Bowen Gas Project

EIS Community Information Sessions

October 2012

Arrow’s Moranbah Compression Station
Bowen Basin
ARROW ENERGY
TODAY’S AGENDA

Arrow Energy Overview

Bowen Gas Project (BGP) Environmental Impact Statement (EIS)

Understanding Groundwater

Questions and Answers
Arrow is a leading coal seam gas company with five domestic gas supply operations, interests in three gas-fired power stations and plans to deliver liquefied natural gas to the international market through a world class plant in Gladstone.

- Queensland based company which started in 2000.
- Shell (50%) and PetroChina (50%) are established owners committed to safety, environment and long term relationships with stakeholders.
- Currently have almost 500 producing coal seam gas (CSG) wells across Queensland.
- Provide approximately 20 per cent of Queensland’s gas needs which is primarily used for electricity.
Coal seam gas (CSG) is naturally occurring gas trapped in underground coal seams, most commonly methane.

Extracted by drilling into the coal seam and pumping water which lowers the pressure and releases the gas.

Commercially produced in Queensland for more than 15 years.

Liquefied Natural Gas (LNG) is natural gas that has been cooled and converted to liquid for transport.

Arrow is planning a LNG plant in Gladstone that will convert CSG to LNG in preparation for international shipping.
DOMESTIC GAS OPERATIONS

- Tipton
- Daandine
- Kogan
- Stratheden
- Moranbah Gas Project

ARROW LNG (PROPOSED)

- Surat Gas Project
- Bowen Gas Project
- Arrow Surat Pipeline
- Arrow Bowen Pipeline
- Arrow LNG Plant
- Power Development

POWER STATIONS

- Braemar 2
Arrow recognises every property is unique and we are committed to working with landholders to ensure our work practices minimise impacts on land and existing agricultural activities.

- Once a possible site for exploration or production is identified, the landholder is contacted by an Arrow Land Liaison Officer (LLO).
- The LLO will discuss site access, schedule cultural heritage and environmental clearances, co-ordinate other activities on the property and ensure the rehabilitation of site.
- Arrow has:
  - a Standard Compensation agreement
  - removed the privacy provisions (landholder can request inclusion)
ARROW ENERGY
OUR ACTIVITIES

Exploration

Appraisals

Production

Rehabilitation
Please visit us to speak with Arrow staff and access information about our operations and long-term plans.

Features maps, fact sheets and other information on the:
- Bowen Gas Project
- Moranbah Gas Project
- Arrow Bowen Pipeline
- Arrow LNG project

Provides information on how Arrow will manage potential environmental impacts such as groundwater, salt, drilling, land access and exploration.

Opportunity to provide us with feedback or just to have a chat.

15 Town Square Avenue, Moranbah
Open daily between 9am and 5pm, Monday to Friday
Interested suppliers, subcontractors and service providers are invited to:

- Register your interest online at:  

- Visit the Arrow project page on the Industry Capability Network (ICN) Gateway:  
  www.arrow.icn.org.au

- Register your details to receive information regarding upcoming local business briefing sessions through:  
  localcontent@arrowenergy.com.au

Arrow Energy will provide *full, fair and reasonable* opportunity for capable and competitive Local industry to participate in the procurement of goods, equipment and services.
EIS PROCESS AND OVERVIEW OF FINDINGS
EIS PROCESS AND OVERVIEW OF FINDINGS

OUTLINE

- Environmental impact assessment
- Environmental framework
- Key issues
- Approvals timeframe
EIS PROCESS AND OVERVIEW OF FINDINGS
ENVIRONMENTAL IMPACT STATEMENT (EIS)

- **Bilateral agreement** between Queensland and Commonwealth Governments
- Terms of Reference (**TOR**) issued by Department of Environment and Heritage Protection (previously DERM)
- Informed by **technical studies**
- DEHP undertakes **adequacy review** (EIS meets TOR)
- Published for public and government agency **comment**
- Arrow prepares **supplementary** EIS to address submissions
- QLD and Commonwealth Governments decide **approval and conditions**
EIS PROCESS AND OVERVIEW OF FINDINGS
ENVIRONMENTAL IMPACT ASSESSMENT

Purpose

- Assess **potential impacts** on environment, society and economy
- Propose feasible ways to **manage** them

Approach

- We know **what** is going be done
- We know **how** it is going to be done
- **Where** and **when** managed by the **Environmental Framework**
EIS PROCESS AND OVERVIEW OF FINDINGS
ENVIRONMENTAL FRAMEWORK

- Desktop and Field Studies
- Project Activities
- Sensitivity of Environmental Value
- Potential Impacts
- Significance of Impact
- Potential Impacts Environmental Management Criteria
- Constraints to Development Suitable Activities & Methods
- Constraints Mapping Environmental Management Controls
- Site Selection Environmental Management
<table>
<thead>
<tr>
<th>Constraint</th>
<th>Infrastructure</th>
<th>Applicable Framework</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Wells</td>
<td>Flowlines &amp; Pipelines</td>
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<tr>
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</table>
EIS PROCESS AND OVERVIEW OF FINDINGS
CONSTRAINTS MAPPING
EIS PROCESS AND OVERVIEW OF FINDINGS

KEY ENVIRONMENTAL ISSUES

- Groundwater
- Amenities (eg. noise, air quality)
- Socio-economic
- Roads and traffic
EIS PROCESS AND OVERVIEW OF FINDINGS

NOISE

Sources

- Production facilities (compressors, gas turbines)
- Well head infrastructure (gas engines)
- Vehicles, plant and equipment

Impact assessment

- Typical installation modelled – worst case meteorological conditions
- Very quiet background - more onerous noise limit criteria
- Facilities criteria met at 1-1.5 kilometre with attenuation and unmitigated at 3-5 kilometres
- Production wells criteria met at 300 metres
 Possible Sources

- Production facilities (gas engine exhausts, flares)
- Well head engines (assessed, with potential to be elec. motors)

 Pollutants

- Key indicators are oxides of nitrogen ($\text{NO}_x$) and ozone ($\text{O}_3$)

 Impact assessment

- Peak development year modelled (production facilities and wells)
- Worst-case meteorological conditions assumed
- Single exceedence at regional level for NO2 levels from Integrated Production Facility (IPF) / Central Gas Processing Facilities (CGPF) at 1400m. Hence a constraint has been placed on locating these facilities.
EIS PROCESS AND OVERVIEW OF FINDINGS
SOCIO-ECONOMIC IMPACT

Context
- In-field facilities (incl. Accommodation camps) distant from population centres
- Recent higher level of uncertainty surrounding timing of mining projects

Potential Cumulative Impact
- Housing and accommodation demand for operational staff construction camps
- Demand on local services
- Impacts to local roads networks

Social Impact Management Plan will address
- Population and Demographic
- Housing and Accommodation
- Employment, Skills and Business
- Land Use and Property
- Community Values and Lifestyles
- Community Infrastructure and Services; and
- Health, Safety and Environment
EIS PROCESS AND OVERVIEW OF FINDINGS
ROADS AND TRAFFIC

Road network
- Highways and arterial roads more resilient to increased traffic
- Local roads most susceptible to impacts

Traffic
- Modelling based on conceptual location of production facilities/depots
- Anticipate a low significance impact on Suttor Developmental Road between Elphinstone and Red Hill Road (subject to mitigations)
- All other locations were found to be negligible impact

Mitigation
- Traffic management plan (in consultation with Councils and DTMR)
- Road safety eg protected turning lanes, traffic controls etc
## EIS Process and Overview of Findings

### Environmental Impact Statement (EIS) Update

<table>
<thead>
<tr>
<th>EIS Process</th>
<th>Expected Timeframes</th>
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<tr>
<td>Lodge Voluntary EIS Application</td>
<td>Completed</td>
</tr>
<tr>
<td>Lodge Initial Advice Statement</td>
<td>Completed</td>
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<tr>
<td>Draft Terms of Reference available for public comment</td>
<td>Completed</td>
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<tr>
<td>Terms of Reference issued to Arrow</td>
<td>Quarter 4 2012</td>
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<tr>
<td>Prepare EIS (including undertaking field surveys and technical studies)</td>
<td>Quarter 4 2011 – Quarter 4 2012</td>
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<tr>
<td>Submits draft EIS to DEHP for adequacy review</td>
<td>Quarter 4 2012</td>
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<tr>
<td>EIS available for public comment</td>
<td>Quarter 1 2013</td>
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<td>Prepare Supplementary EIS (addressing submissions)</td>
<td>Quarter 2 2013</td>
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<tr>
<td>Qld and Commonwealth Government project decision</td>
<td>Quarter 3 – Quarter 4 2013</td>
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UNDERSTANDING GROUNDWATER
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AGENDA

- Introduction to Groundwater
- Groundwater Levels
- Groundwater Quality
- Aquifer Properties
- Water Balance
- Numerical Modelling
- Bowen Basin Groundwater
UNDERSTANDING GROUNDWATER
WHAT IS GROUNDWATER

Groundwater is stored below the land surface in:

- Pores within sediments
- Fractures and micropores within rock

An **aquifer** is a unit capable of transmitting water

An **aquitard** is a unit that impedes the flow of groundwater

Aquifers can be:

- Unconfined
- Semi-confined
- Confined
Groundwater levels are measured in groundwater bores. Data collected can be used to construct a piezometric surface map to determine groundwater flow directions.
Groundwater Quality:

- Water - the liquid
- Solutes - present as minerals and nutrients
- Dissolved gases - dissolved oxygen, dissolved CO2, dissolved methane, dissolved hydrogen sulfide etc.

Need to consider these in terms of:

- Groundwater quality
- How the groundwater/ aquifer system behaves

Unlike head values, groundwater chemistry provides time-integrated data about how the flow system has developed.
UNDERSTANDING GROUNDWATER

AQUIFER PROPERTIES

- Porosity

- Specific Yield is the ratio of the volume of water that drains from a saturated rock owing to the attraction of gravity to the total volume of the rock.

- Compressibility is when water is stored at depth, in a confined aquifer, a drop in pressure causes a small amount of water to be released.
1 cubic metre of Alluvium yields about 2 jerry cans of water for every 1 m fall in water level

1 cubic metre of Coal Measures yields about 1 tablespoon of water for every 1 m fall in water level
All materials have microstructure (e.g. layering)

- low K
- high K

\[ K_h \text{ for layer} \]
\[ K_v \text{ for layer} \]

Effective \( K_v \) is dominated by the smallest \( K_v \)

Effective \( K_h \) is the weighted average of \( K_h \) in layers

“anisotropy ratio” \( K_h : K_v \) can be 10 or 100 or 1000 or more
Water Balance is fundamental to being able to predict the behaviour of a groundwater system.

Net flux is “recharge”
to the water table

evapotranspiration
rainfall or irrigation
infiltration
surface runoff
percolation
recharge
groundwater flow

Sum of all inflows – the sum of all outflow = change in storage
A groundwater model is a representation in computer software of a regional scale hydrogeological system:

- based on a complete description of the natural system (geometry, material properties, recharge etc.)
- including proposed changes (e.g., Pumping)
- with which we can predict water levels, piezometric heads and flows in space and time

500,000 or 1 million cells with water balance computed every day, week or month
UNDERSTANDING GROUNDWATER
BOWEN BASIN GROUNDWATER CHARACTERISTICS
Questions and Answers

Freecall: 1800 038 856

Email address: bowengas@arrowenergy.com.au

Website: www.arrowenergy.com.au