



REVIEW OF ENVIRONMENTAL FACTORS (REF)

Tintsville CSG Pilot

Narrabri Coal Seam Gas Project

Petroleum Exploration Licence 238
Gunnedah Basin, New South Wales

November 2009

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Location of lands referred to by REF

The proposed pilot activity will on two freehold pastoral properties, ‘Tintsville’ and ‘Linden’, situated approximately 15 kilometres west southwest of the Narrabri Township in northern NSW (see **Figure 2.2**). Further operational activities are proposed to occur on property owned by Eastern Star approximately 3km northeast of the pilot location upon which the Wilga Park powerstation is situated. (see **Figure 5.1**).

Declaration

Eastern Star Gas Ltd declares the information contained within this document an accurate representation of the existing operational environment and the extent of impacts likely to occur as a result of the proposed development. Eastern Star has endeavoured to characterise the environment within which the project is located and with the assistance of Government agencies and external contractors mitigate environmental impacts and ongoing operational risks.

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1 EXECUTIVE SUMMARY

This Review of Environmental Factors (REF) has been prepared by Eastern Star Gas Ltd for the ongoing development of the Narrabri Coal Seam Gas Project and specifically the Tintsville Coal Seam Gas (CSG) Pilot located in Petroleum Exploration Licence (PEL) 238. The objectives of the pilot are to demonstrate the technical feasibility of ‘in seam’ drilling and multi lateral completions in the previously untested Hoskisson’s coal seam, to extend on recent core hole drilling success at Tintsville-1 and to confirm the viability of this locality as a potential commercial gas production area.

Located across three private properties, the total area of land impacted by this activity will be a maximum of 10 hectares in total; six well pads of 100 meters x 80 meters (total 4.8ha) and up to five additional hectares of operational lands for water and gas management facilities. These facilities will permit the operation of the pilot over a testing phase of between 12-18 months and consist of production water impoundments and a reverse osmosis water treatment unit. All gases produced from the pilot will be preferentially consumed at the Wilga Park powerstation 5.5 km east northeast of the pilot.

Consultation with the NPWS AHIMS database indicates that the proposed location does not present any risk to known sites of aboriginal heritage significance. Survey data collected during the preparation of the Coonarah Gas Project furthermore confirm that no known sites of heritage significance will be impacted by the proposal.

Consultation with the NPWS threatened species registers indicates that the proposed location will not impact on any known populations of rare or threatened species of native flora or fauna. Site selection has been based, in part, on the minimisation of vegetation modification to furthermore mitigate any residual risk of impact on such species.

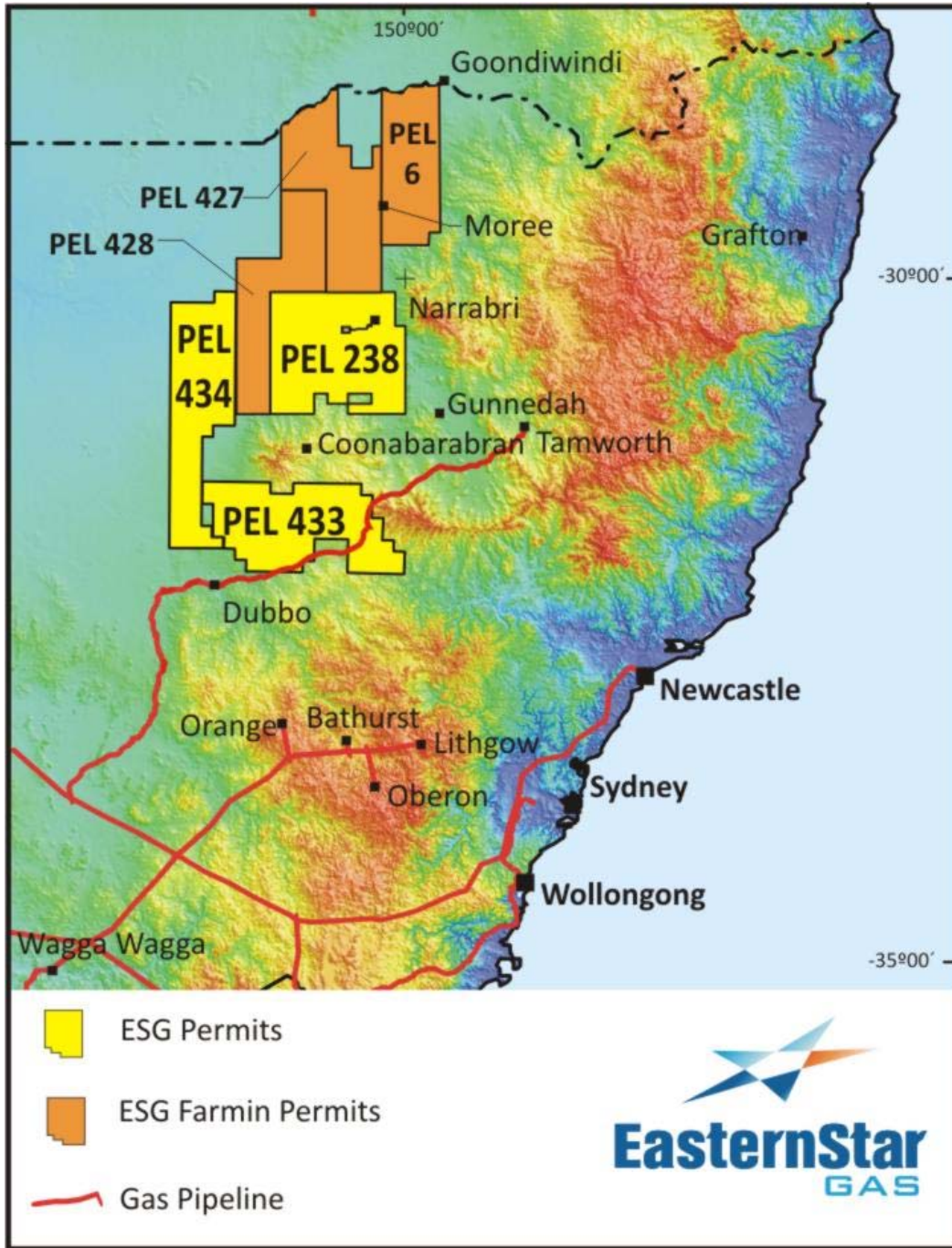
In terms of greenhouse gas impacts, gas generated by the proposed pilot will be consumed in a number of key processes including gas fired generators supplying power to the well head skids, SCADA telemetry and the water treatment facility. Surplus production gases will be transferred into the Coonarah gas pipeline for consumption at the Wilga Park Powerstation.

The provision of this document fulfils the company’s responsibility under Part 5, Section 111 of the *Environmental Planning and Assessment Act 1979* in which the NSW Department of Industry and Investment (Minerals and Energy) is required to consider the likely and actual environmental impacts of the activity. It is the opinion of Eastern Star Gas that the impacts created by the proposed activity when considered alongside the mitigation strategies in place will create no long term effect on the localised and regional environment.

2 INTRODUCTION

This Review of Environmental Factors (REF) has been prepared by Eastern Star Gas Ltd (ESG) for the continuing development of the Narrabri Coal Seam Gas (CSG) project in Petroleum Exploration Licence (PEL) 238, northern NSW (Figure 2.1).

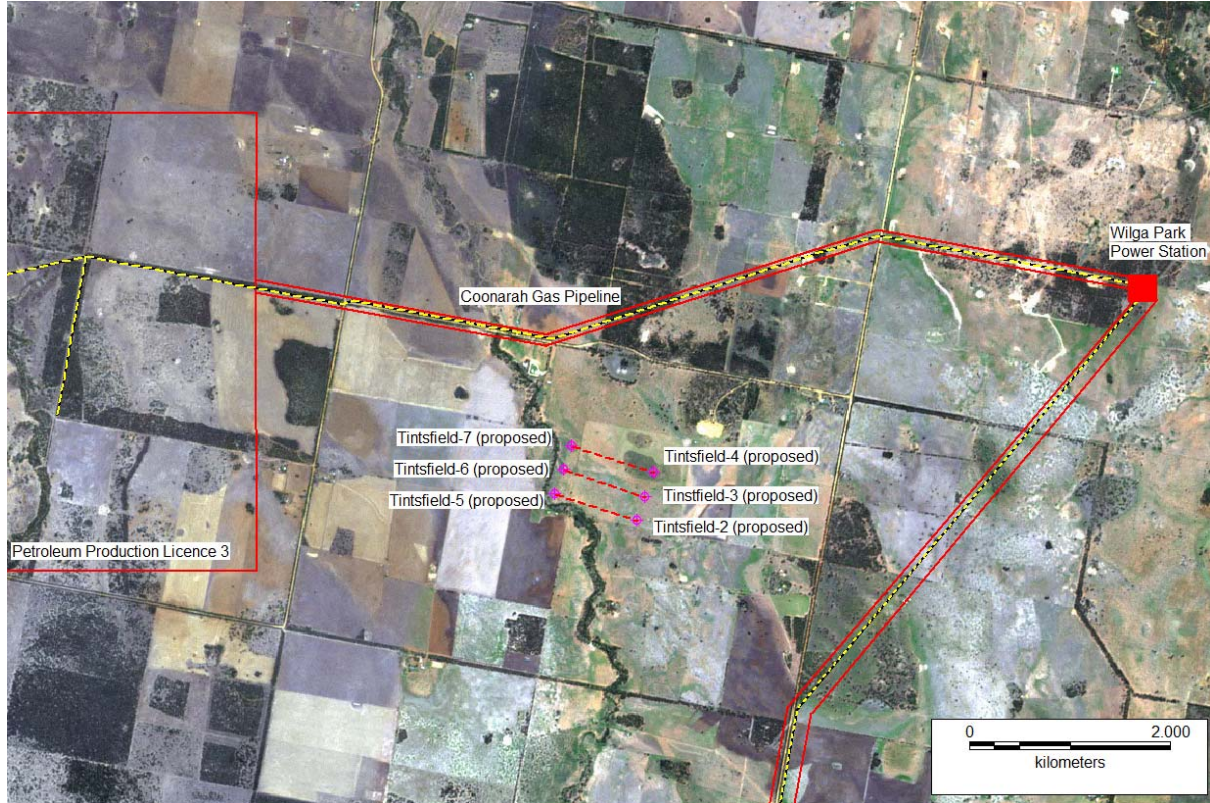
Figure 2.1: Eastern Star Gas – Current Exploration Licences.



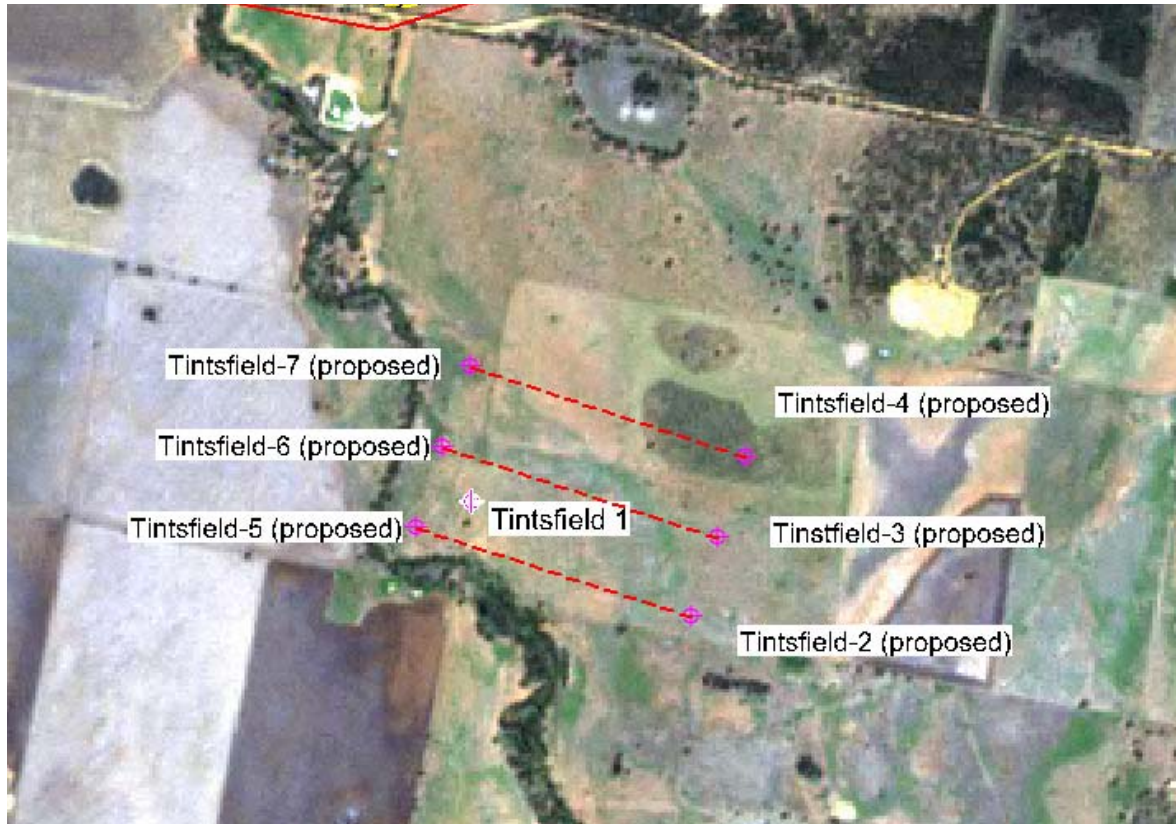
2.1 Location

The proposed Tintsville CSG Pilot will be located within PEL 238, 15 kilometres west southwest of the Narrabri Township (**Figure 2.2**).

Figure 2.2: Location of the proposed Tintsville CSG Pilot Area



The pilot will be located nearby to Petroleum Production Licence (PPL) 3 and the northern extent of Petroleum Assessment Lease 2 (PAL2) throughout which drilling and extensive seismic data confirms the presence of thick, gassy coals suitable for testing as CSG reservoirs. The project area is located immediately adjacent to the recently completed Tintsville-1 core hole as shown in **Figure 2.3**.

Figure 2.3: The proposed Tintsville CSG Pilot

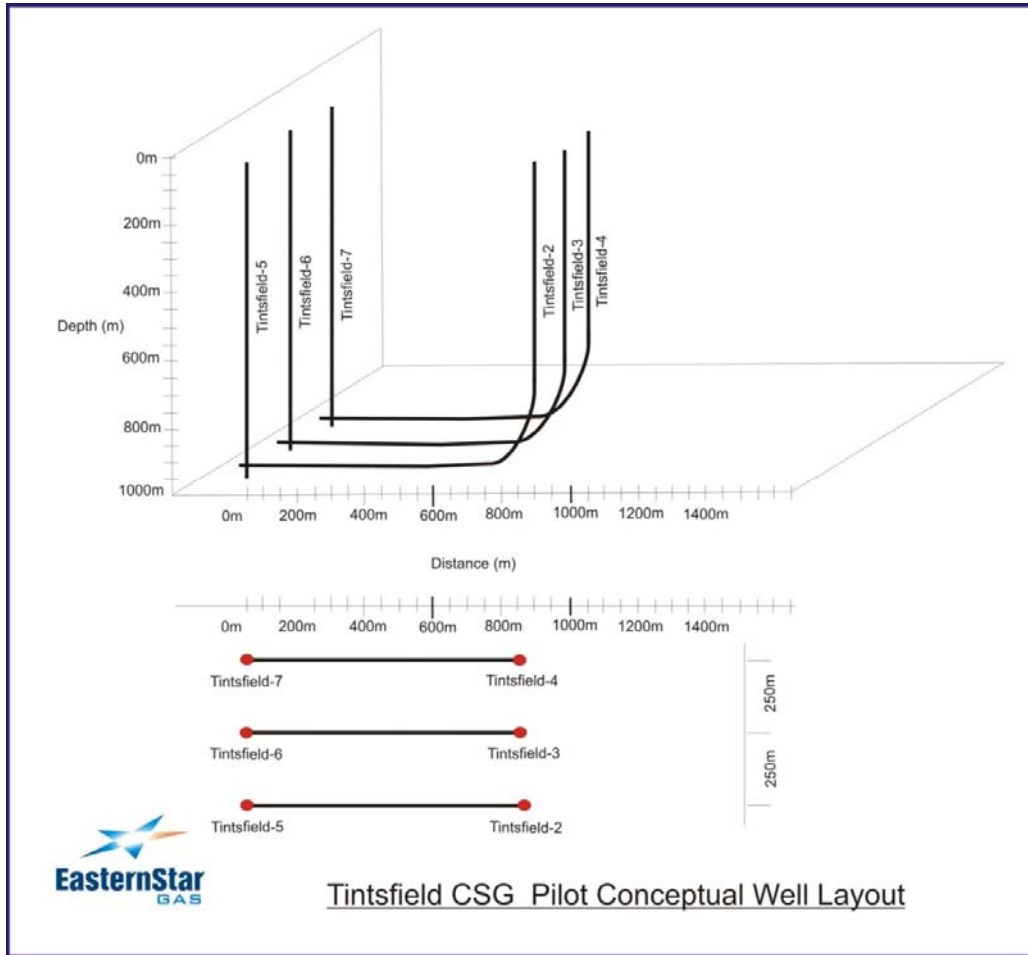
2.2 Description of the Activity

The proposed activities which the following REF refers include:

- The preparation of six (6) drill pads to a maximum of 100 metres by 80 metres;
- The drilling of three (3) vertical production wells at Tintsville-5,6 and 7;
- The drilling of three (3) lateral production wells at Tintsville-2, 3 and 4;
- Installation of water and gas gathering system linking the three vertical production wells to Wilga Park; and
- The operation of the pilot under a site specific operations and water management plan (see section 5)

The employment of the multi lateral completion technique at Tintsville builds on the success of other CSG pilot developments located in PAL2 where multiple ‘in seam’ wells are drilled on a close spacing of around 250 metres (**Figure 2.4**).

Figure 2.4: Conceptual layout of the Tintsville CSG Pilot



The three vertical wells in the lateral pilot are drilled first to provide a target to which the horizontal ‘in seam’ wells (**Figure 2.4**) can intersect. At the completion of the drilling process, subsurface pumps and pressure monitoring equipment will be placed in the vertical wells and the pilot operated over a period of between 12 to 18 months.

Table 2-1: Location of the proposed wells in the Tintsville CSG Pilot

Well	Well Type	Easting (m)	Northing (m)
<i>Tintsville-2</i>	<i>lateral</i>	<i>752363</i>	<i>6635670</i>
<i>Tintsville-3</i>	<i>lateral</i>	<i>752444</i>	<i>6635906</i>
<i>Tintsville-4</i>	<i>lateral</i>	<i>752524</i>	<i>6636142</i>
<i>Tintsville-5</i>	<i>production</i>	<i>751557</i>	<i>6635932</i>
<i>Tintsville-6</i>	<i>production</i>	<i>751636</i>	<i>6636169</i>
<i>Tintsville-7</i>	<i>production</i>	<i>751717</i>	<i>6636405</i>

(Datum: GDA 94, Zone 55).

2.3 Hours of Operation

The proposed drilling activity will occur on continuous 24 hour shift cycle with crew changes at 1200 hours and 2400 hours each day. Site construction activities will occur generally between 0700 hours and 1800 hours.

2.4 Site Access

Access to the general site area is available using the existing Shire Roads including Jones Lagoon Road, Kiandool Lane and Yarrie Lake Road then internal property roads and tracks constructed by Eastern Star to an all weather standard.

Figure 2.5: Proposed access to the project site



2.5 Water and Gas Management

The operation of the Tintsville CSG Pilot will be managed under a site specific water and operations management plan (See section 5).

2.6 Activity Timeframes

The proposed activity is expected to occur over a timeframe of approximately 10 weeks from the date of commencement of site preparation to the point at which the pilot will be operational.

The drilling of each production well is expected to take 4-5 days from the arrival of the drilling rig on each site and includes rigging up and mobilisation to the next site in the activity sequence. The lateral wells would be expected to take up to 8 days to drill to completion.

The work over program, well setup and gathering system installation would soon follow the drilling program and comprise between 3 and 4 weeks work on site.

At this stage there is no comprehensive rehabilitation schedule being proposed for this activity. Partial rehabilitation of non essential areas of each well pad will occur at the completion of the drilling program, however as the wells are generally operated over an extended period, the timeframes for plugging and abandonment and furthermore site closure has not been discussed in this REF in any detail. The initial rehabilitation program is discussed in section 4.2.3.

2.7 Alternatives

The only method of testing for subsurface accumulations of petroleum (including gas) is to drill a petroleum exploration well. Surface mapping, gravity, magnetic, seismic reflection and other forms of geophysical exploration are only able to provide an interpretative view of geological parameters and the discovery of petroleum rely on drilling. The discovery of a petroleum accumulation by the drilling of an exploration well generally requires that the hydrocarbon bearing area/s be evaluated by flow testing prior to a decision being made as to the commercial significance of that discovery.

The main objective of the Narrabri CSG project to date has been exploration for and appraisal of the two coal seam reservoirs across PEL 238. The 2007/2008 core hole program carried out across PAL 2 was successful in gaining a significant quantity of technical data on the quality of the CSG reservoir including a number of areas with high potential to support further production development activities. The Bibblewindi and Bibblewindi West lateral CSG pilots have been completed as has the delineation the spatial limits of the Maules Creek coal measures to the south of the pilots (Bibblewindi 20) and north (Dewhurst 8). Further to this activity, ESG is embarking on the development of lateral production pilots around Dewhurst 8 and to the west of Narrabri as a result of the core drilling undertaken at Tintsville-1.

Tintsville-1 differs from a majority of the CSG exploration and appraisal undertaken by ESG to date in that this will be the first pilot focussing on the Hoskisson's coal seam located within the larger and more widespread Blackjack coal measures. A significant advantage will be gained through the successful appraisal of this seam including potentially larger reserves certification in PEL238.

2.8 Recent Activities:

The ongoing development of CSG resources in PEL 238 represents the main focus of company activity at this time. The operation of a total of 18 production wells across the Narrabri CSG Project area continues to provide important technical data on the coal reservoir and its production capabilities.

Core hole drilling has continued throughout 2008/09 and is currently focusing on new prospects in the Narrabri region. Rig 27 has completed Tintsville-1, located approximately 16 kilometres southwest of Narrabri and designed to assist in the further delineation of the Black Jack and Maules Creek coal measures in this relatively under explored area of PEL238. The second core drilling rig operated by ESG is currently situated at the Dewhurst 11 site on Rockdale Rd, 25 kilometres south of Narrabri and will gather additional coal thickness and gas quality and quantity from the northern limits of the Dewhurst Prospect.

Lucas Rig 26 is currently drilling at the Dewhurst CSG pilot adjacent to the Dewhurst 8 well where a pilot nearly identical to the proposed Tintsville Pilot is well underway. This activity is expected to be completed by mid December.

3 THE EXISTING ENVIRONMENT

The information contained in this section has been collated from a range of sources and characterises the existing environment within and around the Tintsville CSG Pilot Area.

3.1 Topography

Natural slopes in the Narrabri region generally range from less than 1 degree on the flat terrain of the Namoi River floodplains to in excess of 30 degree with the Mount Kaputar National Park. The project site is located in the private grazing/cropping lands west of Narrabri. Indicative elevations of this area approximate 220 metres Australian Height Datum (AHD) and fall gently away to the north and northwest towards the Namoi River.

3.2 Drainage

The Tintsville CSG Pilot Area lies within the Namoi River Basin Catchment, one of the main tributaries of the Barwon Darling River System. The Namoi River Basin covers an area of 43 000 square kilometres and incorporates the region's major centres of Tamworth, Gunnedah, Narrabri and Walgett (Corkery and Assoc., 2004).

The project site lies within the vicinity of Mollee Creek, a moderately well defined ephemeral creek with some semi-permanent water holes. There are no permanent flows within or adjacent to the project site with surface run off from the localised drainage features generally being poorly defined sheet flow towards this and other drainage features. As a consequence of the very low slope angles, surface run off tends to pond after heavy rain with some areas becoming swampy or temporarily inundated.

3.3 Land Use

The Narrabri district is a major primary production area in NSW whose main agricultural industries are beef cattle, fat lambs and wool, olives and various cereal crops including barley, wheat and oats. The land in the general area of the project sites is dominated by seasonal crop rotation and grazing activities under private freehold title. Native vegetation including remnants of varying quality is sparse to moderately common except where the freehold lands adjoin existing reserves and riparian zones.

The Tintsville CSG pilot is located within private freehold land to the southwest of Narrabri and has previously been cultivated for both cropping and grazing activities. A key feature of landholder negotiations has been the focus on implementing the proposal with minimal disruption to present land uses, impacts on existing farming infrastructure and integrating with seasonal agricultural production planning. Contained within each landholder easement agreement are stated conditions of entry, operation and compensation as defined by each individual title holder/s and each generally reflects the focus on impact minimisation and integration into current and future farm planning.

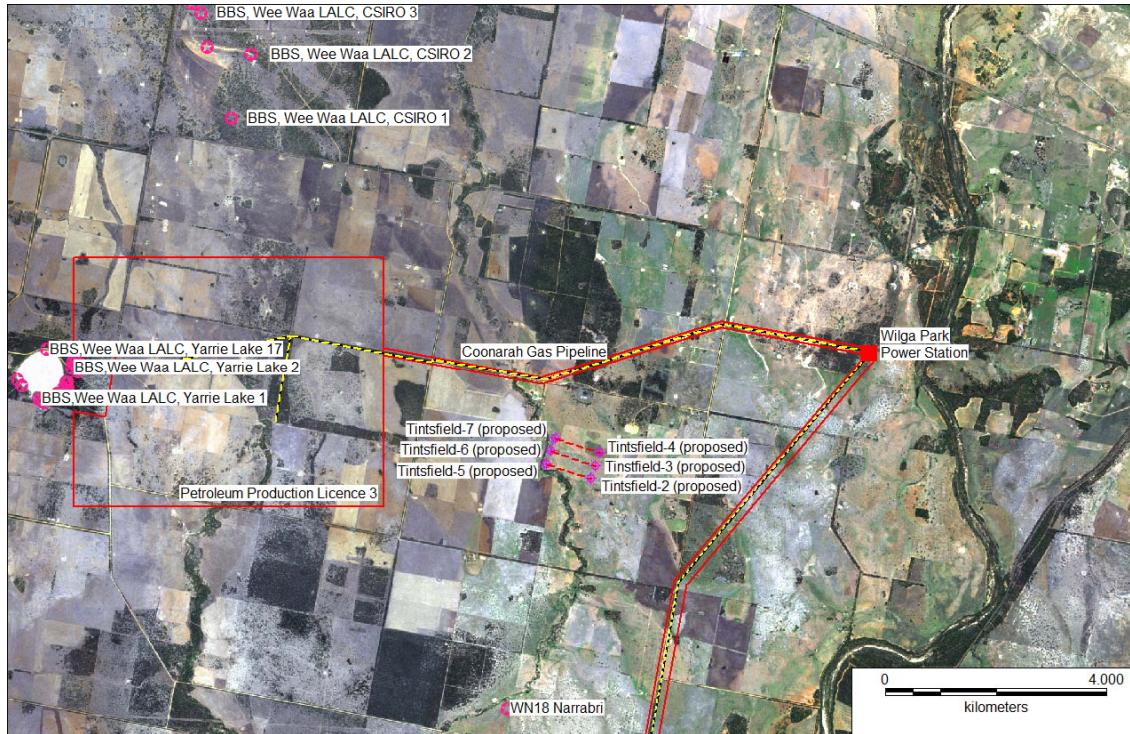
3.4 Cultural Heritage

Throughout the development of the Narrabri CSG Project, the existing knowledge base on the extent of Aboriginal inhabitation across the region has steadily grown. Cultural heritage surveying has occurred frequently since ESG commenced the active development of PEL 238's CSG reserves in 2004.

Survey efforts carried out to date have included numerous site specific cultural heritage investigations for the installation of production and core hole well pads, the surveying of the area impacted by the installation of the Bibblewindi CSG Pilot, water management facilities, gas gathering systems and the pipeline linking the Bibblewindi and Bohena CSG Pilots with the Wilga Park power station. The surveys have been directed by Mr Eddie Trindall, cultural heritage advisor and representative of the Pilliga Forest Aboriginal Management Committee and Narrabri Local Aboriginal Land Council.

The existing archaeological record for the region consists of various sources of cultural heritage information including the National Parks and Wildlife Service (NPWS) Aboriginal Heritage Information Management System (AHIMS) database, the Forestry NSW/ Pilliga Forest Aboriginal Management Committee (PFAMC) site register and a number of published reports on the Aboriginal inhabitation of the Pilliga Forests. These sources corroborate on the understanding that the Narrabri region and Pilliga Forests were frequently utilised by Aboriginal communities for a range of important uses and that a number of significant sites have been identified during subsequent survey efforts.

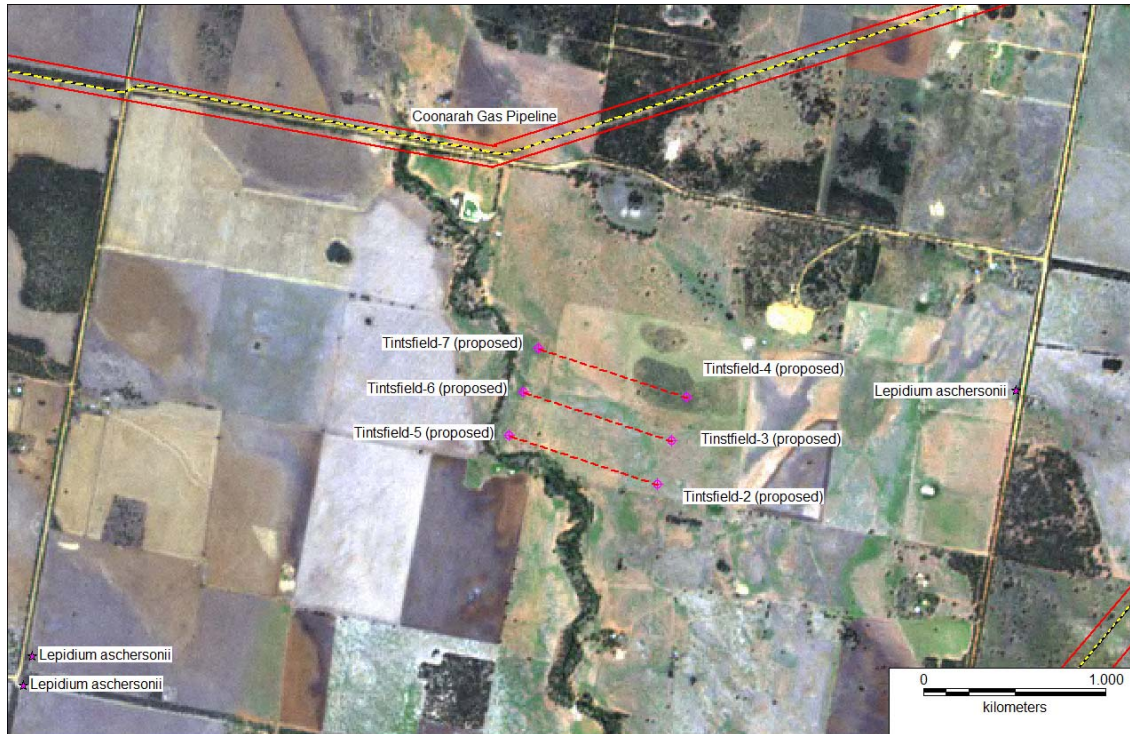
Figure 3.1: AHIMS data for the area surrounding the Tintsville Project site



3.5 Flora

Consultation with the NPWS threatened species register indicates 34 records of five species of threatened flora located within the Narrabri region. Detailed DECC data indicates that 3 records of the Spiny Peppergrass *Lepidium aschersonii* have been recorded within 5 kilometres of the proposed pilot area (Figure 3).

A majority of the recorded sightings of *L. aschersonii* occur approximately 2 kilometres east of the proposed site within a road reserve and further examples to the west and southwest in similarly retained roadside vegetation. More significant native vegetation remnants acquired and maintained by DECCW (National Parks) do contain more concentrated record of this and other species, however it is clearly apparent that historical land use practice of wide spread vegetation clearance impacts on the frequency and distribution of native flora in the agricultural environment.

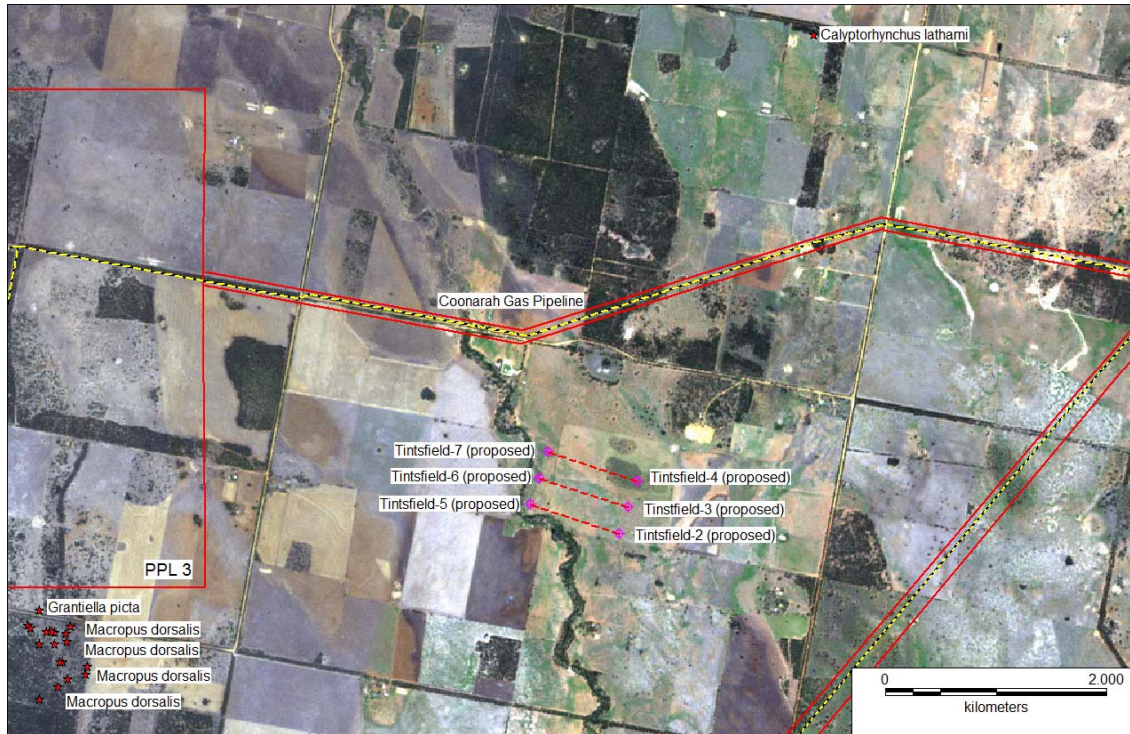
Figure 3.2: Threatened flora records in the area surrounding the Tintsville Project site

The environment surrounding the proposed pilot is dominated by intensive agricultural production and large open grazing paddocks generally devoid of remnant vegetation. Previous clearing and grazing practices have impacted heavily on the quality and diversity of native vegetation in this region including the vegetation retained in shelter belts and riparian zones. The proposed activity requires the preparation of a drilling pad at the stated locations. In terms of potential and likely impacts on existing vegetation, the site does not require any significant quantities of existing native vegetation to be modified or removed to permit access.

3.6 Fauna

Consultation with the NPWS threatened species register 254 records of 28 species of threatened fauna located within the Narrabri region (**Figure 3.3**). A majority of the recorded sightings of *Macropus dorsalis* Black Striped Wallaby occur more frequently in areas 5-10 kilometres west southwest of the Tintsville site within a significant native vegetation remnant acquired and maintained by DECC (National Parks). This endangered species occurs in close association with the Brigalow Endangered Ecological Community (EEC) of which there is two major remnants under conservation status within 10km of the project site.

Figure 3.3 also clearly illustrates the predominantly agricultural production environment surrounding the project site and the large open grazing paddocks devoid of remnant vegetation and therefore potential habitat.

Figure 3.3: Threatened fauna species records in the vicinity of the Tintsville Project site

3.7 European Heritage

A desktop search for all listed heritage sites within the Narrabri Local Government Area was completed across the available State and Commonwealth site registers. They include:

- The Narrabri Local Environment Plan 1992;
- The Australian Heritage Database (<http://www.environment.gov.au/heritage/ahdb/>) which includes places listed in the World Heritage List, the National Heritage List, the Commonwealth Heritage list and the Register of the National Estate);
- State Heritage Register; and
- State Heritage Inventory.

The results of an online search of the Australian Heritage Database are reproduced as follows (**Figure 3.4**).

Figure 3.4 Australian heritage database search for the Narrabri LGA

The screenshot shows the Australian Heritage Database search results for Narrabri LGA. The page header includes the Australian Government logo and the Department of the Environment, Water, Heritage and the Arts. The search results are as follows:

Search Results	Location	Registration Status
Collins Park Grandstand Tibbereena St	Narrabri, NSW, Australia	(Indicative Place) Register of the National Estate
Indigenous Place	Berrygill Creek via Terry Hie Hie, NSW, Australia	(Registered) Register of the National Estate
Indigenous Place	Bullawa Creek, NSW, Australia	(Registered) Register of the National Estate
Mount Kaputar National Park Narrabri Bingara Rd	Narrabri, NSW, Australia	(Registered) Register of the National Estate
Narrabri Gaol (former) Barwan St	Narrabri, NSW, Australia	(Registered) Register of the National Estate
Narrabri Post Office and former Telegraph Office 138-140 Maitland St	Narrabri, NSW, Australia	(Registered) Register of the National Estate
Narrabri Post Office and former Telegraph Office 138-140 Maitland St	Narrabri, NSW, Australia	(Indicative Place) Commonwealth Heritage List
Narrabri Public School 90 Barwan St	Narrabri, NSW, Australia	(Registered) Register of the National Estate
Police Residence 50 Maitland St	Narrabri, NSW, Australia	(Registered) Register of the National Estate

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3.7.1 The Existing Environment

No heritage sites were listed as occurring within the vicinity of the four prospect areas, with the majority of the registered items being found within the Narrabri Township. The Indigenous Place listing for Bullawa Creek refers to a site located within the boundary of the Mount Kaputar National Park, to which the survey carries no risk of interference.

4 ASSESSMENT AND PREDICTION OF ENVIRONMENTAL IMPACTS

The assessment and prediction of the likely environmental impacts associated with the proposed activity is provided by ESG pursuant to Section 111 of the *Environmental Planning and Assessment Act 1997*. The level of detail contained in this REF document was determined by factoring together the intensity of the activity and the relative sensitivity of the environment in which the activity will occur.

4.1 Location Selection

The selection of the location for the Tintsfield CSG Pilot is based on a number of factors including:

- Results of recent core hole drilling;
- Geophysical analysis of existing seismic data; and
- Coal seam reservoir modelling.

Additional factors influencing the final location of well sites and Project related infrastructure included proximity to existing drainage features and other site specific features consistent with current and future farming operations.

4.2 Land

The confidence levels in predicting the impact on the land within the Tintsfield CSG Pilot area are high. The process of preparing the sites for drilling, the actual drilling activity and the operation of the sites during production testing is relatively small in scale and limited to a finite area and hence the extent of resources impacted by the proposed activity.

The size of each well pad is dictated by the operational and safety considerations linked with operating petroleum exploration drilling rigs. The minimum pad size to accommodate the rig and support equipment and permit the safe operation of the blow out prevention system/flare line is 100 metres by 80 metres or 0.80 hectares per well site or a cumulative 4.8 hectares for the six (6) drill pads. The installation of the GGS and water management facilities on Wilga Park is estimated to require up to an additional 5 hectares of the land of the same land use type resulting in a cumulative area of operations approximating 10 hectares.

The operational phase for this pilot is expected to occur over a 12-18 month period while production data is gathered.

4.2.1 Access

Access to the Project site will utilise existing roads and farm tracks and does not require the construction or upgrade of any existing infrastructure. The main route leading to the Tintsfield site from Narrabri is Yarric Lake Rd (sealed), Kiandool Lane (unsealed) and Jones Lagoon Rd. The entrance to site will utilise existing, although upgraded farm tracks to ensure they are trafficable in most weather conditions.

A copy of this REF will be supplied to the Narrabri Shire Council from which road dilapidation assessments can be carried out and a suitable traffic management plans formulated for the project duration.

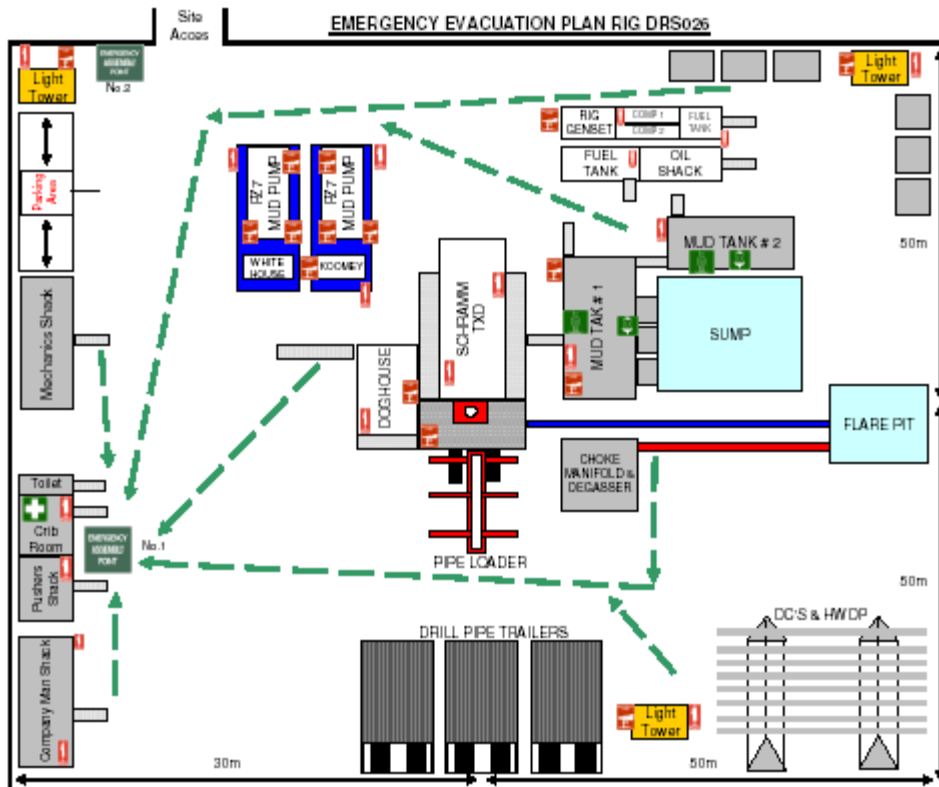
4.2.2 Well Pad Construction:

The construction of the well pad is designed to provide a stable and level platform for the drilling rig and associated equipment to operate safely.

Site construction involves a number of steps to ensure that cumulative impacts are minimised to the greatest extent. The construction of the well pad at the proposed site will require the following:

- Each location will be pegged and verified by certified surveying contractor;
- Topsoils are stripped from the area surrounding the proposed well location and stockpiled at the edge of the pad for use during interim rehabilitation;
- The surface cellar is installed and flare pits excavated;
- The cuttings ditch is excavated; and
- Any gravel base material is placed and compacted ready for the arrival of the drilling rig.

Figure 4.1: Typical site layout for the Schramm TXD production drilling rig



Eastern Star Gas considers the impacts as a result of this activity are relatively small and localised with the well pad only as large as defined by safety requirements.

4.2.3 Initial Rehabilitation and Site Restoration:

At the completion of the drilling operations the well site will be set up for operations with the installation of subsurface equipment, pumps and surface generators and other essential equipment (**Figure 4.2**) on each of Tintsville 5, 6 and 7. The Tintsville 2, 3 and 4 lateral well sites will be cleared of all non essential equipment and mud pits rehabilitated as soon as practicable.

The operational site will then be fenced with an appropriate five strand (or equivalent) stock proof fence and lockable gate.

Figure 4.2: Typical surface installation required to operate a CSG well



4.2.4 Subsurface Impacts:

Protection of the subsurface environment is an important consideration in the drilling of petroleum wells. The intersection of over/undercharged aquifers from surface to total depth presents various issues to the drilling of wells as does the intersection of gas bearing formations. The design of the wells i.e. how they are to be drilled and completed, provides the mechanism by which the wells can be drilled with due consideration of the subsurface environment.

The main functions of a drilling fluid are to cool and lubricate the drill bit, provide a mechanism to carry drill cuttings up and out of the well bore, keep the annular bore hole space clean and 'balance' the hydraulic pressures exerted on the bore hole as vertical depth increases.

Whilst some exchange of fluids is inevitable in the lead up to the formation of the filter cake or where the mud system is too low in weight (or 'under balanced'), the gain or losses of fluids is readily controllable and is unlikely to result in the loss/generation of any significant volumes of water or fluids.

The well design for coal seam gas wells has several objectives:

- to protect potable water aquifers from contamination;
- to prevent formation damage to sensitive coal seams which may reduce their potential for gas production;
- to achieve permanent isolation of the permeable zones within the well;
- to prevent uncontrolled discharge of water and gas from the well while drilling;
- to avoid the loss of equipment down hole; and
- to locate the well bore accurately to assist possible future extraction of mineable coal.

These objectives are achieved by the appropriate selection of:

- casing depths;
- drilling fluids;
- blow out prevention equipment;
- surface facilities for the containment of drilling fluids; and
- down hole surveying.

In combination, the selection of appropriate equipment and techniques form the well design which is documented in the drilling program for each well. In general the well design for PEL 238 wells includes the following:

- The surface hole will be drilled initially with fresh water and bentonite clay (also known as gel) based drilling fluids to avoid contamination of potable aquifers. This fluid will build a filter cake on the borehole wall over permeable zones which will limit fluid transfer, both into and from the well bore. Reactive clays are often intersected below and throughout near surface horizons and it is often necessary to add chemicals to the drilling fluid that inhibit swelling of the clays. The chemicals used to inhibit the reactive clays will generally be potassium chloride and cellulosic polymers. All drilling fluids are treated with a biocide prior to use to prevent contamination of subsurface aquifers with surface bacteria.
- Surface casing will be set in the first competent and sufficiently thick clay stone below the surface, to provide permanent isolation of any potable aquifers near surface from possible saline aquifers below. Surface casing will be cemented to surface, to permanently protect any aquifers and provide structural support for blow out prevention equipment. A formation integrity test will be conducted prior to drilling below the surface casing to ensure that pressured fluids found deeper in the well cannot break down the formation at the shoe and escape to surface in a well control event.

- The intermediate section will be drilled with a weighted drilling fluid with inhibitory properties, to prevent the influx of formation fluids, provide hole stability and prevent swelling of reactive clays. This fluid will generally include sodium chloride and potassium chloride for fluid density, potassium chloride and cellulosic polymers to inhibit reactive clays, viscosifiers to help clean drill cuttings from the well, and minor quantities of other chemicals, including lime and caustic soda for pH control.
- Intermediate casing will be set and cemented as close as possible above the potential production zone in the well to permanently isolate any permeable zones from produced fluids. The casing design loads will include both drilling and production conducted over the life of the well, with industry accepted safety factors.
- The next section of the well is likely to intersect the CSG production targets which are possibly fractured and sensitive to damage through invasion of weighted drilling fluids, particularly where those fluids include chemicals which may form a persistent filter cake that is slow to degrade. Where possible, the target coal seams will be drilled with water produced by other wells from the same formation, to ensure chemical compatibility of the drilling and formation fluids. The drilling fluid will not be weighted unless necessary to achieve well bore stability. This will minimise invasion, and by allowing the well to flow if artesian, will clean up rather than damage the fractures. All produced fluids will be contained in tanks or surface pits (which will be lined if sandy and permeable) and recycled as drilling fluid where possible or else treated appropriately. The level of fluid in the surface tanks and pits will be monitored closely, with personnel residing on the well location to provide 24 hour supervision. The surface tanks and pits will not be permitted to overflow onto the well location. Tankers will be used to cart water from the pits for treatment as required. At any time the well can be shut in to prevent further production of fluids to surface using the blow out prevention equipment installed on the well. Once drilling is complete and wellhead equipment has been installed, the well will be shut in pending completion for production.
- After drilling is complete, a gyro log will be run on wire line to accurately determine the location of any mineable coal seams.

4.2.5 Plugging and Abandonment Procedures:

Prior to the cessation of production operations and the initiation of plugging and abandonment procedures, a notification of the plan of abandonment will be provided to the DII-Minerals for approval.

As per standard oil field practice, a dry hole marker or such surface preparations indicating the well location will be installed in the final stages of abandonment in a manner which is appropriate for both the local land uses and in accordance with department regulations.

4.3 Air

4.3.1 Fugitive Dust Generation:

The dust generated by the mobilisation of the drilling and ancillary equipment to and from a location is generally no greater than localised traffic movements, however can increase due to the cumulative volume of vehicular traffic into the site. At the completion of road dilapidation inspections by the Narrabri Shire Council, measures to upgrade and stabilise the road surfaces will be implemented where required. Furthermore, in the event that roads are excessively dry or soft and where traffic may be expected to generate excessive amounts of dust, a water truck will be deployed to water the roads before and during the move to location.

4.3.2 Noise Impacts:

The proposed drilling and construction activity at the Tintsville CSG Pilot may impact on nearby residences; however suitable mitigative measures can be implemented to reduce noise impacts to acceptable levels.

4.3.2.1 Existing Environment

The residential receptors as shown in **Figure 4.3** are located between 900 and 1800 metres from the closest well site respectively and therefore have the potential to create noise impacts greater than background levels on residential receptors.

Figure 4.3 Distance to residential receptors from each respective well site



4.3.2.2 Noise Criteria

The relevant guideline for assessing the relative impact of the drilling activity on nearby receptors is the NSW Industrial Noise Policy (INP) and the *Environmental Noise Control Manual* (ENCM) published by the NSW EPA (now DECCW).

Operational noise limitations are proscribed in section 2.1 of the INP, as follows:

- Intrusiveness criteria - $L_{Aeq, 15\text{minute}} \leq \text{rating background level plus 5 dB}$ which equates to a project specific noise level of 35 dB(A) $L_{Aeq, 15\text{minute}}$ for evening based upon the assumption that the rural, residential environment maintains a background level at or below 30 dB(A). For the purpose of determining the applicable noise criteria the NSW INP states that where a rating background noise level of less than 30 dBA is measured, the rating background noise level is set to the threshold level of 30 dBA.

Recommended construction noise criteria vary depending on construction duration, as outlined in Section 157 of the DECC *Environmental Noise Control Manual* (ENCM) as follows.

- Construction period more than 4 weeks but less than 26 weeks: L10 level restricted to background (L90) + 10 dB, which equates to a project specific noise level of 50 dB(A) $L_{Aeq, 15\text{minute}}$ for the day time period based upon the assumption that the rural, residential environment maintains a daytime background level of 40 dB(A). Construction of various project related components will only occur during the day time period.

Residential receivers surrounding the site are not currently experiencing significant industrial noise or high levels of traffic noise therefore this additional source of noise will not be considered as significantly affecting any given receiver in the vicinity of the project.

The rating background levels applied to the proposed activity will therefore be 40 dB(A) and 35 dB(A) for the day time and night time period respectively.

4.3.2.3 Noise Monitoring and Modelling

ESG commissioned Heggies Pty Ltd to undertake attended source noise monitoring of Lucas Rig 26 across the day time, evening and night time period while in operation at Dewhurst. The measurement of sound power levels at or adjacent to the drilling rig, within the near field (approx 0-1000m) and far field (>1000m) was successful in characterising the operational noise emitted from the rig and its impact on receptors located within the offset distances.

The figures in Table 4.1 clearly illustrate the relationship between noise propagation and distance from source as a means to understand how an activity may impact on nearby receptors.

Table 4-1 At Source noise monitoring on Lucas Rig 26, Dewhurst CSG Pilot

Location Name	Measurement Start Time	Approximate Offset Distance from Drilling Rig	L _{Aeq} Sound Pressure Level (dBA)
Dewhurst 15	10:58 am	60 m	73 dBA
Dewhurst 14	11:25 am	200 m	62 dBA
Dewhurst 13	11:42 am	400 m	55 dBA
Receptor 1 Northern Boundary	11:55 am	617 m	56 dBA
Power Line Crossing Near Rockdale Road	12:15 pm	1,500 m	35 dBA
South Eastern Corner of Rockdale Road	12:29 pm	2,167 m	32 dBA
Receptor 2 Boundary	12:39 pm	2,900 m	30 dBA
Receptor 2 Boundary	9:59 pm	2,900 m	29 dBA
Power Line Crossing Near Rockdale Road	10:19 pm	1,500 m	37 dBA

Based upon the noise measurements undertaken both within the near-field of drilling activity undertaken at Dewhurst 15 and at the far-field receptor, the predicted L_{Aeq, 15minute} noise levels are estimated to be:

- 46 dB(A) at 1000m; and
- 32 dB(A) at 2000m.

4.3.2.4 Impact Assessment and Mitigation

The environment surrounding the proposed Tintsville pilot site is typical of the rural setting. The ambient noise levels in the local environment are affected by a large range of farming activities during most times of the year, by prevailing weather conditions (i.e. wind) and by incidental sources insect noise, especially during the summer months. The assumed background noise levels (rating background levels) for this environment is 35 dB(A) L_{Aeq, 15minute}.

The physical distance between the nearest residential receptor and the closest Tintsville well site approximates 900m and is partially obscured (i.e. no direct line of sight) by the riparian vegetation of Mollee Creek and other vegetation surrounding the house proper. In terms of potential noise impacts, the noise propagation modelling carried out by Heggies is integral to understanding the mode and extent of noise propagation in the rural environment and specifically the proposed activity at Tintsville.

The findings of Heggies indicate that the noise emissions and propagation from the Lucas Rig and the expected impacts on residential receptors can be generalised as:

- During operations in which the drilling rig noise emission are highest, the noise levels at or about 1000m from the source are expected to approximate 46 dB(A);

The predictions of Heggies do not take into account the attenuation due to various external factors including meteorological conditions, topography and existing vegetation.

- Adverse weather conditions such as temperature inversion or strong winds blowing from source to receiver can often increase the noise levels at nearby sensitive receptors. Conversely, neutral weather conditions (low wind speeds, moderate humidity and moderate temperatures) can also reduce the propagation of noise towards receptors. Adverse weather is considered likely to impact on the distance noise travels from between 0 dBA at 0m to 5dbA up to 2000m from the source. Penalties of between 0 and 5 dBA are to be made where “worst case” weather is encountered (10°C, 90% humidity, temperature inversion in effect and winds >2m/s from source to receiver.
- Topography can dramatically affect the propagation of noise emitted from a point source. The degree of shielding is a function of the frequency spectrum of noise and the extra distance the noise must travel where the noise is diffracted by topographic features. Noise attenuation as a result of partial shielding typically ranges from 0 to 5 dBA while optimal shielding (i.e. no line of sight) can result in reductions of up to 15dBA. Taking into account the topography and the impact of vegetation barriers between the nearest residential receptor and well site, the attenuation of noise is expected to range between 5 and 15 dBA, reducing the noise emissions to between 31 and 41 dBA under neutral weather conditions.
- Vegetation lying between source and receptor decrease the propagation of noise, where vegetation is above 2m tall and is sufficiently dense. The increased sound absorption of vegetation has been estimated at between 5 and 10 dBA per 100m of propagation distance.
- Opportunities to mitigate the propagation of noise from the rig sites are numerous and will focus on the orientation of the rig, the location of major noise sources and the location of ancillary equipment such as sites offices.

The mitigation strategies to assist in the reduction of noise emissions towards the residential receptor include a range of physical barriers and site specific measures to direct noise away from nearby receptors. In this regard, Heggies suggest that:

- Based upon near-field measurements taken on the rear side of the drill sites, the orientation of the front side of the drilling rig away from sensitive receptors can reduce the predicted L_{Aeq} noise level 1000m from 46dB(A) to 39 dBA;
- Additional attenuation in the order of 5-10 dBA could be expected if the site office or an equivalent physical barrier is located between the drill rig and the receptor, which would bring the predicted level down to 34-29 dBA;
- The installation of physical barriers on the receptor side of each drill site could be expected to attenuate noise propagation to the order of 5-10dbA
- The screening of rig engine exhausts and other point sources on site could also be expected to reduce significantly the noise emissions from site

In consultation with the noise experts at Heggies, it is the intention of Eastern Star to develop a site specific noise management plan to limit the impacts on nearby residents to the greatest extent and take all opportunities to attenuate noise emissions from the drilling sites.

Consultation with the residents of Tintsville will also be undertaken to both discuss potential mitigative action for the duration of the short drilling program.

4.4 Water

4.4.1 Impacts on localised water courses

No impacts are likely to be introduced onto localised creeks and water courses through the installation of the Tintsville CSG Pilot.

Mud containment onsite will involve an integrated mud sump/cuttings ditch with dimensions of approximately 6 metres by 3 metres by 3 metres. The sump will be located adjacent to the drilling rig and accept all mud returns and rock cuttings from the well during drilling. The mud/fluid sump will be lined with a temporary liner to mitigate any risk of soil contamination.

The issue of mud containment and potential risks of land and groundwater contamination (e.g. percolation through walls/base of sump, accidental discharge (overtopping) during rainfall etc.) has been reviewed along with risk assessments carried out by Lucas/ESG prior to the commencement of the Bohena CSG Pilot. The review concludes:

- The risk of contamination of groundwater from the percolation of drilling fluids from the unlined surfaces of mud/cuttings sumps is negligible as they will be lined with a polyethylene liner; and
- The risk of a mud sump/cuttings ditch overtopping due to excessive well discharge or inflow from a rainfall event is low. The risk assessment process undertaken by Lucas/ESG identifies this as a potential risk and provides a response mechanism of manual pump out where any danger of overtopping is identified by the drilling supervisor.

4.4.2 Source:

The water used in the drilling of each well will be sourced from suitable on farm supplies and/or from licensed bores before being transported to site as needed. Storage onsite consists of the mud pits themselves and additional 'day tanks' to provide ready access to additional supplies when required.

4.5 Flora

No specific flora surveying has been conducted in preparation for this Project as the site has been previously cleared and is currently being grazed. There remains no requirement for the destruction or modification of any vegetation in accessing each site or during the conduct of the activity and therefore no further impact assessment is required.

4.5.1 Weed Species

The risk of introduction of weeds and pests species to the site via the entry of vehicles and plant will be mitigated by the wash down of all vehicles, plant and ancillary equipment new to the region at the ESG maintenance yard in Narrabri. This will entail the complete removal of soils and organic matter from wheels, wheels arches, chassis and other sites capable of holding seed or vegetative material prior to any vehicles accessing the Project site.

4.6 Fauna

No specific fauna surveying has been conducted in preparation for this Project as the site has been previously cleared and the pasture species grazed by stock and domestic animals. There remains no requirement for the destruction or modification of any vegetation or habitat in accessing each site or during the conduct of the activity and therefore no further impact assessment is required.

4.7 Cultural Heritage

The likelihood that the proposed activity will impact on sites or items of Aboriginal Heritage significance is low considering the previous and current land use practices at the site. The field inspections served to confirm the highly disturbed nature of the land in question and the ongoing utilisation of each for intensive agricultural activity that would furthermore reduce the likelihood that items or sites have remained undisturbed and potentially at risk from the preparation of the drill pads and the conduct of the drilling activity.

Eastern Star Gas is confident that this proposal carries no potential for direct impacts on the cultural heritage values of the project area. However, in the small likelihood that the activity locates a potential site or item of significance, it is proposed that all activities are ceased until such time as a qualified archaeologist or local aboriginal land council representative is able to assess further the significance of the find and suggest suitable mitigative action.

4.8 European Heritage

No mitigation strategy is required for the protection of known, recorded heritage sites within the vicinity of the seismic prospects. However, to account for any perceived residual risk of impacting on heritage sites, operators and field contractors are to be notified of Eastern Star's "stop work" policy for heritage discoveries. If any potential places, sites or items European heritage significance are identified during the construction process, all activities will cease in the immediate area of the site until such time as the appropriate representatives from the Narrabri Shire Council or an alternative authority has assessed the site and adequate site management plans have been devised.

4.9 Waste Management

4.9.1 Drilling Fluid and Cuttings Disposal:

At the completion of the drilling activity,

- The fluids contained within the sumps will be pumped out and disposed of in the lined evaporation ponds located at Bohena
- The cuttings settled in the bottom of the pit will be removed and stockpiled on the site
- The liner will be removed from the sump for disposal at the Narrabri waste depot; and
- The excavation will be backfilled with a mixture of subsoil and the retained cuttings before the replacement of the topsoils.

The term ‘drill cutting’ describes the material generated from the drilling activity once removed from the drilling fluids. Eastern Star Gas generally employs drilling bits that generate cuttings of a size similar to very coarse sand (<3-5mm millimetres) as shown in **Figure 4.4**.

Figure 4.4: Drilling fluid and drill cuttings exiting the mud system (PEL433 Allambi-1C)



4.9.2 Putrescible Waste Disposal

Day to day materials and putrescible wastes will be collected in rubbish cages located on the drilling site for the duration of the activity and will be serviced by a licensed waste contractor from Narrabri.

A portable toilet will be located onsite and maintained by services from Narrabri.

4.10 Greenhouse Gas Impacts

Eastern Star Gas, in preparation for the submission of a major project application to Planning NSW, commissioned Heggies Pty Ltd to conduct a greenhouse gas assessment of the Bibblewindi and Bohena CSG Pilots and the relative benefits of gas capture and consumption at the Wilga Park Power Station in preference to atmospheric venting and/or flaring. The conclusions of this report and the findings of ESG as the proponent of the major project that would gather and transport all gas produced at these two pilots suggest that considerable environmental and economic benefits can be gained from the proposal.

The Tintsville CSG pilot does not differ from this scenario; a majority of the gas produced by the pilot will be consumed *in situ* by generators providing power to surface and subsurface equipment with the remainder gathered from each well head by small diameter, low pressure gathering lines. It is also envisaged that excess production gas will be discharged into the Coonarah Gas Pipeline and consumed at the Wilga Park Power station thereby ensuring that no methane is vented to atmosphere.

4.11 Chemical and Hazardous Substance Management

The consumption and storage of potentially hazardous materials including fuels, oil based lubricants and drilling fluid additives is addressed in the generic risk assessment carried out by ESG and Lucas Drilling. The following mitigation strategies have been devised to limit the incidental risks of land or water contamination from materials stored on the drill site for the duration of the activity.

- Mud tanks will be employed for the mixing of drilling fluids and longer term storage (*not to be confused with mud pits/sumps);
- Ablution facilities equipped with 3 separate black water tanks to extend the capacity in the event of limitations on services access to site;
- Drilling fluid additives (dry) stored in covered/weather proof trailer;
- Bunded trailers designed to AS/NZS used for fuel and chemicals storage; and
- Spill kits located at frequent locations across the drill site.

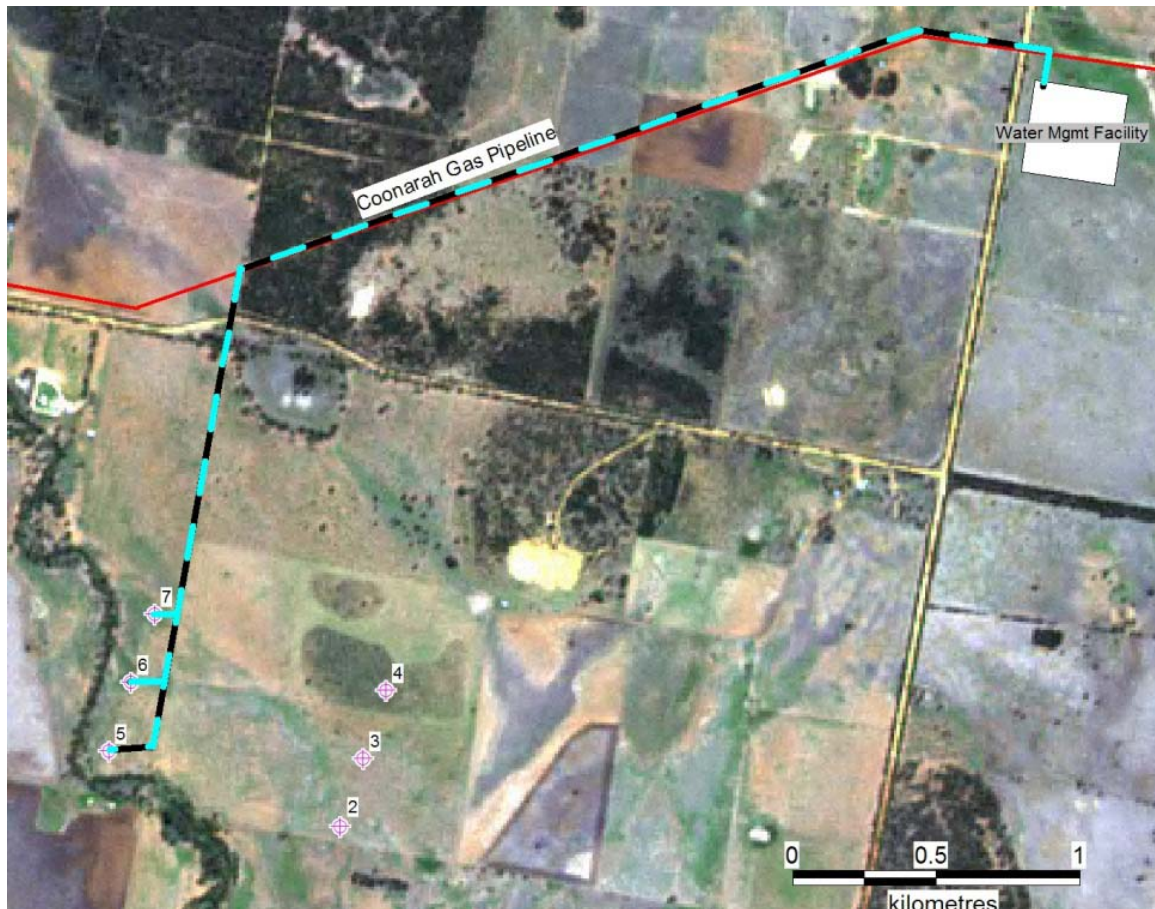
5 WATER AND GAS MANAGEMENT

The following section describes the manner in which gas and water will be managed at the Tintsville CSG Pilot. In general terms it is proposed gas and water gathering system (GGS) from the Tintsville CSG Pilot will be transported to the Wilga Park power station site approximately 3.5 kilometres to the northeast of the pilot wells.

5.1 Water and Gas Gathering System

The proposed GGS system will comprise separate buried, low pressure flow lines for water and produced gas linking the vertical production pilot wellheads through to a centralised manifold before being discharged into a main flowline to Wilga Park (**Figure 5.1**). Gas and water will be collected from each vertical production well head (Tintsville-5, 6 & 7) by buried low pressure piping and into a flow line located on or about the north-south fence line, passing under the Jones Lagoon Rd and intersecting the Coonarah gas pipeline easement. The GGS will then head northeast and follow the easement back to Wilga Park. Upon entering Wilga Park, the gas stream and water stream will separate. Gas will be fed into Coonarah gas pipeline and used for electricity generation at the Wilga Park power station. Water will be transported to a stand alone water management facility for treatment and reuse/storage.

Figure 5.1: Conceptual layout of the proposed gathering system at Tintsville CSG Pilot.



5.1.1 GGS Specifications

The specifications of the GGS being proposed for installation at Tintsville is shown in the Table 5.1.

Table 5-1: Gathering system specifications.

GGS Component	Gas Gathering Design Specifications – Tintsville CSG Pilot to Wilga Park	Water Gathering Design Specifications – Tintsville CSG Pilot to Wilga Park
Length	5 km	5.5 km
Diameter	Up to 10” O.D	Up to 10” O.D
Material	High Density Polyethylene (PE100)	High Density Polyethylene (PE100)
Static Pressure Rating	To AS4130	To AS4130
Depth Cover	Minimum 750mm cover to AS2885	Minimum 750mm cover to AS2885
Construction ROW	≈10m	≈10m

5.1.2 Compliance with Australian Standards

The relevant Australian Standard for polyethylene pipes is AS4130; all construction materials, methods and work practices for the proposed GGS installation and operation will be designed in accordance with this and other pertinent standards (AS2885) to the satisfaction of DPI (Minerals and Petroleum).

5.1.3 Approvals Required

In order for the proposed GGS installation to proceed, ESG will seek the approval of DPI (Mineral Resources) in accordance with Part 5 of the *Environmental Planning and Assessment Act 1979* and the licencing provisions of Petroleum Exploration Licence 238.

5.1.4 Hours of Operation

The proposed construction activities will occur between 0700 hours and 1800 hour.

5.1.5 Activity Timeframes

The proposed activity is expected to occur over a timeframe of approximately 6-8 weeks.

5.1.6 Construction Activities

The installation of the gathering system will require the following component activities

Surveying the Gas Flow Line Corridor

The proposed gas flow line corridor will be surveyed by a registered surveyor before any preparatory activities take place.

Topsoil Stripping and Stockpiling

The topsoil within approximately 3 metres of the flow line trench will be stripped to a depth of at least 100 millimetres and stockpiled next to the retained vegetation.

Trench Surveying

The location of the trench centreline will be marked within the surveyed corridor.

Trenching

A wheel or chain trencher will excavate the gathering system trench. Subsoils will be stockpiled in a windrow adjacent to the topsoil stockpile.

Pipe joining and laying

The lengths of poly pipe will be strung out along the work area and joined together before being lowered into the trench.

Backfilling and Restoration

The backfilling of the trench will commence at the completion of the system testing procedures. A magnetic identification/warning tape will be installed approximately 300 millimetres above the flow lines. The topsoil stockpile will only be returned once the trench has undergone sufficient backfilling and compaction.

5.1.7 Road Crossings

The crossing of roads intersected by the gathering system will occur with minimal disruption to traffic and observe council policy on road closures where required. The re-instatement of the roads surface will be undertaken as soon as practicable to ensure minimal disruption to traffic flow.

Consultation with the Narrabri Shire Council engineering department with a view to developing acceptable traffic management plans will occur prior to the mobilisation of construction crews to site.

5.2 Wilga Park Water Management Facility

The water management facility to be located at Wilga Park will comprise an integrated system of impoundments and water treatment that will manage all water produced from the Tintsfield pilot for the duration of the production testing. This model has been successfully implemented at the Bibblewindi CSG pilot and presents the most effective method of water management during pilot studies.

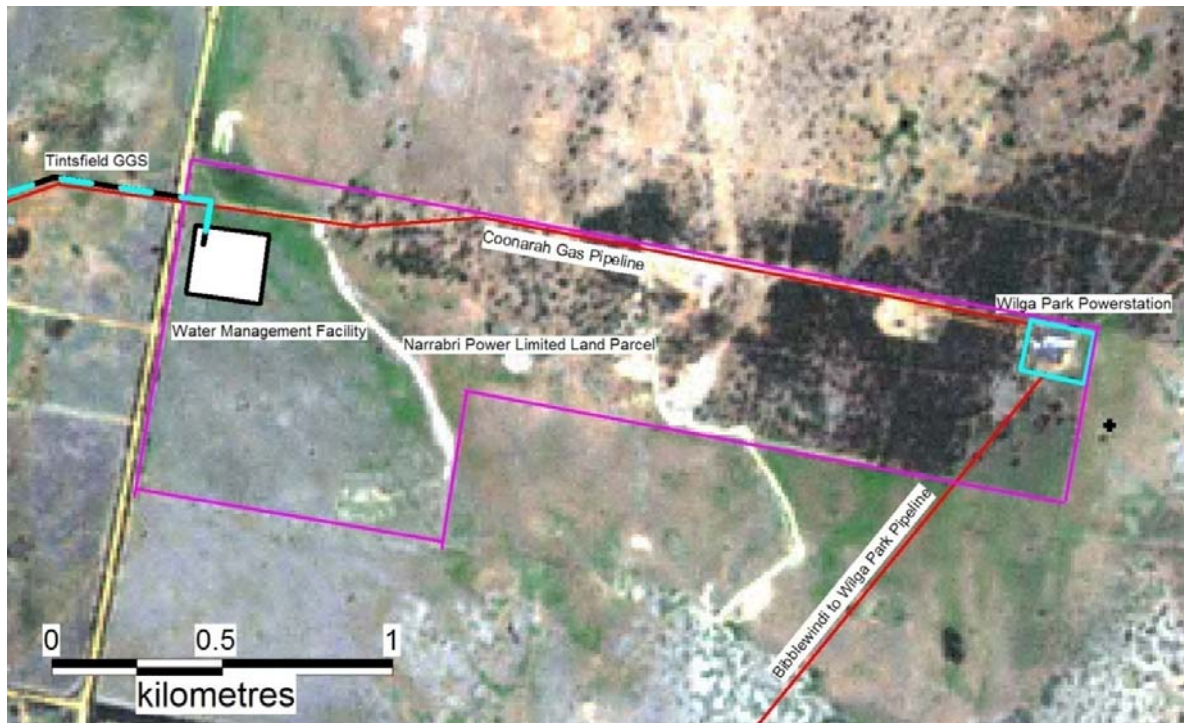
The facility will comprise the following:

- A water treatment unit with a capacity of up to 5000 bwpd.
- A lined impoundment for raw production water (feed water) containment
- A lined impoundment for concentrate containment; and
- An unlined dam for permeate storage and reuse.

5.2.1 Location

The location of the Wilga Park water management facility will be adjacent to the existing Wilga Park Powerstation on a cleared, freehold block owned by Narrabri Power Limited, a wholly owned subsidiary of Eastern Star Gas Ltd.

Figure 5.2 Location of the proposed water management facility on Wilga Park



5.2.2 Existing Environment and Impact Assessment

The water management facility servicing the Tintfield CSG pilot will be located on lands currently employed for the grazing of domestic stock. No vegetation or potential habitat will be modified through the implementation of the proposal nor will it impact on known sites of Aboriginal or European heritage significance.

5.2.2.1 Flora

No specific flora surveying has been conducted in preparation for this Project as the site has been previously cleared and is currently being grazed. There remains no requirement for the destruction or modification of

any vegetation in accessing each site or during the conduct of the activity and therefore no further impact assessment is required.

5.2.2.2 Weed Species

The risk of introduction of weeds and pests species to the site via the entry of vehicles and plant will be mitigated by the wash down of all vehicles, plant and ancillary equipment new to the region at the ESG maintenance yard in Narrabri. This will entail the complete removal of soils and organic matter from wheels, wheels arches, chassis and other sites capable of holding seed or vegetative material prior to any vehicles accessing the Project site.

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5.2.2.5 European Heritage

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5.2.3 Treatment Unit

The treatment unit will comprise a modular, containerised reverse osmosis unit with a maximum capacity of 5000 barrels of water per day. The unit will be located within a footprint of approximately 35m x 35m. The unit will be set up adjacent to the impoundments and is connected directly to an outlet manifold where water transferred from the production wells at Tintsville will enter the treatment system.

Target permeate qualities for this treatment unit are expected to approximate 500mg/L total dissolved solids (TDS) and is expected to achieved sustained operating efficiencies of around 80-85 percent. Water of this quality is able be consumed in a large range of reuse strategies including irrigation and stock watering without limitations on volume or frequency of application.

5.2.4 Water Production Modelling

The preliminary production modelling carried out for the Tintsville pilot indicates that water production from the three producing wells is heavily dependent upon the geological characteristics and relative success of the horizontal, in seam wells. It is therefore at this stage not possible to make any reasonable estimates on the potential of the wells to produce water at a given rate until after the horizontal wells are drilled and initial permeability testing is completed.

Any significant variation to the size and/or location of the water management facility as a result of higher than expected rates of water production will be discussed with DII and may be subject to a variation to any approval or consent obtained.

5.2.5 Production water impoundment

It is proposed that a production water management impoundment be constructed at the facility to permit the storage of untreated production prior to treatment. Located within the water management facility site, the impoundment is expected to approximate 50 metres x 50 metres and approximately 4 metres in depth. The impoundment will be constructed to an engineered design and be lined with a 1.5mm HDPE liner.

5.2.6 Concentrate Impoundment

The concentrates discharged from the treatment unit will be contained in a lined impoundment of the same specification as the production water impoundment discussed in section 5.2.2. The impoundment will be constructed to an engineered design and be lined with a 1.5mm HDPE liner.

5.2.7 Permeate Management

The permeate stream discharged from the treatment unit will be transferred to a dam located on Wilga Park and retained for various reuse purposes including maintenance of the pilot facilities and access roads. No liner will be installed in this structure due to the high quality permeate, which at drinking water qualities does not pose a risk of contaminating near surface groundwater.

5.3 Pond Design and Construction

ESG has employed Aquatech Consulting Pty Ltd to assist with the design and construction supervision for the facility. Aquatech is a small firm of engineers specialising in the investigation, design and construction supervision of water resources and irrigation projects. **Appendix A** depicts various options prepared by Aquatech for installation at Bibblewindi-1 that will be reconfigured for installation at Wilga Park; the designs for the production water and concentrate impoundments will comprise a 50 metre x 50 metre (bottom left of design drawing).

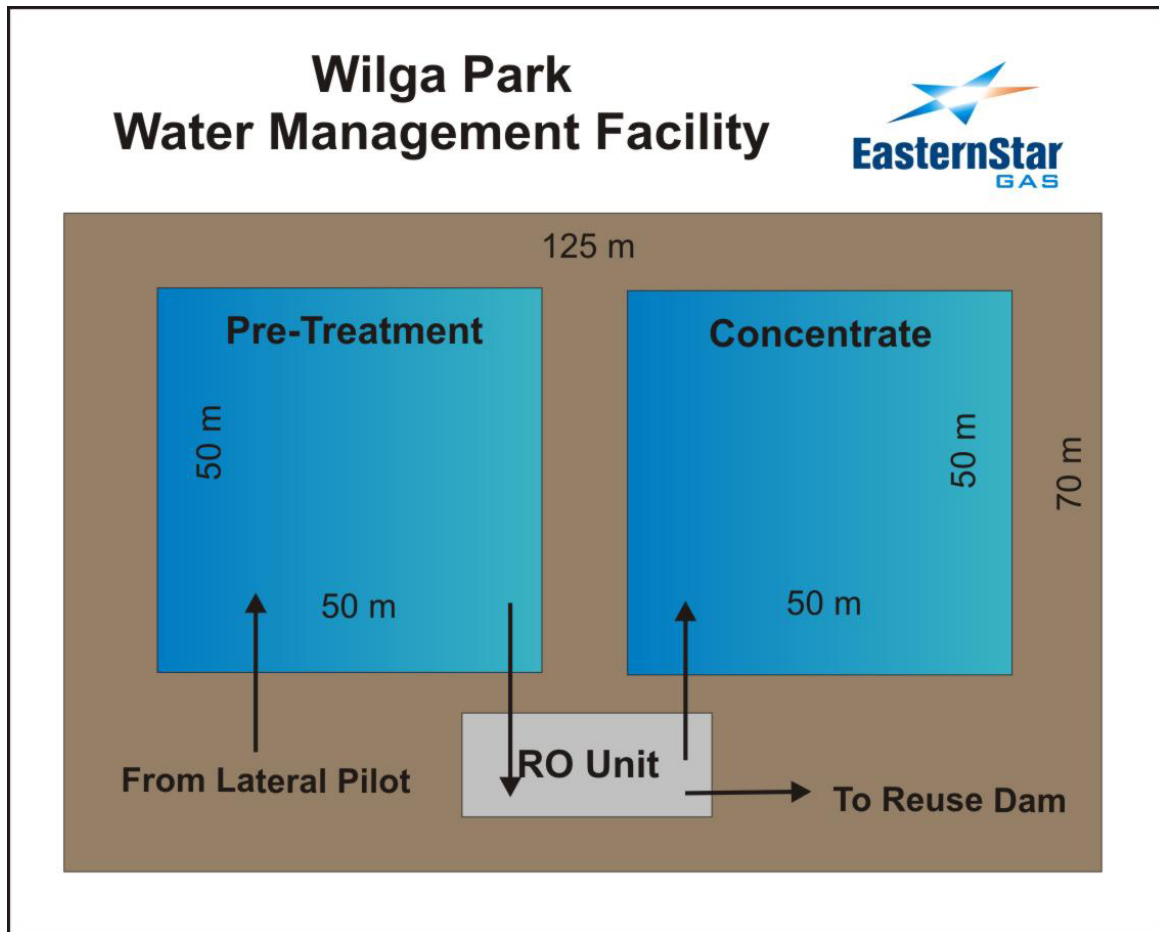
5.3.1 Pond Liner

Based upon the requirements for zero discharge of any saline by product of the CSG production activity, the production water and concentrate impoundments will be lined with a High Density Polyethylene (HDPE) membrane of a thickness not less than 1.5mm.

5.3.2 Facility Layout

The conceptual layout for the water management facility is shown in **Figure 5.2**.

Figure 5.3 Conceptual layout of the Wilga Park water management facility



5.3.3 Waste Management

Waste materials generated during the construction period will include:

- construction materials waste such as timber, plastic and small amounts of metals;
- general domestic refuse; and
- wastes such as engine lubricants and coolant fluids.

In accordance with good field practice, work crews will be required to dispose of all waste materials in designated receptacles or collected for disposal offsite at the completion of each shift. Wherever possible, waste materials will be collected for recycling and/or reuse or otherwise be transported for disposal at the Narrabri Waste Depot.

5.4 Rehabilitation

The rehabilitation of the GGS corridor will commence as soon as practicable after the construction activities have ceased. The main objective of the rehabilitation program will be to return the land disturbed by the proposed GGS installation back to previous land use as soon as practicable.

As no vegetation will be cleared by the proposed installation process, the rehabilitation will focus on obtaining groundcover across the right of way using quick to germinate grass species. In consultation with the landholders of each lot intersected along the 3km length, it is proposed that oversowing of the right of way will occur as soon as practicable to stabilise the disturbed topsoils.

5.4.1 Pond Decommissioning

At the completion of the production testing program, the pond will be emptied of all production water and concentrates, the liner removed for disposal and the site rehabilitated.

5.4.2 Concentrate disposal

It is envisaged that the disposal of the concentrated brine component will involve an additional treatment and handling off site before the liner can be removed. Details of a management plan for concentrates are being developed and will be incorporated into all water and operations management plans upon completion.

Investigations into plant capable of concentrating the brine component to less than 1% of its initial volume are well advanced and will be discussed with DII with a view to incorporation into the project water and operations management plans.

5.4.3 Liner Disposal

The HDPE will be removed from the evaporation pond and disposed of in a licensed disposal facility.

Where an alternative to the disposal of the liner can be identified (reuse or recycling), ESG will consult with DII and provide amended plans as required.

5.4.4 Rehabilitation Earthworks

After the removal of the liner, the main excavation and borrow pits will be filled in with subsoils and re-contoured to approximate pre-existing condition. Drainage lines and small surface contours will be installed as required to ensure that rainfall and surface water does not flow towards the area under rehabilitation and cause ongoing issues with inundation and excessive settling.

The main focus of this stage of rehabilitation is to minimise any impacts associated with the subsidence of reinstalled subsoils across the site. Where required, additional fill from an approved source will be placed on areas where excessive slumping may be an issue

5.4.5 Topsoil Redistribution

At the completion of the major earthworks to reinstall excavated subsoils, the redistribution of the stockpiled topsoils will commence.

5.4.6 Site Rehabilitation Monitoring

The monitoring of the site will occur at least on a monthly basis during the 12 month period from the cessation of rehabilitation earthworks.

Aspects of the rehabilitation program that will be monitored for the duration of the operational period will include:

- Any evidence of slumping within the area of the GGS trench;
- Any suggestion of excessive erosion or topsoil instability;
- Any issues with the adequate drainage of the corridor; and
- Weeds regrowth

Remedial action will be taken where issues such as described or otherwise are evident. No time limits will be placed upon the duration of the monitoring and maintenance program. The success of the site rehabilitation will be assessed with the assistance of the landholder. After this initial 12 month period, the monitoring of the site will occur at least every three months or until such time as the rehabilitation is signed off by the landholder.

6 LICENCES, PERMITS AND CONSULTATION

6.1 Drilling Proposal:

This application forms the first part of the submission requirements for drilling activity and will be forwarded to the appropriate department at DII (Minerals and Energy) prior to the commencement of the proposed activity.

6.2 Additional Licensing

No additional licensing is required from DPI or any other agency to permit the activity as described.

6.3 Landholder Permitting:

Approval to conduct the proposed activity will be sought from the landholder(s) and access agreements finalised that will clearly state the conditions under which ESG may enter the private lands for the proposed activity and ongoing operations.

6.4 Consultation

The planning of this drilling program will include consultation with the following Government agencies and non government stakeholder. They include:

- NSW Department of Industry and Investment (Minerals and Energy)
- Narrabri Shire Council
- Private landholders upon which the pilot is located; and
- Private landholders located on main access roads into the site

7 EVALUATION OF CUMULATIVE ENVIRONMENTAL IMPACTS

The assessment of the proposed activity and the characterisation of the cumulative impacts is pursuant to S228 of the *Environmental Planning and Assessment Regulation 2000* which suggests the factors that must be taken into account concerning the impact of an activity.

S228 (2)(o) specifies

that any cumulative environmental effects arising from the implementation of the proposal with other existing and likely future activities must be identified as part of the assessment process.

The proposed CSG pilot installation illustrated in to which the REF refers includes the following activities (in general order of occurrence):

- The preparation of up to six (6) drill pads to a maximum of 100 metres by 80 metres;
- The drilling of three (3) vertical production wells at Tintsville-5,6 and 7;
- The drilling of three (3) lateral production wells at Tintsville-2, 3 and 4;
- Installation of water and gas gathering system linking the three vertical production wells; and
- The operation of the pilot under an operations/water management plan (see section 5).

Other activities undertaken in the general area by ESG to which this proposal will contribute to the cumulative impacts include the Dewhurst CSG Pilot, Bibblewindi CSG Pilot and Bibblewindi West CSG Pilot.

The biophysical receptors that are likely to or have the potential to be impacted upon include biodiversity (flora & fauna), soils resources and the localised environment surrounding the pilot and water management facility.

The socioeconomic receptors likely to or have the potential to be impacted upon include the local economy, current land use practice and cultural heritage.

7.1 Cumulative Biophysical Impacts

The proposed Tintsville CSG Pilot does not contribute to the cumulative area of native vegetation/habitat impacted by Eastern Star's current operational assets in PEL238, which approximates 75 hectares mostly within the Pilliga East State Forests. No existing or native vegetation is expected to be modified or cleared in implementing the project as described and therefore the cumulative impacts on biophysical receptors will not increase as a result of the proposed activity.

The impact of the proposed activity on localised soil resources is able to be accurately quantified and for the most part mitigated. The conservation of topsoils during construction activity is designed to maximise the effectiveness of future rehabilitation and it is for this reason that the proposed activity is unlikely to result in any reduction in the value of soil resources within the project site.

The scale of fugitive particulate material generation and their impacts on the surrounding environment is generally thought to be negligible. Adequate mitigative measures are available during the construction phase to limit the generation of dust in the localised area and where the activity creates greater than normal levels of traffic on the unsealed access tracks inbound and outbound from the general areas. In cumulative terms, the incidental generation of dusts along existing localised roads and on farm tracks occurs over the short period during which the activity is more intense before reducing to a low level during operations can be reduced considerably by:

- Effectively communicating the proposed work program to the Narrabri Shire for pre-start dilapidation inspections and pre-emptive maintenance,
- Employing water carts to reduce dust on a daily basis and
- Limiting both unnecessary traffic and imposing speed limitations where appropriate.

7.2 Cumulative Socioeconomic Impacts

The scope for impacts on items or sites of cultural heritage significance remain absent from the proposed activity. Consultation with available heritage databases indicates that no known sites of significance will be impacted by the proposed activity.

Positive cumulative benefits for the local business community are an expected result of the proposed activity with the planning and construction phases utilising a range of local professional service providers. The value of the project to the local economy is expected to approach 250 000 Australian Dollars for the program, with all earthworks, site preparation and rehabilitation activities completed with the assistance of local contractors.

7.3 Cumulative Greenhouse Impacts of the CSG Projects

The operation of the Tintsville CSG pilot along with the three other pilots currently or soon to be in operation has the potential to increase greenhouse gas emissions. Heggies (2007) conducted a comprehensive review of the benefits offered by consuming all CSG produced over partial consumption and venting. Coal Seam Gas vented directly to the atmosphere has a greater global warming potential than gas emissions from combustion due to the high (≈ 90 percent) methane content of the gas. Calculations of greenhouse gases from venting, in terms of CO₂-e were calculated by Heggies from modelled throughput values (12 production wells) and thence compared in terms of State and National totals (**Figure 7.1**).

Table 7-1: Comparison Emissions Figures - Project, Venting Option, State and National Figures.

Source	Emissions (t CO ₂ -e)	% of National
Project	204 193 (predicted)	0.0365%
Atmospheric venting option	1 431 624 (predicted)	0.256%
NSW annual total	158 200 000	28.29%
National annual total	559 100 000	

The comparison of predicted emissions with the 2005 State and National emissions figures suggests that the proposed combustion CSG at the Wilga Park Power Station would represent an increase of approximately 0.0365 percent the total baseline Australian emissions for 2005 or 0.265 percent from the venting of the CSG to atmosphere. Further comparison of the two options in terms of equivalent emissions suggested that venting of CSG would produce emissions equivalents in the order of 7.2 times the emissions from combustion *in situ* (localised power generation for surface equipment) and electricity generation at the Wilga Park Power Station.

The conclusions of this report and the findings of ESG as the proponent of the major project that would gather and transport all gas produced at the Bohena Lateral Production Pilot suggest that considerable environmental and economic benefits can be gained from this strategy. Similarly, the intention to collect all gas produced at the CSG pilot for consumption *in situ* (surface and subsurface equipment) and transfer surplus to be transported via the gathering system back to the Coonarah gas pipeline for electricity generation at Wilga Park achieves the objective of minimising greenhouse gas emissions the greatest extent.

8 PROJECT JUSTIFICATION

8.1 Environmental Impact:

The proposed activity can be undertaken without any significant environmental impacts on native flora, fauna, soil and water resources and the cultural values of the Narrabri region.

The benefits of using natural gas and CSG to fuel economic development are widely understood. Natural gas is the environmental fuel of choice having lower atmospheric emissions than any other fossil fuel. Coal Seam Gas field development has a much smaller 'footprint' on the ground than any other fossil fuel extraction process.

A successful gas development project in this part of NSW will form the basis of an economic renaissance in the region by providing a clean, cost effective fuel for process, manufacturing and electricity generation. The net environmental impact for NSW could be positive with part replacement of coal fired electricity generation by gas fired electricity allowing additional coal to be released export and at the same time significantly reducing 'greenhouse gas' emissions whilst promoting new economic development in regional NSW.

8.2 Social Impact:

New oil, natural gas and CSG production in regional rural NSW will have a significant positive impact by providing a local energy source that will attract new industry and economic development and also replace existing more expensive energy sources. The process field development will not only provide new employment opportunities but also pump money into local business. It will also provide the community with an opportunity to diversify from and complement its agricultural base. In summary, if this project is developed it will provide the basis for significant new developments in north western NSW. In addition to attracting new businesses, the creation of new local job opportunities, additional revenue is being spent in the business community, an improvement in local infrastructure and a more diverse economic base for people living in the region.

8.3 Economic Impact:

New South Wales has no oil production and only very small gas production. All of the oil and the vast majority of gas consumed in NSW are imported from other Australian States or from overseas. While it is still too early to quantify the resultant economic rewards of a CSG production development it is generally recognised that such a development will have a major positive effect on the State, the region and the local community. At present all the natural gas consumed in NSW (approximately 150 Petajoules per annum) is sourced from South Australia and Victoria and any opportunity to develop significant gas production within the State will be of economic benefit. The dominant energy source in NSW is coal which although being

present in abundance at a relatively low price is significantly, less environmentally friendly than the use of natural gas both from the effects of a mining operation and atmospheric emissions.

Populations and businesses based in regional NSW are rapidly declining with a movement to the major cities. Coal Seam Gas development within the Narrabri area will have a significant impact on the region by providing a cheap, clean energy source that will attract new business and employment. New and upgraded infrastructure is generally a component of gas field development. The local community will also benefit economically with the gas field operations directly purchasing services and equipment from local suppliers and businesses and the general knowledge that for every dollar invested in developing a property or installing facilities to deliver gas to market, the local economy benefits by approximately seven fold.

9 CONCLUSIONS

The discovery and development of petroleum resources within NSW is aimed at reducing the states dependence on sources of energy from interstate gas fields for electricity production and domestic gas supplies. This project and the ongoing activity in the area will assist in achieving this objective as potential reservoirs are delineated and exploration, development and appraisal activities occur over the next few years. The primary objective of this series of wells is to develop further the production deliverability of the CSG resources that occur across PEL 238.

The installation of infrastructure for the CSG development will require ESG and its contractors to construct well pads and access to the drill sites along predetermined pathways as indicated in this report. Additionally, ESG is confident that:

- No ongoing land use or locally/regionally significant infrastructure such as roads will be impacted by the activity;
- A sufficient buffer zone (distance and physical barriers) exist between the drilling locations and the nearest inhabitation; and
- The bulk of the activity will occur over a relatively short time frame limiting any further impacts associated with noise, visual amenity and any other incidental impacts.

It is Eastern Star's position that the proposed activities can be completed without any long term impacts on threatened species or communities of flora and fauna and places, sites or items of Aboriginal Heritage significance. Eastern Star is committed to the operation of its assets in line with the relevant statutory and regulatory guidelines and as such issues of environmental and heritage concern remain at the forefront of the planning process.

The exploration well will utilise standard oilfield equipment and work will be conducted using good oilfield practice in line with the *Petroleum (Onshore) Act (1991)* and Regulations, the '*Schedule of Onshore Exploration and Production Safety Requirements*' and '*APPEA Code*'. The operations are regarded, from an industry standpoint, as being of a small scale.

The provision of this document fulfils the company's responsibility under Part 5, Section 111 of the *Environmental Planning and Assessment Act 1979* in which the determining authority (NSW Department of Primary Industries – Mineral Resources) is required to consider the likely and actual environmental impacts of the activity. It is the opinion of Eastern Star Gas that the impacts created by the proposed activity when considered alongside the mitigation strategies in place will create no long term effect on the localised and regional environment.

10 REFERENCES

Corkery, R.W & Company (2002). *Statement of Environmental Effects – Natural Gas Gathering System and Associated Electricity Generating Facility*, R.W Corkery & Company Pty Ltd, Orange, NSW

Corkery, R.W & Company (2004). *Petroleum Production Environmental Operations Plan: Coonarah Gas Project* R.W Corkery & Company Pty Ltd, Orange, NSW

Cunningham, G. (2007). *Soils Impact Assessment, PEL238 Narrabri Coal Seam Gas Utilisation Project*, Cunningham Natural Resource Consultants Pty Ltd

11 ENVIRONMENTAL MANAGEMENT PLANS

The consent to operate as described is provided under a range of legislative and regulatory instruments, specific to the onshore oil and gas industry in NSW and standard NSW planning and environmental law. Additional industry based guidance for the effective environmental management of onshore exploration and development is incorporated at all stages of development during project planning.

11.1 Dust Management EMP

The access roads leading to the proposed Tintsville site are of good quality and are maintained by the Narrabri Shire to a high standard. The following EMP has been devised to mitigate to the greatest degree the generation of fugitive dusts during construction and operational phases as a result of excessive deterioration of the road surface.

Management Measures
<ul style="list-style-type: none">• Access to operational sites should be limited to essential traffic and personnel to the greatest extent• Vehicle speed limit restrictions on all unsealed roads and access tracks must be observed to minimise fugitive dust generation• The deployment of a water cart to suppress dusts will be at the discretion of Narrabri Shire representatives or Eastern Star Operations Management but be available at all times during the initial construction period and during drilling activities• subsoils stockpiled in windrows should be replaced as soon as practicable

11.2 Noise and Vibration EMP

Equipment currently employed during drilling and for the operation of the production assets are modern, well maintained and have noise attenuation apparatus fitted as standard. Coupled with the physical separation of operational sites from inhabitation, noise impacts are very unlikely to be experienced by any sensitive receptors within the general region surrounding the Tintsville site.

Management Measures
<ul style="list-style-type: none"> • Site construction activities shall be limited to between the hours of 7:00 am to 6:00 pm • Where possible, excessively noisy activities shall be scheduled for periods where nuisance is less likely e.g. after 9am and before 4pm • Construction equipment shall be equipped with appropriate noise mitigation devices, shall be maintained in good working order and meet all relevant statutory guidelines for noise generating activities • Whilst drilling activities do occur over a 24 hours per day, all efforts to reduce noise after 6pm and before 7am shall be made • Noise attenuation apparatus (i.e. temporary barriers) shall be set up on site around all generators and other point sources where practicable and safe to do so • The movement of vehicles to and from site (i.e. delivery of consumables etc) shall be limited to within the approved construction hours as far as practicable

11.3 Waste Management EMP

Management Measures

- Where possible, materials capable of being recycled and/or reused will be stockpiled and transported to the recycling centre at the Narrabri Waste Depot
- General domestic refuse will be collected regularly from rubbish cages located onsite for disposal at the Narrabri Waste Depot
- Material wastes such as engine lubricants and coolant fluids will be stored and disposed of according to manufacturers and government guidelines
- At any time during the construction activity, ESG and its contractors shall ensure that all liquid and / or non-liquid waste generated and / or stored on the site is assessed and classified in accordance with Waste Classification Guidelines Part 1: Classifying Waste (DECC, 2008), or any future guideline that may supersede that document.

11.4 Traffic Management EMP

Management Measures

- All roads leading to the Tintsville site will be subject to an initial dilapidation inspection by the Narrabri Shire Council (NSC) and pre commencement remediation undertaken where required. Regular inspections of the roads during operations will ensure that any and all damage to Shire infrastructure is remediated in a reasonable timeframe so as to minimise nuisance to local traffic and residents.
- All project related traffic will be restricted to the signposted access and egress routes to limit noise, dust and nuisance on residents
- Vehicular speed limits of 60km/hr are to be observed along unsealed public roads

APPENDIX A – IMPOUNDMENT DESIGN

