7

ENVIRONMENTAL FRAMEWORK

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7 Environmental Framework

This section outlines how the environmental framework approach has been applied to the Project. The framework approach was developed for Arrow's Surat Gas Project EIS (Arrow, 2011) and has also been adopted for this EIS.

A key premise of traditional environmental impact assessment is that the location, type, scale and duration of development is known; thus enabling the assessment of impacts from proposed construction, operation and maintenance activities on the environmental values at that place, at the nominated time. However this approach is not suitable for CSG field development projects.

For the proposed Project, development of the CSG field and production facilities will be progressive, extending over the life of the Project which would be at least 30 years. Unlike conventional gas resources, CSG resources are extensive, requiring widespread field development to recover the resource. The yield from target coal seams is variable across the gas field. This leads to uncertainty about the precise number, timing and location of wells required to dewater the coal seams and extract the gas.

This lack of certainty about the preferred location of infrastructure is an issue for the EIS because the detailed impacts at any specific location cannot be fully determined. However, they have been described in this EIS based on the typical impacts of CSG project activities. With that knowledge, greater certainty about potential impacts has been achieved by identifying those areas that are not amenable to certain types of development and if they were developed, how development should proceed. This has been achieved through the identification of constraints to development and the establishment of environmental management controls that will apply to Project activities in constrained areas.

For these reasons, the EIS has not been able to identify the exact locations of all wells, pipelines and other associated infrastructure throughout the life of the Project. However, as required under the *Environmental Protection Act 1994* (EP Act), the EIS does provide enough information about the impacts of the Project to enable the administering authority to decide whether the Project should proceed and, for the purposes of the bilateral assessment for the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) process, to provide the Commonwealth Environment Minister sufficient information to make a decision about the Project.

The siting of CSG infrastructure for this Project is a process of progressive refinement informed by exploration, resource validation, gas field design and environmental assessment to optimise the recovery of economic reserves. It has commenced with the development of a reference case or conceptual layout that describes how wells, gathering systems and production facilities might be arranged to extract and process gas (refer to the Project Description chapter (Section 4) of this EIS). The reference case has informed the assessment of impacts given in this EIS and it represents the worst case development scenario in terms of impact assessment.

The lack of certainty regarding the preferred location of infrastructure has resulted in the approach adopted for this Project being the identification of constraints to development and the establishment of environmental management controls that should apply to Project activities in constrained areas. Known as the environmental framework, this approach is an internal process developed by Arrow for managing impacts in the planning phase and in the construction and operation phases through the application of environmental controls that reflect the sensitivity or vulnerability of environmental values.

Constraints mapping, an integral part of the environmental framework, is informed by the environmental impact assessment and guides site and route selection that seeks to avoid and minimise impacts, thereby protecting environmental values.

Sections 7.1 to 7.4 explain the application of the framework approach to the EIS, and how the environmental framework will integrate with Arrow's health, safety and environmental management system (HSEMS).

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

7.1 Objective of the Environmental Framework

The principal objective of the environmental framework is to inform the Project planning and design in the protection of environmental values within the Project area (as defined in government policies and regulations or as an attribute of the environment that is conducive to ecological health, public amenity or safety). Further, the environmental framework identifies appropriate environmental management controls for Project activities, having regard to the constraints imposed by the environmental values.

Implementation of the environmental framework will enable Arrow to:

- Address uncertainty regarding potential impacts of the location and timing of Project infrastructure development, through consideration and avoidance of constrained areas during detail planning and design;
- Identify constraints to CSG development in the Project area, having regard to the sensitivity of identified environmental values;
- Document the constraints through mapping or the establishment of guidelines (including buffers, thresholds and trigger levels) to inform site and route selection for CSG infrastructure;
- Develop environmental management controls to address the identified constraints; and
- Integrate the environmental framework with the HSEMS.

The framework approach ensures that planning and development of CSG fields will occur in an orderly manner, applying environmental management controls (avoidance, mitigation and management) that reflect of the level of sensitivity of environmental values.

7.2 Constraints to Development

Current state government and federal government approvals granted for CSG projects within the region were reviewed to understand the values and conditions that have been of consideration to regulatory bodies.

In the environmental authorities for recently approved CSG projects, petroleum activities have been separated into three categories:

- Low impact petroleum activities;

- Limited petroleum activities; and
- Petroleum activities.

'Low impact petroleum activities' have been defined as: 'limited petroleum activities' which do not result in the clearing of native vegetation, cause disruption to soil profiles through earthworks or excavation or result in significant disturbance to land (e.g. soil surveys, topographic surveys, cadastral surveys, ecological surveys and traversing land by car or foot via existing access tracks or routes or in such a way that does not result in permanent damage to vegetation).

'Limited petroleum activities' are generally listed as a restricted set of activities that may include:

- Well sites less than 1 hectare (ha) (and the infrastructure located on the well site);
- Geophysical surveys;
- Gathering / flow pipelines from a well head to the initial compression facility;
- Supporting access tracks; and
- Communication and power lines necessary for the undertaking of petroleum activities.

Generally 'limited petroleum activities' do not include:

- Dams;
- Borrow pits;
- Compressor stations; and
- Workforce accommodation / campsites.

'Petroleum activities' are all activities that are not classified as either 'low impact petroleum activities' or 'limited petroleum activities'.

Using these definitions, a matrix of constraint levels with associated petroleum activities and mitigation / control measures was developed to govern broad decision making and planning processes. This is outlined in Table 7-1.

Also listed in Table 7-1 are the appropriate levels of environmental management controls for construction, operation and maintenance, and decommissioning activities undertaken in the constrained areas. The controls apply cumulatively (i.e. controls applicable to Project activities in highly constrained areas incorporate the controls that apply to Project activities in moderate and least constrained areas).

Table 7-1 Permissible Project Activities Based on Level of Constraint

Constraint	Project Activity			Environmental Management Control
	Low Impact Petroleum Activities	Limited Petroleum Activities	Petroleum Activities	
No go	Yes	No	No	Site-specific environmental management measures
High	Yes	Yes	No	Site-specific environmental management measures
Moderate	Yes	Yes	Yes	Specific environmental management measures

Constraint	Project Activity			Environmental Management Control
	Low Impact Petroleum Activities	Limited Petroleum Activities	Petroleum Activities	
Low	Yes	Yes	Yes	Standard environmental management measures

This matrix is used as a guide for preferentially locating Project activities within low (or no) constraint areas and moving up constraint levels when it is not possible or feasible to locate activities within the preceding constraint level.

The level of constraint will determine the type of activity that can take place within the mapped constraint area. The constraint categories provide an indication of the level of approval or assessment that may be required and any additional management controls that may be necessary from developing within that area (for example, providing offsets or the clearing of vegetation). An explanation of the categories and some of the additional work that may be required is found below:

No go areas: The only activities to be undertaken in these areas will be low impact petroleum activities, as defined above. Examples of these areas would include; nature refuge areas, national parks, towns, residences etc. No go areas within the Project area include:

- Registered significant Indigenous and non-indigenous cultural heritage sites;
- Homevale National Park; and
- The towns of Coppabella, Middlemount and Blackwater.

High constraint areas: In addition to the mapped constraint, development within these areas would most likely require additional assessment and/or approval processes. Such processes might include flora or fauna surveys, and rehabilitation or relocation programs. Consultation with stakeholders is probable. Extra conditions may be imposed (such as limiting the width of right-of-ways, limiting road widths or development footprint areas). Offsets may be required. Costs of development in these areas will probably be higher than in non-constrained areas. Examples of these areas would include: endangered regional ecosystems, sensitive receptor buffers and buffer zones of no-go areas.

Moderate constraint areas: In addition to the mapped constraint, development within these areas may require additional approval processes. Such processes may include flora or fauna surveys and rehabilitation or relocation programs. Consultation with stakeholders might be required. Certain types of infrastructure might require site specific mitigation measures and if possible, be required to be located elsewhere. Offsets might be required. Costs of development in these areas may be higher than in non-constrained areas. Examples of these areas might include least concern remnant vegetation or areas with visual amenity values.

Low constraint areas: In addition to the mapped constraint, development within these areas may require additional approval processes. Such activities might include mitigation activities or implementation of management plan activities. Offsets are unlikely. Costs of development in these areas may be slightly higher than in non-constrained areas.

Initial assessment of the Project area was undertaken (see Appendix BB), and using various datasets, values within the following categories were identified and mapped:

- Natural Environment / Ecology,
- Surface water,
- Land tenure,
- Land use,
- Cultural heritage (indigenous and non-indigenous),
- Landscape and visual amenity,
- Engineering, and
- Roads.

7.3 Constraints Analysis

The method for undertaking constraints analysis is described in the following section. Presentation of the constraints maps produced for the Project area are provided in Constraints Mapping (Appendix BB of the EIS).

7.3.1 Methodology

Constraints analysis was undertaken to construct a number of GIS datasets or layers for each relevant environmental aspect, and then a spatial analysis was undertaken to determine the level of constraint.

Two analyses were performed. The first involved determining the level of constraint posed by each environmental aspect. The second evaluated the cumulative effect of combining certain layers (e.g., all nature conservation related environmental aspects).

Analysis was performed on each individual environmental constraint in isolation from other constraints. Where multiple constraints overlapped, the highest level of constraint prevailed. The individual constraints were then compiled into a combined layer where all constraints could be viewed on one map. All individual constraints layers and the combined constraints maps are presented in Constraints Mapping (Appendix BB of this EIS).

The maps are restricted to a resolution of 1:100,000 or higher due to is the accuracy of the base information. Queensland and Australian government GIS data is typically collated at 1:100,000 or 1:250,000 scale. At the scale of 1:100,000, a distance of 1 mm on the map is equal to 100 m on the ground. Detailed mapping compiled through field surveys is more accurate, but is limited by the method and accuracy of the equipment used to acquire the data. Where available, more detailed data was used, but the maps are still restricted to the scale of the least detailed mapping.

To facilitate conceptual design of the CSG fields, constraints analyses was undertaken based on available Queensland and Australian government GIS data and advice and information from the technical specialists.

Constraints were identified for:

- Natural environment and ecology;

- Surface water;
- Land tenure;
- Land use;
- Cultural heritage (including indigenous and non-indigenous);
- Landscape and visual amenity; and
- Roads.

The criteria that defined the constraints for each of the above environmental aspects are described in the following sections.

7.3.1.1 Natural Environment and Ecology

Constraints mapping for natural environment / ecology and surface water is based upon the Environmentally Sensitive Areas (ESA) mapping categories performed by EHP. Two ESA categories are defined under the *Environmental Protection Regulation 2008* (Categories A and B) with a third category defined within the *Code of environmental compliance for mining lease projects* (Category C). In addition to ESA categories, other significant values have been included in the natural environment and ecology constraints mapping. These values include;

- Areas identified as possessing significant conservation value;
- Confirmed EPBC listed species habitat; and
- EHP mapped high value regrowth.

The breakdown of the ESA categories and other values in conjunction with the constraint matrix has been used to determine the level of activity within each constraints category. The Constraints categories identified by constraints mapping are outlined below in Table 7-2.

Table 7-2 Natural Environment / Ecology Constraints Categories

Constraint Category	Value
No go	Category A ESA Significant conservation area
High	EPBC species habitat area Category A ESA buffer zone Category B ESA Some Category C ESA
Moderate	EHP High Value Regrowth Category B ESA buffer zone Balance of Category C ESA Category C ESA buffer zone

7.3.1.2 Surface Water

Surface water constraints differ depending on the values potentially being impacted. For the purpose of the Project, buffer zones will be adopted for Project activities (with the exception of required creek

crossings), in different areas of constraint, as defined by the Project's constraints mapping (outlined in Section 7 and detailed in Appendix BB).

The buffers outlined below are indicative based on the current regulatory conditions; however these may be subject to change in future. The buffers that will be implemented for the Project will be in line with the regulatory requirements at the time of implementation. Indicative buffers at this time include:

- In areas mapped as high constraint a buffer of 100 m, measured from the high bank edge, will be adopted during all phases of the Project, with a further 100 m constrained to low impact activities; and
- For areas mapped as moderate constraint, the following buffer zones, measured from the high bank edge, will be adopted during all phases of the Project:
  - a riparian buffer of 50 m width on either side of first and second order streams; and
  - a riparian buffer of 100 m width on either side of third, fourth, fifth and higher order streams

7.3.1.3 Land Tenure

The land tenure and land use constraints maps have been developed to identify potentially conflicting land uses with the Project area. Areas identified as no go areas are sensitive receptors (such as schools, towns and hospitals). These areas have been identified as being incompatible with CSG activities. Other areas have been identified as high, moderate and low constraint areas and may require specific management or mitigation measures.

The following constraint areas were identified:

- **No go**:
  - Within 200 m of sensitive receptors; and
- High Constraint
  - Mining leases granted within the Project area
- **Moderate**:
  - easements;
  - water resources; and
  - railways.

7.3.1.4 Land Use

Land use constraints associated with Good Quality Agricultural Land (GQAL) Categories A and B, and Strategic Cropping Land (SCL) are identified on mapping provided by EHP.

Land use constraints were compiled also using the Queensland Land Use Mapping Project data produced by EHP. Due to the inability for the data to distinguish between "grazing natural vegetation" and "grazing exotic vegetation" categories, which would result in the entire petroleum lease area being under high constraint, these categories were excluded from the constraints mapping.

The following constraint areas were identified:

- **Moderate**:
  - GQAL Category A and B;
  - Strategic Cropping Land; and
  - Contaminated land.

7.3.1.5 Cultural Heritage

Cultural heritage data from the following databases were incorporated into the cultural heritage constraints layer:

- The National Heritage Register;
- The Cultural Heritage Information Management System;
- Non-Indigenous Cultural Heritage register; and
- The Indigenous Cultural Heritage Register and Database.

This layer includes both Indigenous and non-Indigenous cultural heritage values. Areas identified as containing cultural heritage were classed as 'no go' areas.

The following constraint areas were identified:

- **No go**:
  - Registered significant Indigenous cultural heritage sites; and
  - Non-Indigenous cultural heritage sites;
- **Moderate**:
  - Cultural heritage site (Indigenous and non-Indigenous) buffers (500 m).

7.3.1.6 Visual Amenity

Visual amenity constraints have been identified in conjunction with the Landscape and Visual Amenity chapter (Section 20) of this EIS. Sensitive receptors (such as urban areas and homesteads) have been identified and have been constrained as no go areas. This report has identified landscape and visual constraints that reflect the capacity of existing environmental values to adjust to impacts arising from the key Project activities. Following a determination of visual and landscape significance, constraints have been defined on the following basis:

- **'No go'**: the Project activities could cause significant adverse landscape and visual impacts. Project activities will not be permitted to disturb existing environmental values (it should be noted that there no areas of this constraint category are found within the Project area).
- **High Constraint**: key landscape and visual values will be at risk from key Project activities. Only certain types of Project activities might be permitted under stringent environmental controls. (It should be noted that no areas of this constraint category are found within the Project area).
- **Moderate Constraint**: key landscape and visual values will be at risk from key Project activities but the application of standard environmental procedures in conjunction with site-specific controls will ensure likely impacts will not exacerbate threatening processes.

- **Low Constraint**: no specific landscape or visual values have been identified and the application of standard operating procedures will ensure minimal impact as a result of the key Project activities.

Table 7-3 identifies visual sensitivity areas (as identified in Table 20-12 of the Landscape and Visual Amenity chapter (Section 20) of this EIS) and their constraint category for that sensitive area.

Table 7-3 Constraint Category for Visual Sensitivity Ratings.

Constraint Category	Visual Sensitivity Ranking
No go	High sensitivity
High	High sensitivity buffer (1 km)
Moderate	Medium Sensitivity
Low	Low Sensitivity

7.3.1.7 Roads

The roads constraints layer has been developed to identify existing and future roads and road easements that may restrict development, as well as influence route planning for gathering flowlines, pipelines and other related infrastructure.

The following constraint areas were identified:

- **Moderate**:
  - Road reserves;
  - Stock routes; and
  - Railway crossings.

7.3.2 Results of Preliminary Constraints Analyses

The development of the constraints framework allows for a broad, preliminary assessment of values and constraints throughout the Project area. As a result of the constraints analysis, eight maps have been produced to guide planning and development within the lease area. These maps can be found in Constraints Mapping (Appendix BB of this EIS).

- Map 1: Natural environment / ecological constraints;
- Map 2: Surface water constraints;
- Map 3: Land tenure constraints;
- Map 4: Land use constraints;
- Map 5: Cultural heritage constraints;
- Map 6: Landscape amenity constraints;
- Map 7: Roads constraints; and
- Map 8: Overview of constraints.

The maps have been produced to provide an overview of the level of constraint and to address specific gas field planning issues.

7.3.3 Ongoing Constraints Analyses

The preliminary constraints analysis is based on Queensland and Australian government mapping and has incorporated the findings of the EIS including the results of field surveys; sensitivity analyses performed by the technical specialists, and proposed mitigation measures. The constraints analysis will be updated to incorporate any findings from the supplementary report to the EIS, and negotiations with regulatory authorities and ongoing community consultation will also inform update of the constraints mapping and environmental management controls.

The Project GIS, a live system, will be periodically updated to include updates to Australian and Queensland government GIS data, the results of ecological and preconstruction clearance surveys, and any subsequent environmental impact assessment processes.

Modelling undertaken in the technical studies has refined separation distances required to ensure public health and safety. Noise remains the more dominant determinant. Separation distances for attenuated and un-attenuated noise have been provided, and they vary considerably. An appropriate buffer distance, to be used for planning purposes, will be selected on the basis of attenuation options being considered in detailed design.

The technical specialists have proposed mitigation measures, presented in the impact assessment chapters (Sections 8 to 29) of this EIS. The measures or environmental management controls reflect the significance of potential impacts of the proposed development, and hence respond to the level of constraint posed by the environmental values. The mitigation measures will be incorporated in documents comprising Arrow's HSEMS, enabling implementation of the environmental framework.

7.4 Environmental Management Framework

The environmental framework, comprising constraints and environmental management controls, will be incorporated in, and implemented through, Arrow's HSEMS. Mitigation measures presented as commitments in this EIS will be incorporated in standard operating procedures. The procedures will also incorporate procedural environmental management controls that will apply to all Project activities, specific procedures that respond to a particular issue (e.g., rehabilitation of Vertosol or black soils) and site specific management measures where Project activities occur in a highly constrained area (e.g., in or adjacent to cultivation areas). Arrow has already developed and implemented a standard operating procedure for site and route selection, which uses the output of constraints analysis.

Work plans set out the procedures to be followed by Arrow staff and contractors while carrying out construction, operation and maintenance and decommissioning activities. The plans dictate the work methods and safety requirements for each particular activity. Currently, these plans operate separate to environmental management plans (standard operating procedures). To improve environmental management, Arrow is investigating the integration of environmental management procedures in work plans to provide staff and contractors with a single point of reference, and to ensure environmental management measures are implemented at the appropriate time and in the correct manner.

Implementation of the environmental framework as an integrated component of Arrow's HSEMS and field development process is described below.

7.4.1 Integration of Environmental Framework with Arrow's HSEMS

The environmental framework – constraints maps and environmental management controls – will be incorporated in Arrow's HSEMS, as standard operating procedures.

A standard operating procedure will be developed to describe the process and frequency of updates to the constraints maps. The procedure will incorporate the following requirements:

- Periodic review of the constraints criteria to ensure they reflect state and federal government policy, guidelines and listings, and the results of any environmental impact assessment undertaken by Arrow.
- Periodic update of the Project GIS to incorporate updated government datasets and the results of any ecological surveys and any environmental impact assessment processes undertaken by Arrow.
- Constraints analyses, as required, to ensure constraints mapping is up to date.

Development and implementation of this procedure will ensure the findings of this EIS are incorporated in the constraints mapping including updating the constraints criteria to reflect the sensitivities assigned to the environmental values identified by the technical specialists.

Mitigation and management measures proposed in this EIS will be incorporated in standard operating procedures of the Arrow HSEMS. Standard or procedural controls that apply to all Project activities regardless of the level of constraint will be incorporated in thematically-based procedures e.g., air quality. Controls for the management of activities in moderately constrained areas will be incorporated in procedures that are specific to the identified impact, for example, rehabilitation of black soils (Vertosols and Dermosols). Site-specific management plans that address identified impacts in highly constrained areas will be developed on an as-needed basis, as they will respond to the site conditions and environmental management requirements at the site. The standard operating procedures will be subject to the review and audit requirements of the Arrow HSEMS.

Work plans developed for construction, and operation and maintenance activities will be revised to incorporate relevant aspects of the standard operating procedures or reference the applicable standard operating procedures. This will ensure environmental management is integrated with management and supervision of CSG development activities.

7.4.2 Integration of Environmental Framework with Gas Field Planning

Gas field planning commences with the analysis of exploration and pilot well data to enhance Arrow's knowledge of the CSG reservoirs and their potential yield. Geologists and reservoir engineers highlight the most prospective reserves which are passed onto the field development planning and concept engineers who prepare a conceptual gas field layout. The well density and infrastructure required to transport and process the gas and CSG water is conceptualised and optimised. Technical feasibility of the resource recovery are the primary considerations at this stage in the development process.

Field development engineers use the constraints maps to determine the feasibility of constructing the conceptual gas field layout having regard to the environmental, social and cultural constraints.

The conceptual layout is refined to produce a preliminary design to facilitate landowner and stakeholder consultation, and field surveys of the potential sites and routes. Key considerations in this

phase are technical feasibility (including constructability) and cost. Cost encompasses capital and operating costs, and the cost of mitigation including rehabilitation, which is primarily informed by the constraints and associated environmental management controls.

Ecological and cultural heritage clearance surveys, along with geotechnical investigations inform any further refinement of the conceptual gas field layout, particularly the location and arrangement of production facilities and routes for medium pressure gas pipelines. Road access and interfaces with municipal infrastructure are discussed with relevant authorities and local government to determine any additional controls or measures that should apply to development at the nominated sites and along the nominated routes. Landowner consultation will explore options for realignment of medium pressure gas gathering pipelines and configuring the production wells and associated gathering systems to reduce impacts on farming operations or business activities.

The outcome of consultation, field surveys and geotechnical investigations informs the detailed design of the gas field and selection of equipment and construction methods that address the technical and environmental constraints. The environmental management controls (standard operating procedures) applicable to the proposed activities at the selected sites or routes are identified and incorporated in the work plans.

Whilst field development and optimisation continues throughout the field life, the first phase of the development, up to the point of commencement of production drilling and start of construction of infrastructure, stretches roughly a four to five year period, covering the following main steps:

Step 1:

Analysis of geological and geophysical data to inform exploration program including location of exploration wells.

Step 2:

- Analysis of exploration data; and
- Installation of pilot wells to prove CSG yields and CSG water production.

Step 3:

- Conceptual and preliminary design of gas field;
- Land access negotiations with landowners initiated;
- Consultation with landowners and key stakeholders on gas field development; and
- Ecological and cultural heritage clearance surveys and geotechnical investigations.

Step 4:

- Detailed design of gas field and production facilities; and
- Ongoing land access negotiations.

Step 5:

- Detailed design of gas field and production facilities, revision and/or development of work plans, preparation of site specific environmental management plans; and
- Land access arrangements finalised.