulative impacts are not likely. |
| 10. Gladstone LNG Project – Fisherman's Landing | Gladstone LNG Pty Ltd | The EIS Assessment Report has been issued to the project is considered suitable to proceed to the next stage of the approval process. | GLNG PL is proposing to develop a 2.6 million tonne per annum, mid-scale, liquefied natural gas (LNG) plant at Fisherman's Landing in the Port of Gladstone, which will process coal seam gas sourced from the Bowen Basin gas fields and load it onto vessels for export. The development will incorporate the construction and operation of a medium scale LNG plant, including treatment and liquefaction facilities, storage tanks and jetty/ship loading facilities. | Fisherman's Landing, Gladstone. Located ~270km to the north-east of the project development area. | Upon approval, the project anticipates a ~5 year construction period for two stages, with an expected project life of 25 years. | No. The operational impact of this development and the proposed Arrow Surat Gas Project would be experienced separately, due to the large distance between; therefore cumulative impacts are not likely. |
| 11. Moura Link – Aldoga Rail Project | Queensland Rail Ltd | The Coordinator-General determined that the project can proceed subject to specific recommendations | New maintenance yard and rail link (Moura link) and rail upgrades (west of Yarwun) to carry Moura/Surat traffic to the North Coast Line to service the increasing demand for the export of coal from Central Queensland coal mines; in particular, the proposed | ~15km east of Gladstone. Located ~240km to the north-east of the project development area. | Construction period anticipated during 2011-2013. | No. The impact of this development and the proposed Arrow Surat Gas Project would be experienced separately, due to the large distance between; therefore cumulative impacts are not likely. |

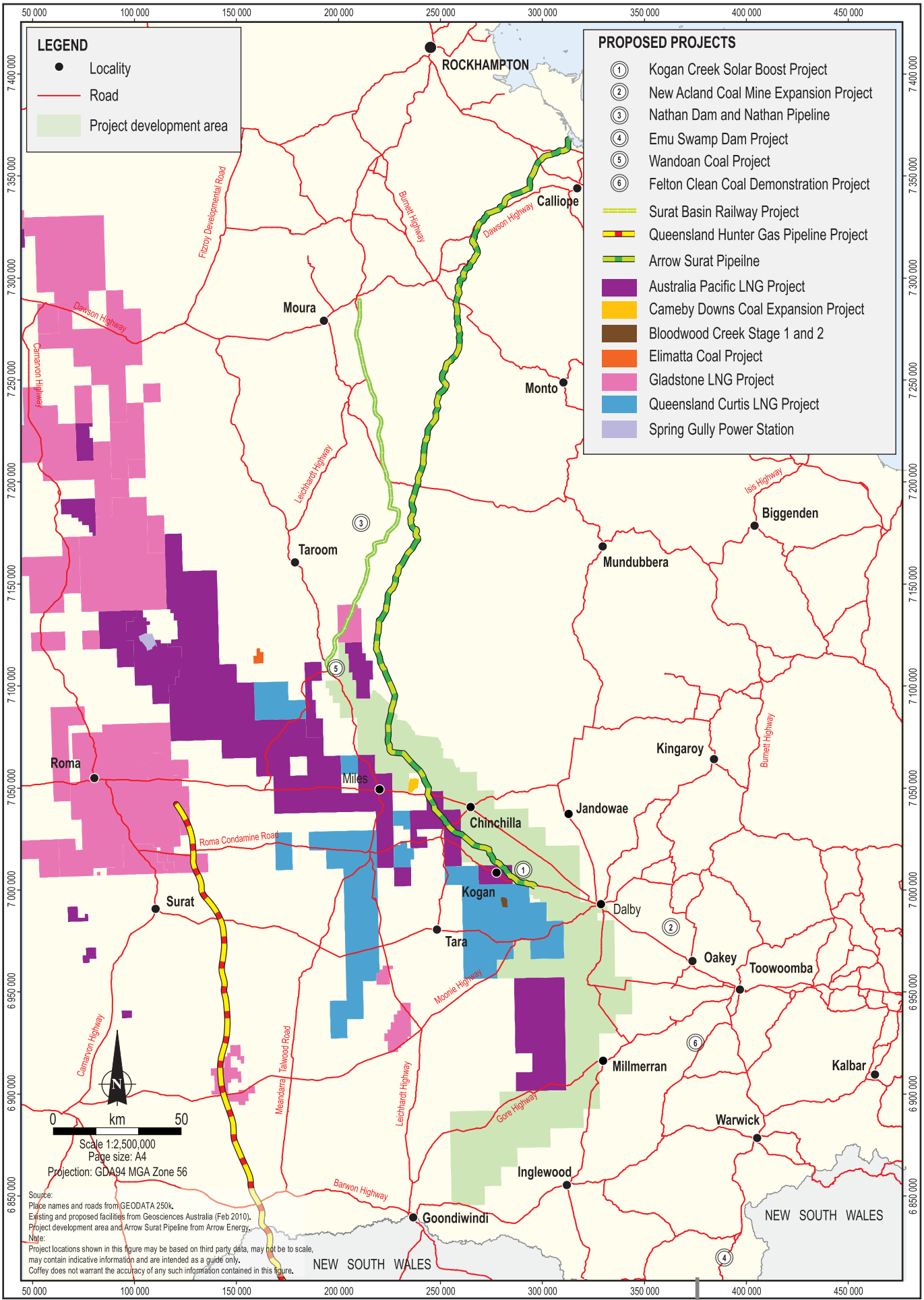
| Proposed Project | Proponent(s) | Stage | Components | Location, distance and direction from project development area boundary | Timing | Consideration in the cumulative LVIA |
|---|---|---|---|---|---|---|
| | | and conditions as outlined in the report to manage potential adverse impacts. | Wiggins Island Coal Terminal and other rail tracks in the Gladstone region. | | | |
| 12. Nathan Dam and Pipelines | Sunwater | The Proponent is currently preparing the EIS. | Water from the dam will be transported via a new pipeline to mines and power stations in the Surat Coal Basin, potentially extending as far as Dalby. Water will also be released downstream to mines in the Southern Bowen Coal Basin, to customers in the Dawson Valley Water Supply Scheme, and as required to meet critical urban supply needs in the lower Fitzroy Basin and other parts of regional Queensland in line with the government's objective to establish a state water grid. In order to meet anticipated demands, Nathan Dam will need to be supplying water by 2014. | ~70km downstream of Taroom.<br>Located ~60km to the north-north east of the project development area. | If approved, construction is anticipated to commence in 2015, with operation commencing in 2018. | No. The impact of this development and the proposed Arrow Surat Gas Project would be experienced separately, due to the large distance between; therefore cumulative impacts are not likely. |
| 13. New Acland Coal Mine Stage 3 Expansion Project | New Hope Corporation Limited | The Proponent is currently preparing the Supplementary EIS. | Expansion to existing open cut coal mine lease (currently operates 4.2 million tonnes per annum [Mtpa]) to a capacity of 10Mtpa. The Project is expected to extend coal production at the Mine until approximately 2042; supplying coal to overseas markets and power stations in South East Queensland. | ~14km north-northwest of Oakey. Located ~40km to the east of the project development area. | The Stage 3 expansion works is expected to extend the mine life to around 2042. | No. Although the traffic along the Warrego Highway may increase during the construction phase; the operational impact of this development and the proposed Arrow Surat Gas Project would be experienced separately, due to the large distance between. Therefore cumulative impacts are not likely. |
| 14. Queensland Curtis LNG | QGC Pty Ltd (BG Group | The Project received | Coal seam gas fields in the Surat basin, construction of 380 km gas | The gas fields lie adjacent to the western boundary of the | Construction phase 2010 to | Yes cumulative impacts are likely. The impact of this |

| Proposed Project | Proponent(s) | Stage | Components | Location, distance and direction from project development area boundary | Timing | Consideration in the cumulative LVIA |
|---|---|---|---|---|---|---|
| Project (QCLNG) | Business) | conditional environmental approval by DERM in June 2010 and DSEWPC in October 2010. FID taken 31 October 2010. | pipeline linking the gas fields to Gladstone, and development of a natural gas liquefaction plant (12 Mtpa) on Curtis Island. | project development area near Chinchilla and Kogan. | 2013. Operation phase 2014 to 2021. | development (gas fields and pipeline only) in addition to the proposed Arrow Surat Gas Project would be experienced cumulatively, due to the close proximity between gas field project development areas. |
| 15. Queensland Hunter Gas Pipeline Project | Hunter Gas Pipeline Pty Ltd | Pipeline license issued by QLD government in April 2007. Project conditions issued by NSW government in February 2009. | 831 km gas pipeline between Newcastle (NSW) and Wallumbilla Gas Hub (approximately 50km north of Surat). | The northern part of the pipeline is located ~120km west of the project development area, west of Miles. | Construction was expected late 2010-2011; but now expected to commence in 2012. | No. The impact of this development and the proposed Arrow Surat Gas Project would be experienced separately, due to the large distance between; therefore cumulative impacts are not likely. |
| 16. Spring Gully Power Station | Origin Energy Power Ltd | The Project received conditional environmental approval in September 2006. | A 1,000WM gas fired power station located at the site of Origin Energy's Spring Gully coal seam gas production development area. Part of the project involves construction of a high voltage double circuit overhead electricity transmission line to transport power into the national grid, including a 250km line to the Braemar substation near Kogan Creek (to be assessed and developed separately). | ~80km north- east of Roma. Located ~90km to the north-north west of the project development area. | Construction of the Spring Gully Power Station has been delayed. Once commenced, power station construction to take 30-34 months. | No. The impact of this development and the proposed Arrow Surat Gas Project would be experienced separately, due to the large distance between; therefore cumulative impacts are not likely. |
| 17. Surat Basin Rail project | Surat Basin Rail Pty Ltd | The Project received conditional environmental approval in December 2010. | The Surat Basin Rail Joint Venture has received environmental approval from the Queensland Government to proceed with the construction of a new rail line to link the Western Railway System (near Wandoan), with the Maura Railway System near Banana. | Between the proposed Wandoan coal mine to the coal loading facility at the Port of Gladstone. Located ~3km to the west of the northern part of the project development area. | Construction commencement anticipated in 2012, pending commercial agreements with foundation | Yes cumulative impacts are likely. The impact of this development in addition to the proposed Arrow Surat Gas Project would be experienced cumulatively in northern parts of the project development area, |

| Proposed Project | Proponent(s) | Stage | Components | Location, distance and direction from project development area boundary | Timing | Consideration in the cumulative LVIA |
|---|---|---|---|---|---|---|
| | | | The single line railway (approximately 60 metres in width, with wider sections as required for related earthworks) is planned to accommodate diesel hauled trains up to 2.5km in length to carry coal from the proposed Wandoan coal mine to the coal loading facility at the Port of Gladstone. The railway will be fenced along the entire length and will be supported by signalling and communication equipment that will require power supply. A maintenance track will run adjacent to the rail line and within the fenced boundary. | | customers. . Design life of the railway is a minimum of 50 years. Railway construction to take approx 33 months (6 months early works, 24 months main construction and 3 months commissioning). | due to the potentially small distance between the components of each scheme. |
| 18. Wandoan Coal Project | Xstrata Coal | IAS lodged December 2007. EIS lodged December 2008. Supplementary EIS prepared October 2009. Project approved with conditions by the Queensland CG in November 2010. Federal government approval with conditions in March 2011. | Xstrata have received conditional environmental approval from the Commonwealth Government (November 2010) for the construction and operation of an open cut coal mine and supporting infrastructure, proposed to produce around 30 million tonnes of Run of Mine (ROM) coal per year, using dragline, truck and excavator equipment. It is proposed that the coal will be crushed, processed and blended on site before being transported by rail to the Gladstone area for export. | Immediately west of Wandoan.<br>Located ~3km to the west of the northern part of the project development area. | Construction expected to commence once necessary approvals and Mining Lease have been granted, and critical rail and port infrastructure is in place | Yes cumulative impacts are likely. The impact of this development in addition to the proposed Arrow Surat Gas Project would be experienced cumulatively, due to the potentially small distance between components of each scheme, as well as an increase in traffic along rural roads such as the Leichhardt Highway. |
| 19. Wetalla Water Pipeline Project | New Hope Corporation Limited | Operational. The Project received conditional environmental | 45 km underground pipeline to carry waste water from WWRF to the expanding New Acland Coal Mine; including ancillary equipment (storage | Between Toowoomba's Wetalla Water Reclamation Facility (WWRF) and New Acland Mine. | Operational. | No. Although the traffic along the Warrego Highway may increase during the construction phase; the operational impact of |

| Proposed Project | Proponent(s) | Stage | Components | Location, distance and direction from project development area boundary | Timing | Consideration in the cumulative LVIA |
|---|---|---|---|---|---|---|
| | | approval in December 2008. | tanks at the WWRF and mine, pump station at the WWRF, surge tower at highest pipeline point and several small maintenance points and control valves along the pipeline route). | Located ~40km to the east of the project development area. | | this development and the proposed Arrow Surat Gas Project would be experienced separately, due to the large distance between. Therefore cumulative impacts are not likely. |

The location of each project is illustrated in **Figure 41**.

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**LOCATION MAP OF PROJECTS INCLUDED IN THE CUMULATIVE IMPACT ASSESSMENT**

Arrow Energy
Surat Gas Project LVIA

Figure
41

## 11.2 Assessment of Cumulative Impact

The assessment of cumulative impact is judged on the basis of publicly available information for each project listed in Table 31 (e.g. Developer website, EIS), information from the Department of Infrastructure and Planning (e.g. "Key" infrastructure projects), Arrow's description of the Surat Gas Project and site visits.

Three types of cumulative impacts on landscape character and visual amenity have been considered in the assessment:

- "Combined" impacts occur where a static receptor is able to view two or more developments from a standpoint/viewpoint within the receptors arc of vision (assumed to be 120 degrees for the purpose of this assessment) at the same time.
- "Successive" impacts occur where a receptor is able to view two or more developments from a viewpoint, but needs to turn their head to see them.
- "Sequential" impacts occur where a receptor is moving from one area to another, for instance when a person is travelling along a road or track, and is able to see two or more developments at the same, or at different times as they pass along the route. Sequential effects can potentially affect views from routes over a wide area, but for the purposes of this assessment, we have described these to within a ~30km off-set to the project development area boundary.

With the exception of Chinchilla coal gasification demonstration facility project, Wandoan Coal Project, Cameby Downs Coal Mine expansion project and Surat Basin Rail Project; there are few places from which multiple developments may be seen at the same time (i.e. "combined" and "successive" impacts) or sequentially. This is primarily due to the large distance between the developments, combined with the presence of vegetation and changes in landform (i.e. undulations in the landscape providing enclosure to views). It is likely that 8 of the 19 developments listed above will result in significant cumulative landscape and visual impacts, described as follows:

**Arrow Surat Pipeline**

Arrow proposed to develop a pipeline to deliver coal seam gas from a point adjacent to the Kogan North Central Gas Processing Facility near Dalby to a proposed Liquefied Natural Gas (LNG) facility at Gladstone. The alignment of this 467km long buried gas pipeline between the Surat Basin gas fields and Gladstone, traverses through the central and northern part of the project development area. Construction will require a 30m right-of-way (ROW) for clearing and grading, trenching and spoil placement, pipeline stringing, welding and laying. Above ground facilities would be required at intervals along the pipeline, including: mainline valves; cathodic protection systems and marker signs. The EIS received conditional environmental approved in January 2010. It is anticipated that construction of the pipeline will start in 2015/16, with first gas supplied two to three years after that. The pipeline has a technical design life of 40 years.

Assuming this project and the development of Arrow Surat Gas Project go ahead, there are likely to be cumulative impacts in the region near Miles, as a result of:

- Combined and successive visual impacts for residents and visitors in the region of Dalby, Kogan, Chinchilla, Miles and Wandoan.
- Sequential visual impacts, potentially along the Warrego Highway and Dalby-Kogan Road.
- Additional traffic along rural roads, particularly along the Warrego Highway and Dalby-Kogan Road, including transportation of the pipe sections via trucks and the construction crews.
- Presence of at least three temporary workforce accommodation adjacent to the pipeline route for the pipe laying crew, requiring accommodation units, power generation, sewage treatment and potable water.
- Potential temporary road closures and realignments (i.e. the pipeline route passes beneath the Warrego Highway between Chinchilla and Miles).
- Additional short term impacts on the landscape character, views and visual amenity as a result of construction activities installing the coal seam gas facilities in addition to the pipeline route, as indicated in (including vegetation removal, topsoil stripping and stockpiling, grading, trenching and backfilling, welding, temporary lighting) in additional to the coal seam gas construction activities.

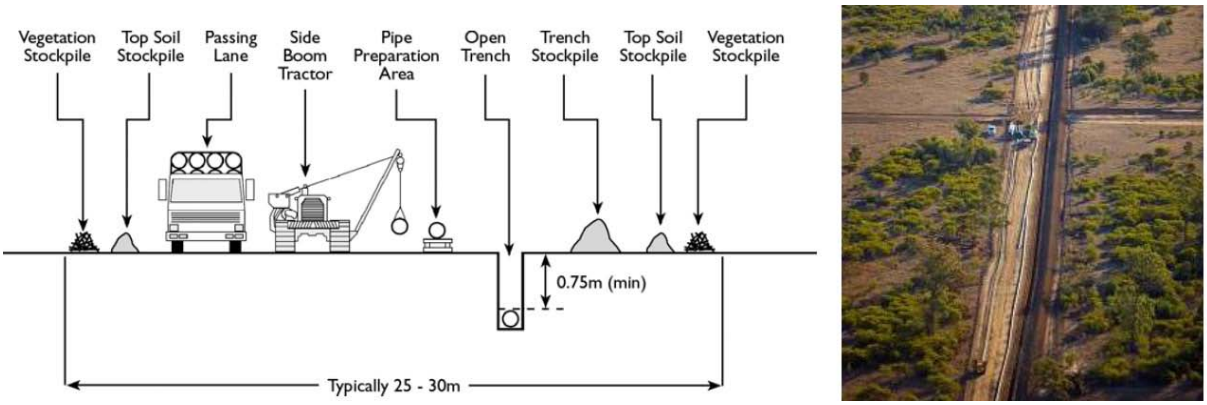


**Figure 42 Typical ROW Corridor for Pipeline Construction**
(source: Arrow Energy (2008) *Initial Advice Statement: Surat Gladstone Pipeline*, (URL: http://www.derm.qld.gov.au/register/p02936aa.pdf)

These activities would be likely to influence several of the landscape character types within the project development area, between Dalby, Kogan, Chinchilla, Miles and Wandoan. The pipeline will be layed and restored section by section, within three months. The rehabilitation will take place as soon as practical after pipe laying and backfill, and tailored to the site-specific conditions, in consultation with the landholders. Long term effects will include the presence of a fenced 15m easement with marker signs; resulting in a noticeable magnitude of change in the appearance of surface landscape and visual character.

**Australia Pacific LNG Project**

APLNG proposes to develop the Walloons gas fields in the Surat Basin (requiring ongoing drilling of wells and installation of associated field infrastructure), a high pressure gas transmission pipeline linking the gas fields to Gladstone, and a LNG facility on Curtis Island over 30 years, with construction due to begin in 2011. The gas field mining leases are located adjacent to the northern and western boundaries of the project development area near Wandoan Miles, Kogan and Millmerran. Assuming this project and the development of Arrow Surat Gas Project go ahead, there are likely to be cumulative impacts resulting from the incremental development of the gas fields and high pressure pipeline, which are located in close proximity to the Arrow field development activities and occur in parallel over a 30 year life. The key cumulative impacts anticipated include:

- Significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the installation of the APLNG and Arrow field development, including gas wells and associated well head infrastructure (involving a maximum 18m cleared ROW during construction), low pressure gas and water gathering networks, APLNG high pressure pipeline, gas processing facilities, water treatment facilities, storage ponds (for brine and water), access roads, temporary accommodation camps, and supporting facilities, sewage treatment systems, and services (e.g. site offices, lunch rooms, ablution blocks, generators, waste storage facilities). Installation of these facilities will require the transportation and presence of major machinery and equipment (e.g. dozers, graders, excavators, cranes, trucks, trenchers).
- The potential residual loss of landscape features required as a result of installing the coal seam gas components within the development areas, which may fundamentally change the character of the landscape.
- Impact on sensitive visual receptors, including those that may live in close proximity to the coal seam gas. facilities (near Wandoan Miles, Kogan and Millmerran) who would experience the facilities on a daily basis
- Additional traffic along rural roads due to .the construction and ongoing maintenance to the coal seam gas facilities, particularly along Dalby-Kogan Road and the Warrego Gore Highways.
- Sequential visual impacts for visitors and travellers/motorists, particularly along Dalby-Kogan Road and the Warrego Gore Highways.
- Changing perception of the character of the landscapes and townships i.e. changing from a landscape defined by farming and grazing, to a landscape strongly characterised by coal seam gas development.

**Bloodwood Creek Queensland – Stage 2 (Commercial Gas Production)**

Carbon Energy (Operations) Pty Ltd is currently operating a pilot Underground Coal Gasification (UCG) trial (Stage 1, including a 5MW Power Station) at Bloodwood Creek, using the Walloon Coal Measures within the Surat Basin, ~40km west of Dalby (south of Kogan). Stage 2 environmental investigations are currently underway, involving the development of a 25MW power station fuelled by UCG syngas, to be located adjacent to

the existing 5 MW plant at Bloodwood Creek, as indicated in **Figure 43**. The scoping study for Stage 2 will be progressed in 2011 and construction works are due to commence in 2014, with a mine life of 30 plus years.


**Figure 43 Location of the Proposed Stage 2 Bloodwood Creek 25MW Power Station site**
(source: Carbon Energy (2008) *Bloodwood Creek Queensland Phase 2 Power Generation*, (URL: http://www.carbonenergy.com.au/index.php/projects/bloodwood-creek-queensland)

Assuming this project and the development of Arrow Surat Gas Project go ahead, there are likely to be cumulative impacts in the region near Kogan, as a result of:

- Significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and construction activities.
- The potential residual loss of landscape features (i.e. trees, shrubs, understorey) required as a result of installing the projects, which may result in a considerable change the character of the landscape; particularly the *Lowland Native Forest* landscape character type.
- Increase in traffic on rural roads e.g. due to required construction and ongoing maintenance of the projects.
- Changing perception of the character of the landscapes i.e. changing from a landscape defined by farming, grazing and native forest, to a landscape strongly characterised by coal seam gas development and other energy infrastructure.

**Cameby Downs Coal Mine expansion project**

Syntech Resources' (Syntech) submission for the Cameby Downs Stage 1 Coal Mine (ML50233) has been approved and construction works were planned to commence during 2009. Syntech are now proposing to increase the rate of mining of run of mine (ROM) coal from 1.8 million tonnes a year (Mt/y) to 25Mt/y to produce 15Mt/y to 20Mt/y of product coal for export, as part of the Stage 2 development plan. The mine life is estimated at around 40 years, comprising a two year construction period and 35 to 40 years of production. The project site has an area of approximately 13, 370ha.

Coal will be transported from the Rywung area to the Cameby Downs coal handling and processing plant. While it is not currently proposed to mine through or under the Warrego Highway and the adjacent Western Railway Line, a further mining lease (ML) or MLs for transportation will also be required to transport coal across the Warrego Highway and Western Railway Line. Various options, such as a private haul road, rail, conveyor as well as tunnels and bridges are being considered.

Assuming this project and the development of Arrow Surat Gas Project go ahead, there are likely to be cumulative impacts in the region near Miles, as a result of:

- Combined and successive visual impacts for residents and visitors in the region of Miles and Columboola.
- Sequential visual impacts, potentially along the Warrego Highway and other minor rural roads (e.g. Boort Koi Road).
- Additional traffic along rural roads, particularly along the Warrego Highway.
- Potential temporary road closures and realignments.
- Additional short term impacts on the landscape character, views and visual amenity as a result of construction activities installing the coal seam gas facilities (including excavation, trenching, drilling, earthmoving, vegetation clearance/trimming, temporary lighting) and mining facilities (approximately 2 year

construction period, including vegetation removal, topsoil stripping and stockpiling, and installing the coal handling and preparation plant, run of mine pad, coal transfer area and lay-down areas, rail loop area, train loading facility, sewerage treatment plant, substation, surface water management dams, water pipelines, workshops, offices, car parking, fuel, oil and chemical storages, fencing, access roads and haul roads).

- Additional long impacts as a result of the presence of mining crews and accommodation facilities (including transportation of the crew between activity sites and nearby towns i.e. Miles), large scale machinery (and associated noise emissions, including dragline excavator), presence of the coal seam gas facilities in combination with the mining elements (including mine pits, coal handling and preparation plant, tailings dam, substation), and on-going coal seam gas and mining activities (including constant use of access and haul roads, blasting and crushing of raw feed in pit)
- Additional movement in the landscape east of Miles due to rail loading and transport of processed coal via the existing rail system from Cameby Downs to the Port of Brisbane, and via the proposed Surat Basin Rail Link to the Gladstone Port.
- Additional short term, impacts on the landscape and visual resource as a result of the presence of construction crews, temporary mobile camp, and large scale machinery removing the coal seam gas and mining facilities and rehabilitating sites.

These activities would be likely to influence the high level of naturalness with a strong sense of remoteness in this *Lowland Native Forest* landscape character type. However, sites affected are likely return to a more rural appearance over time, as the sites are rehabilitated and the vegetation (grassland, trees and shrubs) established and matures; resulting in a negligible impact on the appearance of surface vegetation in the longer term. Although selected access tracks may remain in situ (as agreed) for use by the farmers/ landowners.

**Kogan Creek Solar Boost Project**

This project involves the installation of a 44 megawatt solar thermal addition to the Kogan Creek Power Station plant, as illustrated in Figure 44. It will work by using compact linear fresnel reflector technology to supply additional steam to the turbine, supplementing the conventional coal-fired steam generation process. The project is anticipated to be operation by 2013.


**Figure 44 An aerial impression of where the Solar Boost Project will be constructed at Kogan Creek Power Station** (source: CS Energy (2011) *Kogan Creek Solar Boost Project*, (URL: http://www.csenergy.com.au/userfiles/file/Kogan%20Creek%20Solar%20Boost%20fact%20sheet%20April%202011.pdf)

Assuming this project and the development of Arrow Surat Gas Project go ahead, there are likely to be cumulative impacts, particularly in the central-western part of the project development area near Kogan due to the construction and operation of the projects. The key cumulative impacts anticipated include:

- Significant adverse, albeit short term, impacts on the landscape character, views and visual amenity as a result of the presence of construction crews and temporary mobile camp (including transportation of the crew between activity sites and nearby towns) and construction activities
- The potential residual loss of landscape features (i.e. trees, shrubs, understorey) required as a result of installing the projects, which may fundamentally change the character of the landscape
- Increase in traffic on rural roads e.g. due to required construction and ongoing maintenance of the projects
- Changing perception of the character of the landscapes i.e. changing from a landscape defined by farming and grazing, to a landscape strongly characterised by coal seam gas development and other energy infrastructure

**Queensland Curtis LNG (QCLNG) Project**

QGC received approval in 2010 and has commenced construction of the gas fields (adjacent to the western boundary of the project development area near Chinchilla, Kogan and Miles) and high pressure pipeline ROW, linking the Surat Basin gas field with Gladstone, including a workforce accommodation camp near the Chinchilla-Tara Road crossing. Assuming the Arrow Surat Gas Project goes ahead, there are likely to be cumulative impacts resulting from the incremental development of both project gas fields and high pressure pipelines, which are located in close proximity and occur in parallel over a 30 year life. The key cumulative impacts anticipated will be similar to those listed under the APLNG project (due to the similar timescale and character of these LNG developments).

**Surat Basin Rail Project**

The proposed Surat Basin Rail project is being facilitated through a joint venture, including Australian Transport and Energy Corridor Limited, Xstrata Coal and Queensland Rail. The project is described as an open access, multi-user railway initially consisting of a single track (with up to eight passing loops) which provides access for diesel hauled trains (up to 2.5km in length) carrying coal from the proposed Wandoan coal mine to the coal loading facility at the Port of Gladstone. The project will have a minimum life of 50 years and is expected to reach full operational capacity within five to ten years of construction. Following the submission of a Supplementary EIS Report to the Coordinator-General in November 2009, the proponent received conditional environmental approval from the Queensland Government in December 2010 to proceed with the construction and operation of the project. Construction commencement is anticipated in 2012, pending commercial agreements with foundation customers.

Assuming this project and the development of Arrow Surat Gas Project go ahead, there are likely to be cumulative impacts in the northern part of the project development area, as a result of:

- Combined and successive visual impacts for residents and visitors in the region of Wandoan.
- Sequential visual impacts, potentially along the Leichhardt Highway and other minor rural roads (e.g. Roche Creek Road).
- Additional traffic along rural roads, particularly along the Leichhardt Highway.
- Potential temporary road closures and realignments.
- Additional short term impacts on the landscape character, views and visual amenity as a result of construction activities installing the coal seam gas facilities (including excavation, trenching, drilling, earthmoving, vegetation clearance/trimming, temporary lighting) and rail infrastructure (approximately 3 year construction period, including vegetation removal, topsoil stripping and stockpiling, and installing the railway embankment and cuttings, track, bridges and rail crossings, signalling equipment, fencing, drainage works, site access tracks, workforce accommodation and offices, water reticulation for construction site and construction camp, sewerage treatment plant and water treatment plant).
- Additional long impacts as a result of the presence of train operation (approximately 44 train drivers) and maintenance crews, and additional movement in the landscape north of Wandoan as a result of approximately 22 train movements per day at peak coal production levels.

As this project has a minimum 50 year operational lifespan, there are not likely to be cumulative impacts during decommissioning period (the Arrow Surat gas project development area is expected to cease after approximately 38 years).

Activities associated with the Surat Basin Rail project in addition to activities taking place within the Wandoan development area of the Arrow Surat gas project would be likely to influence the small-scale rural character and moderate sense of remoteness in this part of the *Sodic Transitional Pastures* and *Foothill Plains and Valleys* landscape character types. However, sites affected are likely return to a more rural appearance over time, as the sites are rehabilitated and the vegetation (crops, grassland, trees and shrubs) established and matures; resulting in a negligible impact on the appearance of surface vegetation in the longer term. Although selected access tracks may remain in situ (as agreed) for use by the farmers/ landowners.

**Wandoan Coal Project (Xstrata)**

Xstrata's proposed Wandoan Coal Project would include an open-cut coal mine, a coal handling and preparation plant, and supporting facilities. The project site is partly located within the northern part of the project development area, immediately west of Wandoan, and involved the development of an open cut coal mine and supporting infrastructure, producing around 30 million tonnes of Run of Mine (ROM) coal per year. It is proposed that the coal will be crushed, processed and blended on site before being transported by rail to the Gladstone

area for export.

Assuming this project and the development of Arrow Surat Gas Project go ahead, there are likely to be cumulative impacts in the region near Wandoan, as a result of:

- Combined and successive visual impacts for residents and visitors to Wandoan.
- Sequential visual impacts, in particular, the Leichhardt Highway and Jackson-Wandoan Road.
- Additional traffic along rural roads, particularly along the Leichhardt Highway.
- Temporary road closures and realignments.
- Construction of a new airstrip in the Wandoan district and additional flights of aircrafts in the area.
- Upgrading of the Wandoan Town wastewater treatment plant in Wandoan (including a pipeline from the mine site into Wandoan) and potable water treatment plant (including cooling tower for Wandoan and a pipeline to the mine).
- Proposed gas supply pipeline, supply gas to the gas fired power station
- Additional loss of pasture grazing fields and potential disruption to watercourses (and riparian trees) sourced from the *Elevated Native Forest* landscape character type along the Great Dividing Range
- Additional short term impacts on the landscape character, views and visual amenity as a result of construction activities installing the coal seam gas facilities (including excavation, trenching, drilling, earthmoving, vegetation clearance/trimming, temporary lighting) and mining facilities (approximately 3 year construction period, including installing the raw water supply pipeline, access roads and haul roads).
- Additional long impacts as a result of the presence of mining crews and accommodation facilities (including transportation of the crew between activity sites and nearby towns i.e. Wandoan), large scale machinery (and associated noise emissions, including dragline excavator), presence of the coal seam gas facilities in combination with the mining elements (including mine pits, coal handling and preparation plant, tailings dam, gas fired power station), and on-going coal seam gas and mining activities (including constant use of access and haul roads, blasting and crushing of raw feed in pit).
- Additional short term, impacts on the landscape and visual resource as a result of the presence of construction crews, temporary mobile camp, and large scale machinery removing the coal seam gas and mining facilities and rehabilitating sites.

These activities would be likely to influence the small-scale rural character and moderate sense of remoteness in this the in the *Sodic Transitional Pastures* landscape character type. However, sites affected are likely return to a more rural appearance over time, as the sites are rehabilitated and the vegetation (crops, grassland, trees and shrubs) established and matures; resulting in a negligible impact on the appearance of surface vegetation in the longer term. Although selected access tracks may remain in situ (as agreed) for use by the farmers/ landowners.

### 11.2.1 Expansion of coals seam gas developments

In addition to the 19 developments listed above, coal seam gas exploration and development in the Surat Basin is continuing to grow at a rapid rate; partly in response to encouragement by the Queensland Government[8] to make the transition from coal to gas, as an effective mechanism to reduce greenhouse gas emissions. Existing and proposed coals seam gas developments, considered in the CLVIA are listed in the following table:

**Table 32 Coals seam gas developments considered in the cumulative landscape and visual impact assessment[9]**

| Project name | Developer | Development stage | Distance & direction from project development area boundary |
|---|---|---|---|
| Argyle and Argyle East CSG development | Queensland Gas Company (BG Group) | Operational | Chinchilla area (Walloon Coal Measures) |
| ATP 631 CSG development | Santos Ltd | Under development | Injune area (Walloon Coal Measures) |

[8] The Queensland Government's *Smart Energy* Policy and *ClimateSmart 2050* strategy requires that by 2010, 15 per cent of all electricity sold in Queensland is to be sourced from gas-fired generation (the target will be increased to 18 per cent by 2020 to provide additional lower-emission generation for Queensland).

[9] Corporate Communications, Queensland Mines and Energy, *Queensland's coal seam gas overview* (August, 2009), URL: http://www.energy.qld.gov.au/zone_files/coal_files_pdf/new_csg_cc.pdf
The State of Queensland (Department of Employment, Economic Development and Innovation), *Interactive resource and tenure maps* (2009) URL: http://www.dme.qld.gov.au/mines/tenure_maps.cfm

| | | | |
|---|---|---|---|
| Bellevue CSG development | Queensland Gas Company (BG Group) | Operational | Chinchilla area (Walloon Coal Measures) |
| Berwyndale Deep CSG development | Queensland Gas Company (BG Group) | Under development | Chinchilla area (Walloon Coal Measures) |
| Berwyndale and Berwyndale South CSG development | Queensland Gas Company (BG Group) | Under development | Chinchilla area (Walloon Coal Measures) |
| Kenya CSG development | Queensland Gas Company (BG Group) | Operational | Chinchilla area (Walloon Coal Measures) |
| Kenya East/Jammat/Jen/Sean CSG development | Queensland Gas Company (BG Group) | Under development | Chinchilla area (Walloon Coal Measures) |
| Lauren/Codie CSG development | Queensland Gas Company (BG Group) | Operational | Chinchilla area (Walloon Coal Measures) |
| Matilda John CSG development | Queensland Gas Company (BG Group) | Under development | Chinchilla area (Walloon Coal Measures) |
| Owen/McNulty/Avon Downs CSG development | Queensland Gas Company (BG Group) | Under development | Chinchilla area (Walloon Coal Measures) |
| Peat CSG development | Origin Energy | Operational | Wandoan area (Baralaba Coal Measures) |
| Scotia CSG development | Santos Ltd | Operational | Wandoan area (Baralaba Coal Measures) |
| Talinga CSG development | Origin Energy | Operational | Chinchilla area (Walloon Coal Measures) |
| Woleebee Ck/Ross/Cam/Kathleen CSG development | Queensland Gas Company (BG Group) | Under development | Chinchilla area (Walloon Coal Measures) |

The location of these projects is illustrated in **Figure 45**.

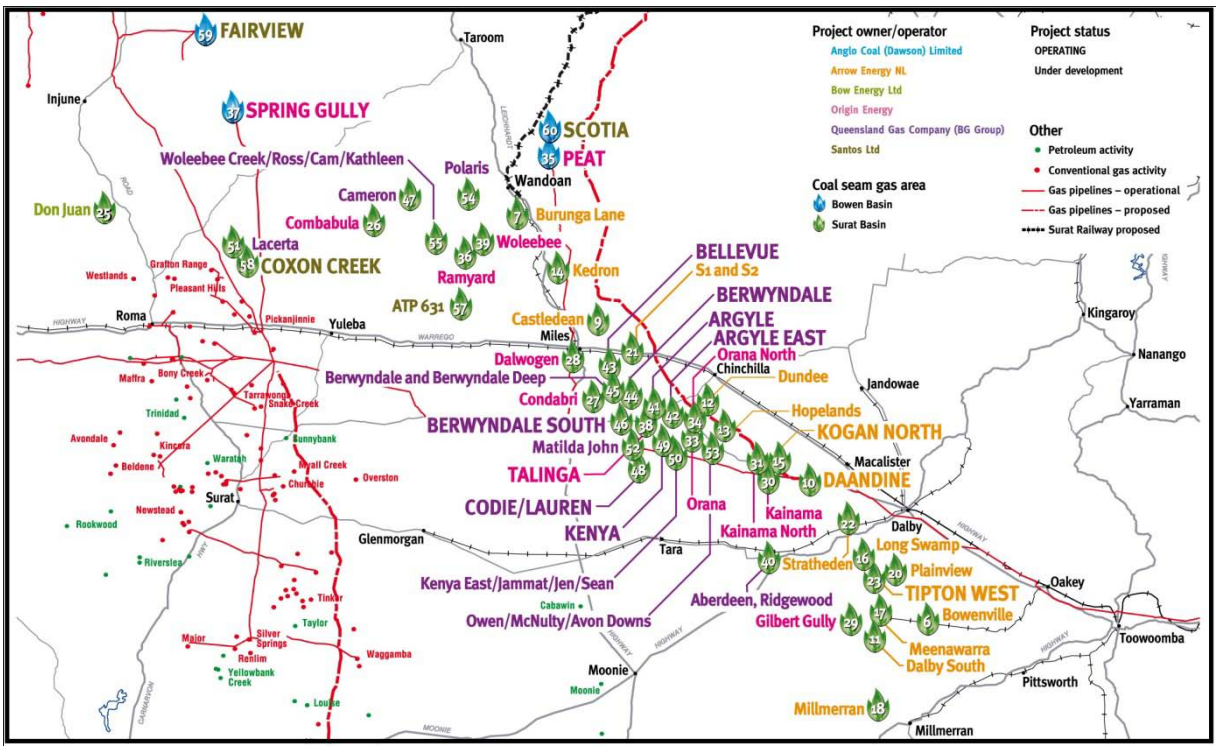


**Figure 45 Coal Seam Gas Ownership and Locality in the Surat and Bowen Basin**
(Source: The State of Queensland (Department of Employment, Economic Development and Innovation), February 2011)

Information to inform this CLVIA is based on approximately 5 development areas (comprising 6 FCFs, 6 CGPFs,

6 IPFs and water storage facilities) and a 800m grid spacing of wells over the 8,600km$^2$ project development area; in addition to similar scale projects listed in **Table 32**. As a result, it is likely that coal seam gas development activities will extend over several different landscape character types within and beyond the project development area. This may lead to a distraction from, and related reduction in the distinction between these different types. For example, as multiple coal seam gas developments are built, they are more likely to 'compete' with the landscape's original foci.

The impact will vary in intensity from location to location, depending on the availability of coal seam gas, and associated project phasing and focus of activity at the time. However, there is likely to be a multitude of development activities experienced across the Surat Basin in different stages of development (e.g. construction/installation; operation and maintenance; decommissioning and rehabilitation) over a number of years.

Cumulative impacts are particularly relevant to sequential impacts or kinetic view experiences i.e. those views experienced moving through a landscape, such as driving along a road. For example, as one moves through the Surat Basin landscape, changes in the landscape character may be increasingly related to the increase/frequency of coal seam gas components of several independent developments; such as Origin Energy's Peat coal seam gas development and Arrow Surat Gas Project in the landscape around Wandoan.

There is likely to be ongoing exploration and progressive development of production well and associated gathering lines in different locations and different times across the Surat Basin. In some cases, two or more production wells may be visible from the one standpoint, within the observer's arc of vision at the same time ("combined" impact) and/or in successively, given the small distance between the production wells (approximately 800m grid spacing). In addition, the wells and associated gathering infrastructure may also be in different stages i.e. during both installation (requiring drilling rig and a 30m wide "cut and cover" trenching corridor to install the gathering lines) and operation. These differing development activities may draw attention to these coal seam gas activities, in an otherwise rural landscape.

Consequently, the project and other coal seam gas developments are likely to be experienced cumulatively, rather than in isolation. Sequential cumulative impacts of the coal seam gas developments are a particular concern; most notably, the impact (combined and successive) of the production wells and as one moved through the landscape, due to their frequency and repetition.

# 12.0 References

Australia Pacific LNG (2010) Australia Pacific LNG Project Environmental Impact Statement, URL: http://www.aplng.com.au/eis-pdfs (accessed 10/05/11).

Carbon Energy Limited (2009) *Underground Coal Gasification Syngas Production and Power Generation – Bloodwood Creek Project Mining Lease Application Initial Asdice Statement,* URL: http://www.derm.qld.gov.au/environmental_management/impact_assessment/eis-processes/documents/bloodwood-initial-advice-statement.pdf (accessed 09/05/11).

The [former] Countryside Agency (CA) and Scottish Natural Heritage (SNH) (2002) *Landscape Character Assessment: Guidance for England and Scotland*.

The Landscape Institute (LI), UK (2009) *Landscape Institute Advice Note 01/09: Use of photography and photomontage in landscape and visual assessment*.

The Landscape Institute (LI) and the Institute of Environmental Management and Assessment (IEMA), UK (2002) *The Guidelines for Landscape and Visual Impact Assessment, Second Edition*.

Linc Energy Ltd (2007) *Underground Coal Gasification Gas to Liquids and Power Generation Project Chinchilla, Terms of Reference for an Environmental Impact Statement*, URL: http://www.dip.qld.gov.au/resources/project/linc/linc_energy_tor_nov07.pdf (accessed 19/02/10).

QGC Limited (2009) *Queensland Curtis LNG Project Draft and Supplementary Environmental Impact Statement*, URL: http://www.qgc.com.au/01_cms/details.asp?ID=427 (accessed 11/05/11).

Scottish Natural Heritage (SNH) and The [former] Countryside Agency (CA), UK (2006) *Topic Paper 6: Techniques and Criteria for Judging Capacity and Sensitivity*.

Scottish Natural Heritage (SNH) (2006) *Visual Representation of Windfarms: Good Practice Guidance*.

The State of Queensland Department of Employment, Economic Development and Innovation (DEEDI) (2009) *Interactive resource and tenure maps*, URL: http://www.dme.qld.gov.au/mines/tenure_maps.cfm (accessed 19/02/10).

The State of Queensland Department of Employment, Economic Development and Innovation (DEEDI) (2011) *Queensland's coal seam gas overview*, URL: http://www.dme.qld.gov.au/zone_files/coal_files_pdf/new_csg_cc.pdf (accessed 21/04/11).

The State of Queensland Department of Environment and Resource Management (DERM) (2010) *Terms of reference for the Cameby Downs Expansion Project EIS*, URL:http://www.derm.qld.gov.au/environmental_management/impact_assessment/current_eis_processes/pdf/cameby_downs_expansion_Project_final_tor_final.pdf (accessed 19/02/10).

The State of Queensland Department of Mines and Energy (2007) *ClimateSmart 2050: Queensland climate change strategy 2007: a low-carbon future*, URL: http://www.dme.qld.gov.au/Energy/energy_policy.cfm (accessed 19/02/10).

The State of Queensland (former) Department of Primary Industries and National Landcare Program (1995) *Land Resource Areas*.

Surat Basin Rail Joint Venture (2009) *Surat Basin Rail Project Environmental Impact Statement*, URL: http://www.suratbasinrail.com.au/eis.php (accessed 19/02/10).

Syntech Resources (2009) *Cameby Downs Expansion Project Initial Advice Statement*, URL:http://www.derm.qld.gov.au/register/p03029aa.pdf (accessed 19/02/10).