REVIEW OF ENVIRONMENTAL FACTORS (REF)

Narrabri Coal Seam Gas Project

Bibblewindi West Lateral Production Pilot

Petroleum Assessment Lease 2

Gunnedah Basin, New South Wales

January 2009

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Location of lands referred to by REF

The proposed activity will occur approximately 4000m west of the Bibblewindi CSG Pilot and approximately 40km south of Narrabri within the Pilliga East State Forest (**Figure 2**).

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.

1 EXECUTIVE SUMMARY

This Review of Environmental Factors has been prepared by Eastern Star Gas Ltd for the development of the Narrabri CSG Project and specifically the Bibblewindi West Lateral Pilot in Petroleum Assessment Lease 2. The objectives of the lateral pilot are to further demonstrate the technical feasibility of 'in seam' drilling as an alternative to fracture stimulated vertical production wells and to confirm the viability of this locality as a potential commercial gas production area.

The Pilliga State Forests, which includes the Bibblewindi SF and the adjoining Pilliga Nature Reserve, form one of the largest forest remnants on the north-west slopes and plains of NSW; this remnant has national, state and regional conservation significance for the protection of biodiversity and threatened species. However, the shrub and understorey vegetation has an inherent resilience to short term impacts and recovers well within a reasonable timeframe where adequate strategies to protect regeneration potential are observed.

The total area of land impacted by this activity will approximate 3.84 hectares based upon six separate drill pads of 80m x 80m. The proposed activity will not create any permanent detrimental impacts on native vegetation resources in this locality nor any threatened species of flora or fauna or known endangered ecological communities.

Prior to the activity commencing, Aboriginal heritage surveying with the assistance of representatives of the Pilliga Forest Aboriginal Land Management Committee will be conducted to ensure that no sites of significance are impacted by the proposed activity. Consultation with existing heritage databases indicates that the proposed locations do not present any risk to known sites of Aboriginal heritage significance or enter any area more likely to contain such sites.

In terms of greenhouse gas impacts, it is to be noted that all CSG generated by the proposed pilot will be consumed *in* situ or otherwise collected and transported via gathering system to Bibblewindi and/or Wilga Park for consumption.

The provision of this document fulfills 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 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 has been prepared by Eastern Star Gas Ltd (ESG) for the continuing development of the Narrabri Coal Seam Gas (CSG) project in Petroleum Assessment Lease 2 (PAL2), which is situated within PEL238, northern NSW.

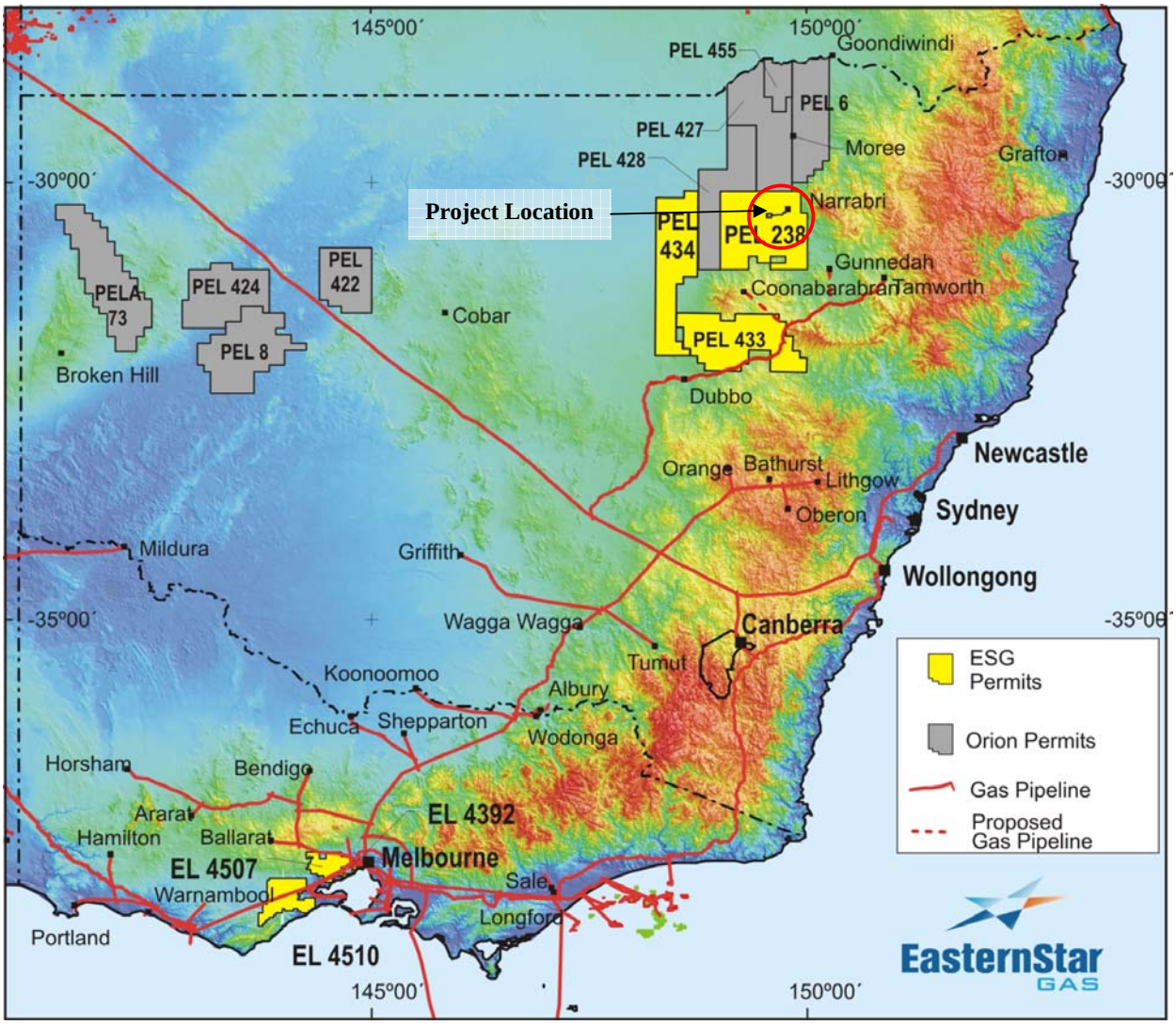

Figure 1 Eastern Star Gas Exploration Licences, NSW & Victoria

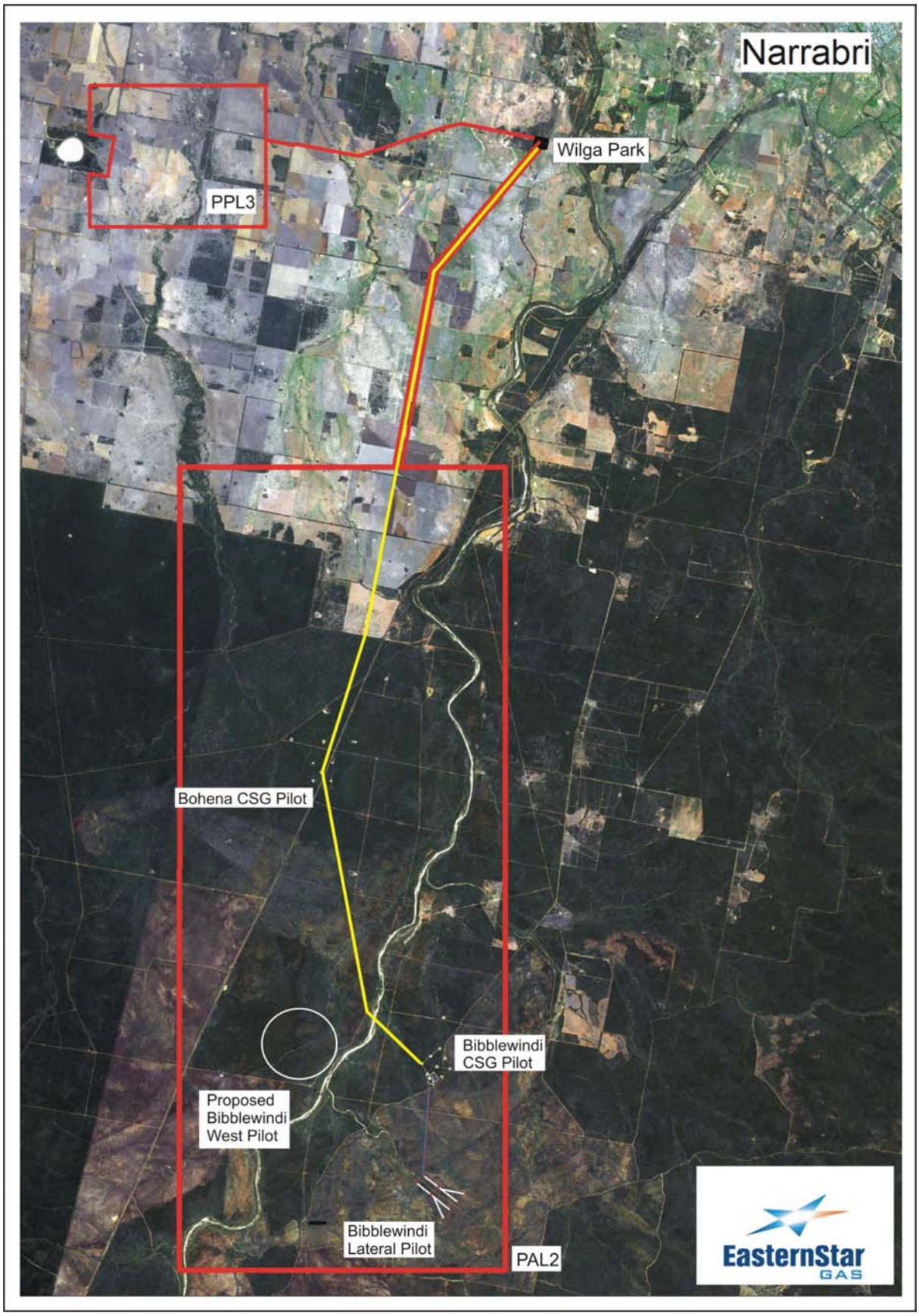

Figure 2 Location of the proposed Bibblewindi West lateral pilot within PAL2

Figure 3 Location of the proposed Bibblewindi West lateral pilot within PAL 2

2.1 Location

The lateral pilot is to be located approximately 4000m west of the existing Bibblewindi CSG pilot on Blue Nobby Rd.

Well	Well Type	Easting (m)	Northing (m)	GL (mAMSL)
Bibblewindi-26 (proposed)	Lateral (surface)	749413	6609350	275
Bibblewindi-22 (proposed)	PCW	749758	6609082	268
Bibblewindi-23 (proposed)	Production 1	750105	6608557	260
Bibblewindi-24 (proposed)	Production 2	750358	6608881	260
Bibblewindi-25 (proposed)	Production 3	750228	6608720	260

Table 1 Location of the proposed wells in the lateral pilot

The proposed pilot is located wholly within the Pilliga East State Forest, on land identified as Staate Forest under the *Forestry Act 1916.*

2.2 Description of the Activity

The proposed lateral pilot installation illustrated in **Figure 4** to which the following REF refers includes the following activities (in general order of occurrence):

- The installation of appropriately sized and located access from Blue Nobby Rd to each wellsite (4 to 5ha in total);
- The preparation of five (5) drill pads to a maximum of 80m x 80m at the locations indicated;
- The drilling of one (1) Pressure Control Wells (PCW) at Bibblewindi 22;
- The drilling of three (3) Production Wells at Bibblewindi 23, 24 & 25;
- The drilling of one (1) lateral well originating at Bibblewindi 26 and intersecting Bibblewindi 22 before diverging towards each of the production wells at Bibblewindi 23, 24 & 25;
- The operation of the pilot under a revised operations/water management plan

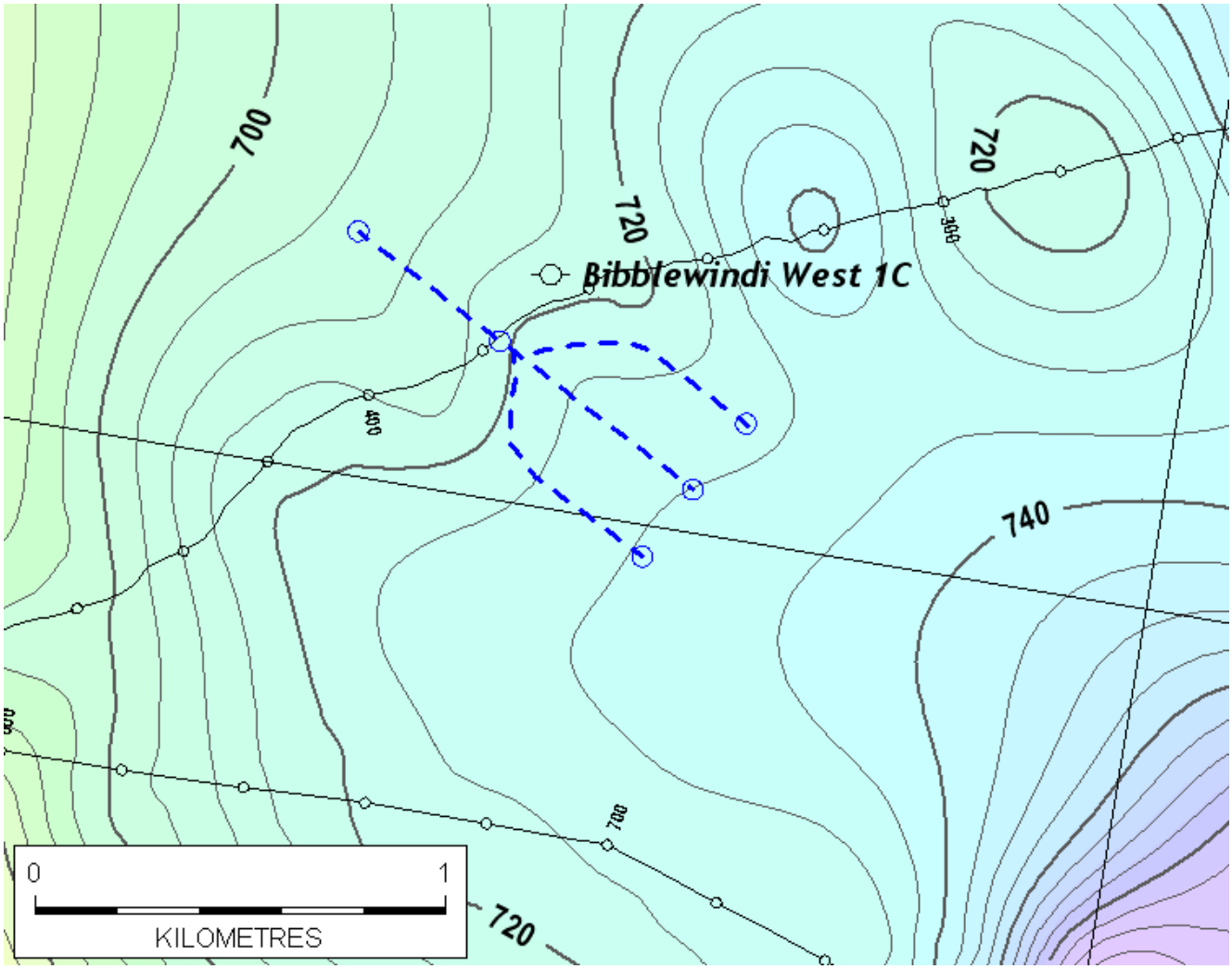

Figure 4 Preliminary lateral completion design incorporating the trident arrangement

Figure 5 illustrates a conceptual layout of the proposed lateral pilot located adjacent to the Bibblewindi West corehole drilled in 2008; a single 'pitchfork' design originating in the northwest and trending to the southeast.

The four vertical wells in the lateral pilot will be drilled in order and will provide the necessary data on the location of the target coal seams to permit the accurate installation of the horizontal 'in seam' well. At the completion of the drilling process, subsurface pumps and pressure monitoring equipment will be placed in the vertical wells in preparation for production to commence.

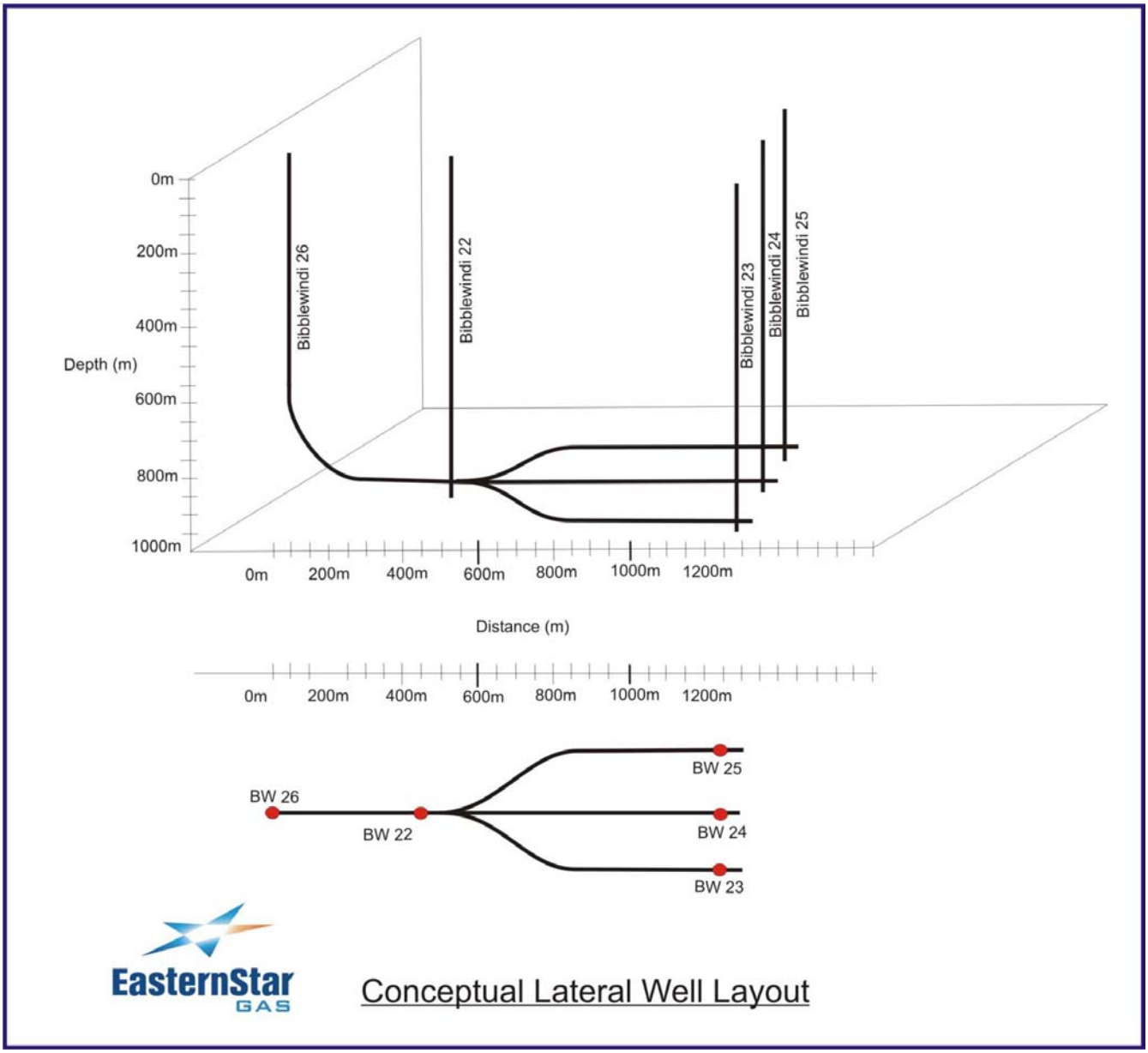

Figure 5 Conceptual representation of the proposed Bibblewindi West Lateral Pilot

2.3 Hours of Operation

The proposed drilling activity will occur on continuous 24 hour shift cycle with crew changes at 12pm and 12am each day.

Site construction activities will occur generally between 7am and 6pm or daylight hours.

2.4 Site Access

Access to the general site area is available using the Newell Highway (sealed) and X-line Rd (unsealed, high quality). Permanent access from Blue Nobby Rd into each site will be installed generally consistent with the conceptual access plan shown in **Figure 6**.

The construction of the roads will generally comprise the following activities

- The surveying and marking of road location by ESG representative under the supervision of Forestry NSW;
- The removal of commercial timber and firewood by logging contractor;
- The clearance of all remaining vegetation along a 4m wide path towards each well site;
- The grading of the road surface and the installation of drainage structures;
- The placement of gravel road base where required; and
- The watering, grading and rolling of the road surface until adequately formed and compacted

Figure 6 Conceptual plan of access into the drill sites from Blue Nobby Rd.

2.5 Water and Gas Management

The installation of the proposed Bibblewindi West lateral pilot will require further revision of the current approved water and operations management plan. The submission of this plan in mid 2008 preceded the negotiation of revised conditions permitting the collection, transportation and treatment of water and gas produced at the Bibblewindi lateral pilot. At this time, the scope for further amendment/expansion of the plan was discussed in light of proposed continuation of production developments such as outlined in this proposal. The issues associated with further expansion of operations plans to include this proposal will be initiated by ESG during the first quarter of 2009.

2.6 Activity Timeframes

The proposed activity is expected to occur over a timeframe of approximately 3 months from the date of commencement of site preparation.

The drilling of each well is expected to take 10-14 days from the arrival of the drilling rig onsite and included rigging up and mobilisation to the next site in the activity sequence.

There is no comprehensive rehabilitation schedule available for the proposed operational sites. Partial rehabilitation of non essential areas will occur at the completion of the drilling program and during the construction of key production infrastructure such as gathering systems etc (*subject to approval). The initial rehab program is discussed in section 5.2.4

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, magnetics, seismic reflection and other forms of geophysical exploration are only able to provide an interpretative view of geological parameters and the discovery of petroleum relies 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 underlying PAL 2. The drilling and fracture stimulation program completed at Bibblewindi in 2006 was successful in achieving greater deliverability of gas utilising a more aggressive dewatering program from the closely spaced wells in the pilot.

The 2007/2008 corehole program carried out across PAL2 has been 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. Bibblewindi West 1C was recently completed as part of this program and not only contributed to the recent reserves upgrade but also identified a thick and well developed coal sequence trending off towards the south east hence the arrangement of the lateral pilot as shown in **Figures 2** and **3**.

2.8 Current Activities:

The ongoing development of CSG resources in PEL238 and PAL2 represents the main focus of company activity at this time. The operation of a total of 12 production wells across PAL 2 continues to provide important technical data on the CSG reservoir and its production capability.

Corehole drilling across PAL2 and PEL238 has continued throughout 2007/08 and is currently focusing on new prospect leads to the north of Narrabri. Edgeroi 1 is located approximately 12km north of Narrabri and was completed in late 2008 with positive results in locating additional gas bearing coals in a previously unexplored area of PEL238. Further drilling now underway at Blue Hills 1 and planned for Edgeroi 2 and Blue Hills 2 (subject to approval) will serve to confirm the distribution of the Maules Creek coal measures in this new province.

The drilling of the Bibblewindi lateral pilot 4km southeast of the Bibblewindi CSG pilot is well underway as is the construction of the water/gas gathering system linking the new production wells to existing water and gas management facilities.

The proposed gas pipeline linking the Bibblewindi and Bohena CSG pilots to the Wilga Park Power station has been approved and construction activities are underway.

3 THE EXISTING ENVIRONMENT

The information contained in this section has been collated from a range of sources and characterises the existing environment around the proposed Bibblewindi West lateral pilot.

3.1 Topography

Natural slopes in the Narrabri region generally range from less than 1° on the flat terrain of the Namoi River floodplains to in excess of 30° with the Mount Kaputar National Park. The project site is located in the Pilliga East State Forest, to the west of Bohena Creek. Indicative elevations of this area approximate 280m AHD and fall gently away to the north and northwest towards the Namoi River.

3.2 Drainage

The lateral pilot 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 km^2 and incorporates the regions major centres of Tamworth, Gunnedah, Narrabri and Walgett (Corkery and Assoc., 2004).

The Bohena Creek sub-catchment covers an area of 1500km^2, and is the major drainage feature in the area. It is ephemeral in nature and flows only with significant rainfall in the catchment further south of PAL 2 towards the north western margins of the Warrumbungle Ranges.

The project site lies within the Bohena Creek sub-catchment, however, there are no permanent natural drainage lines in proximity that will be affected by the installation of any project components or the operation of the pilot over the longer term.

3.3 Land Use

The lateral pilot will be wholly located upon lands designated Crown Lands State Forest under the *Forestry Act 1916*., specifically in Forestry NSW Compartments 717 and 718 (**Figure 7**). This area is made up of forest types 190 (White Cypress Pine-Brown Bloodwood) and type 189 (White Cypress Pine-Narrow leaved Ironbark) and terms of commercial forestry operations is considered of low quality/low productive capacity.

The occupation of Forestry Lands for the purposes of petroleum exploration and production is subject to an occupation permit (pending as at 01/01/09) under the *Forestry Act* 1916. ESG will engage the assistance of Forests NSW in assessing the commercial value of forestry resources located on or

adjacent to operational areas including the proposed lateral well pads. All works conducted in this regard are done so with the endorsement of Forests NSW Baradine.

The *Brigalow and Nandewar Community Conservation Area Act 2005* redefined the land classification for the Pilliga State Forests system. The objects of this Act are to reserve forested land in the Brigalow and Nandewar sub regions for the maintenance of Community Conservation Areas (CCA) which provide a mechanism for the permanent conservation of land, protection of areas of natural and cultural heritage significance to Aboriginal people and sustainable forestry, mining and other appropriate uses. The lateral pilot is located within a zone four CCA which wholly permits the continued exploration for and assessment of petroleum resources.

Figure 7 The project location within Pilliga East State Forest, compartments 717 and 718.

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 Eastern Star commenced the active development of PEL238'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 across PAL2, the surveying of the area impacted by the installation of the Bibblewindi CSG Pilot and water management facility and the proposed pipeline linking the Bibblewindi and Bohena CSG Pilots with the Wilga Park Power Station. The surveys have occurred with the consent of the Pilliga Forest Aboriginal Management Committee and with the assistance of heritage advisors qualified by this group as able to provide advice on heritage matters.

The existing archaeological record for the region consists of various sources of cultural heritage information including the NPWS AHIMS database, the Forestry NSW/PFAMC site register and a number of published reports on the Aboriginal inhabitation of the Pilliga Forests. These sources corroborate on the understanding that 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 8**).

The information contained within the various published reports provides the basis for the cultural heritage investigations for the lateral pilot.

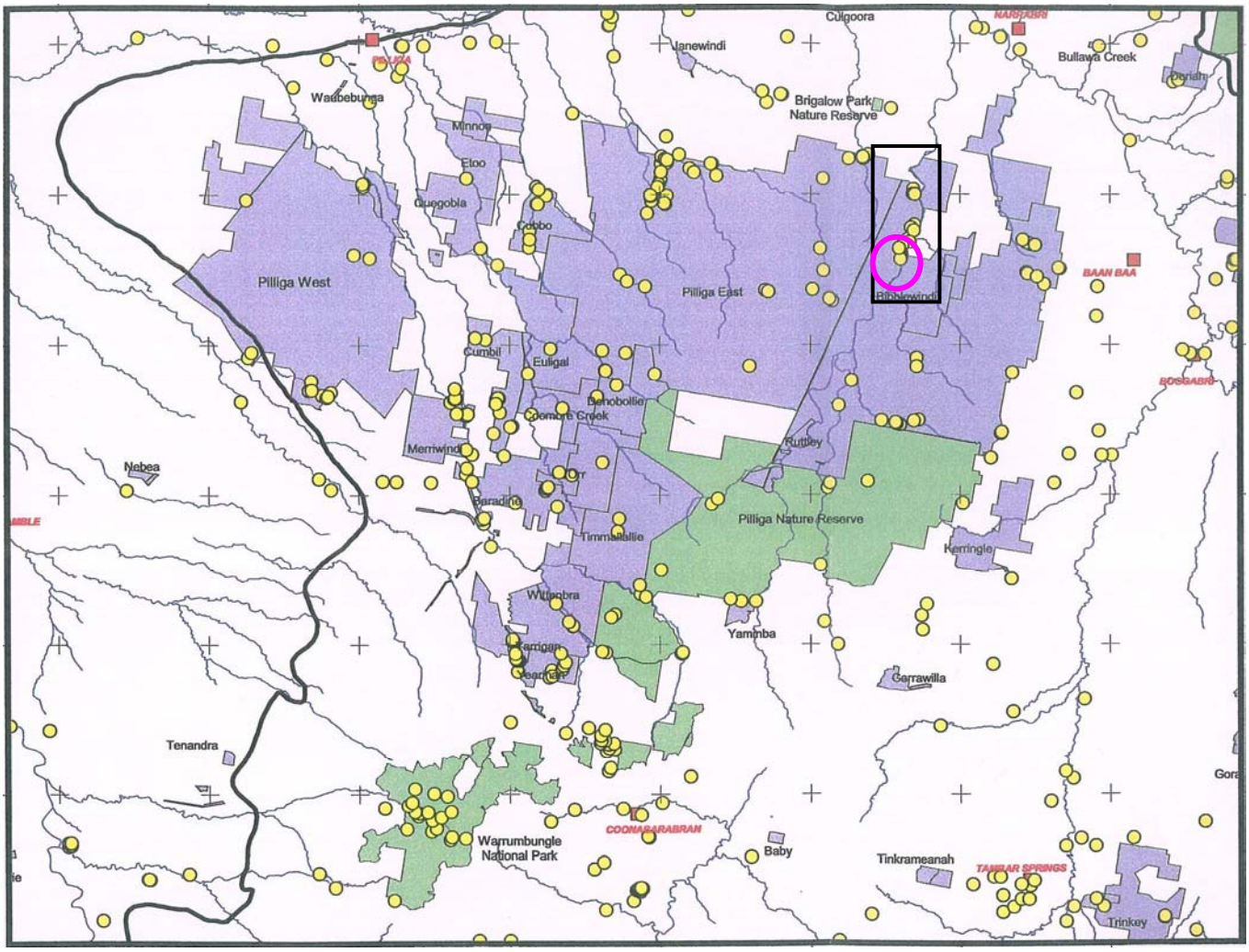

Figure 8 Sites of heritage significance within the Pilliga Forests (WRAC in Trindall, 2007)

3.5 Flora

The Pilliga East and Bibblewindi State Forest has received little detailed attention in terms of systematic botanical surveying to assess the type and quality of floral composition or the presence of threatened floral species, populations or ecological communities and potential habitat for faunal species. The basis for this lack of structured floristic study of native flora across this region can be attributed to the commercial foundations of vegetation management; a majority of the mapping of native vegetation has been developed for commercial management rather than ecological purposes.

Figure 9 Dominant canopy species mapping of the area surrounding the proposed lateral pilot

Lindsay (1974) mapped a majority of the northern Pilliga East State Forests as Cypress Pine, Narrowleaf Ironbark and Forest Oak, corroborating with Binns and Beckers (2001) description of "Grassy White Pine-Ironbark" communities containing the same dominant canopy species. Survey efforts carried out by Mr Greg Elks of Idyll Spaces have been successful in adding to the existing knowledge base on the floristic composition of the operational areas in PAL2.

Preliminary desktop data analysis has been based upon GIS data provide by Forests NSW (Baradine) on dominant canopy species in the area surrounding the proposed lateral pilot location. **Figure 9** indicates that the lateral pilot will be located in and amongst vegetation communities dominated by Narrow leaf Ironbark/Bull Oak/White Cypress (COP) and White Cypress/Narrow leaf Ironbark/Bull Oak (PCO) although field verification of many of these communities cannot identify a consistent difference between the stated dominance of any one species.

The database searches completed prior to the survey indicated that various threatened and endangered ecological communities and threatened flora species have been observed within the Pilliga East State Forest.

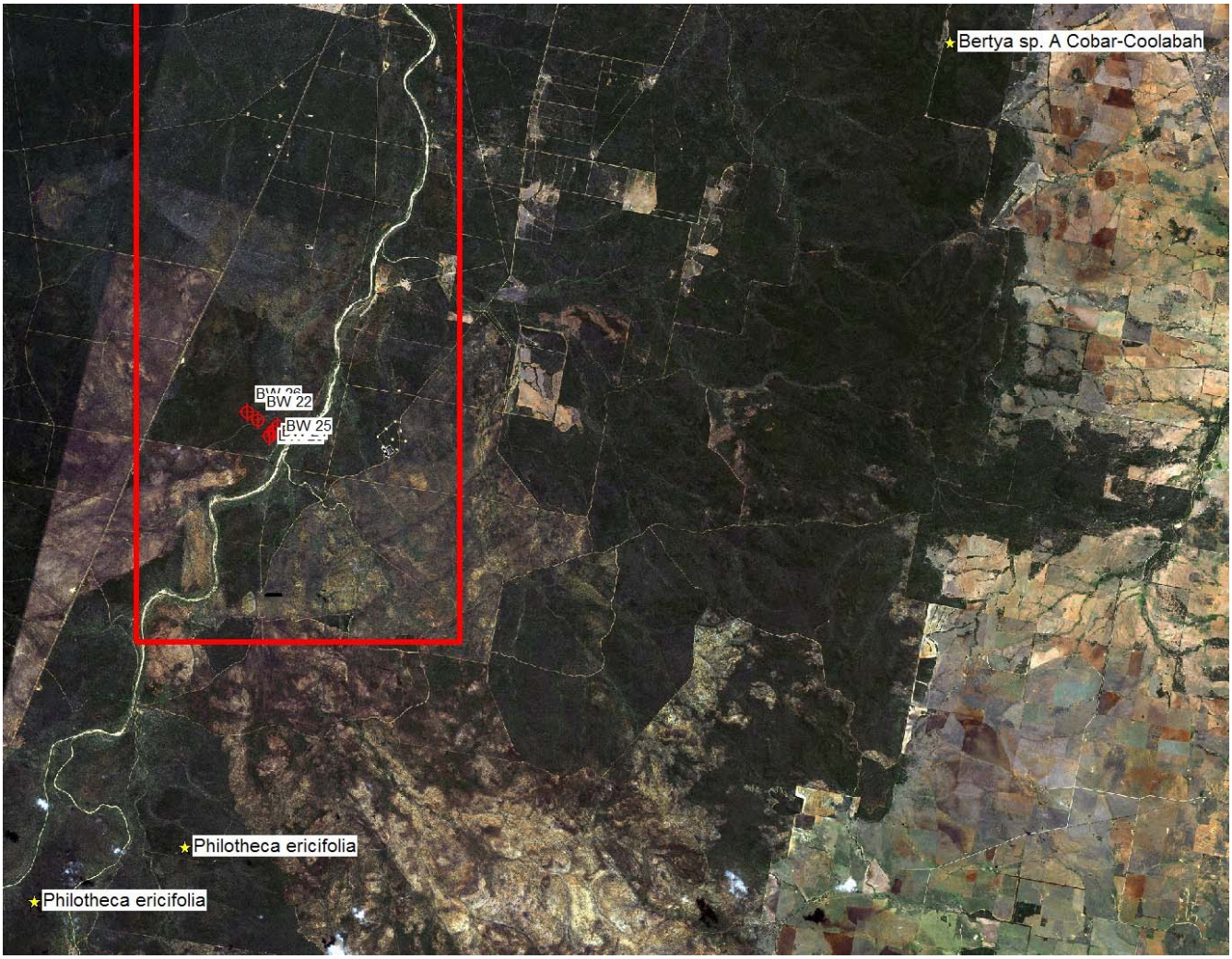

Figure 10 DECC Threatened flora records for the region surrounding the proposed lateral pilot

3.6 Fauna

The Pilliga East State Forest has received little detailed attention in terms of systematic fauna surveying to assess the presence of threatened faunal species, populations or ecological communities and potential/actual habitat. Faunal studies completed for Eastern Star's Pilliga Seismic Survey by Smith (2002) suggest that the Pilliga State Forests and Nature Reserve, including Bibblewindi State Forest, form one of the largest forest remnants on the north-west slopes and plains of NSW. The remnant has national, state and regional conservation significance for the protection of biodiversity and

threatened species due to its large size (>500 000 ha), high threatened species diversity and high quality habitat.

Since the initial fauna assessment in 2002, a number of survey efforts have been carried out across PAL 2 during the development of the Narrabri CSG project. The methodology for this impact assessment has focused on the compilation of existing data sources including the DECC threatened species records, significant fauna and fauna species habitat records held by Natural Resources and additional consultation with State and Federal schedules for the protection of threatened species and threat abatement plans.

Field surveys have generally been carried out on the basis of determining the relationships between habitat types and fauna distribution across the Pilliga and so have utilised the findings of Greg Elks in the various flora survey reports completed to date. ESG has employed Mr Keith Kendall of Kendall & Kendall Ecological Consultants to complete detailed fauna assessments on a number of project related developments.

The impact assessments carried out to date and recent database searches indicate that various threatened and endangered species have been observed within the Pilliga East State Forest. Many of the observations shown in **Figure 10** were registered by Kendall at the completion of the survey efforts carried out for ESG in the past 4 years (Kendall, 2005 and Kendall 2006).

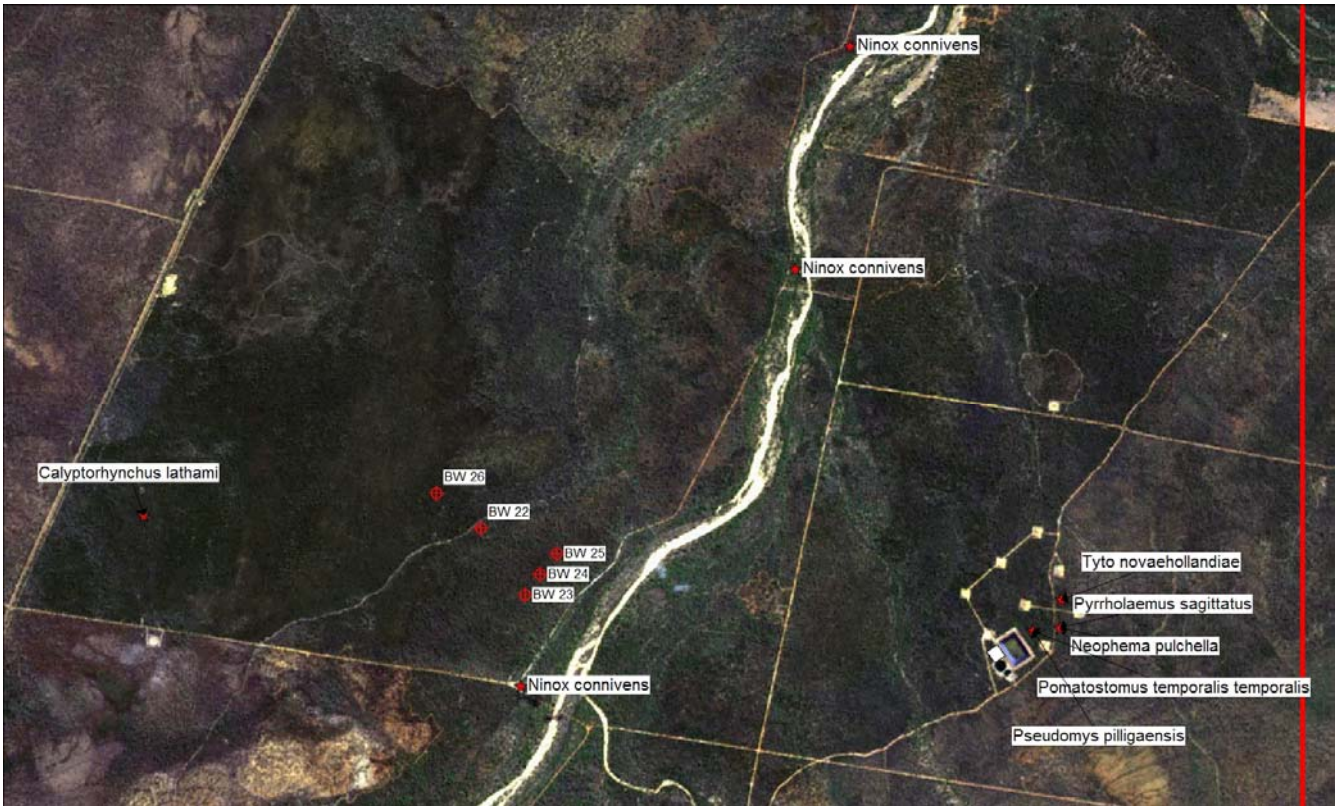

Figure 11 DECC database records for threatened species of fauna nearby the project site

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 in response 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 Bibblewindi West lateral pilot is based on a number of factors including:

- Results of recent core hole drilling
- Geophysical analysis of existing seismic data
- Orientation of the coal fracture system; and
- Coal seam reservoir modelling;

4.2 Land

The confidence levels in predicting the impact on the land within the Bibblewindi Lateral Pilot 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.

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 operation of the blow out prevention system/flare line is 80m x 80m or 0.64 ha per well site.

The installation of access to site will require the clearance of an additional 5ha of the same vegetation types. The construction methods and location of drainage structures along this access occurs under the supervision of Forestry NSW.

The sensitivity of the operational environment is well understood in terms of its resilience to disturbance; whilst the project is likely to occur over an extended period, the likelihood of a full reversion to the pre-existing condition is very high given the actions taken to preserve the regeneration potential of the site.

4.2.1 Access

A major objective of Eastern Star's operations within Forests NSW Lands is to use existing roads and tracks as far as practicable. The extensive system of roads and tracks crossing the Pilliga East and Bibblewindi State Forests permits safe and efficient access to much of PAL2.

Access to the Bibblewindi West lateral pilot will be via the Newell Highway, X-Line Rd and Blue Nobby Rd. The existing roads are unsealed although well utilised and therefore maintained to a high standard.

New, site specific access will be installed to the well sites from Blue Nobby Rd; typically this will approximate 4m wide and require the removal of between 4 and 5 ha of vegetation during its construction.

Any damage to existing roads/access caused by the drilling and operations activity remains the responsibility of ESG and will be rectified as soon as practicable at the discretion of Forestry NSW.

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 and to permit Forestry NSW to assess and utilise any commercial forestry products located onsite. The construction of the well pad at each of the four proposed sites will require the following:

- Each location will be pegged using handheld GPS;
- A representative of the PFAMC will survey each site for places or items of Aboriginal heritage significance;
- Forests NSW will inspect each sit and identify harvestable forestry products for removal by the logging contractor;
- All remaining vegetation is cleared and stockpiled for replacement over non-essential areas post drilling;

- Topsoils are stripped from the area surrounding the proposed well location and stockpiled at the edge of the pad for replacement post drilling;
- The surface cellar is installed and flare pits excavated
- The cuttings ditch/mud pit is excavated
- Any gravel base material is placed and compacted ready for the arrival of the drilling rig

ESG considers the impacts as a result of this activity are relatively small and localised given the distance between each well site. With the well pad only as large as defined by safety requirements, the impact on vegetation and potential faunal habitat is accordingly small in scale and the rehabilitation potential of the site is enhanced by the stockpiling of topsoils.

4.2.3 Drainage:

Topographic maps indicate that there are no natural drainage lines or ephemeral creeks leading to Bohena Creek located nearby the proposed location. Natural slopes in this area are generally slight and trend to the north permitting sufficient natural drainage to prevent pooling during periods of inundation.

Well pad design and construction is designed to maintain a well drained area suitable for the safe operation of drilling machinery and ancillary equipment in all but the heaviest rainfall. At this stage sufficient natural drainage is present to limit requirements for drainage to be installed.

4.2.4 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 piping, pumps and surface generators and other essential equipment. A typical site during operations is shown in **Figure 11**.

Figure 12 Typical surface installation required to operate a CSG well

The rehabilitation of areas not essential to the operation of the CSG wells will commence as soon as practicable after the completion of surface equipment installation. In general, the 80m x 80m drill pad will be reduced to approximately 50m x 50m through the following steps:

- The removal of imported gravels/soils from non-essential areas;
- The redistribution of topsoils over these areas; and
- The respreading of retained vegetation and brush across the site.

The 50m x 50m operational site will then be fenced with an appropriate 5 strand (or equivalent) stock proof fence and lockable gate.

4.2.5 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. In these terms, a number of important features of the drilling process provide physical protection to subsurface aquifers, surface equipment and personnel from the higher pressures experienced as the well deepens whilst also

preventing the inflow of water into the well bore and the loss of drilling fluids into permeable formations.

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.

To maintain ideal conditions during the drilling of the wells, the mud program typically employed by ESG for the drilling of CSG wells in this area consists of:

- A high viscosity, mid weight mud for the surface to approximately 100m vertical depth (surface casing) where water bearing formations are typically overcharged and will readily flow into the well bore; and
- A low to mid viscosity, minimum weight mud from the surface casing shoe to the base of intermediate casing (650-750m) and then onto total depth. The low weight mud program for the deeper drilling is designed to minimise damage to production target.

The mud system is bentonite based and readily forms an impermeable layer or 'filter cake' on the surface of the open hole which:

- Retards the inflow of water into the well bore from overcharged aquifers or formations; and
- Prevents the loss of drilling fluids into undercharged aquifers or porous formations.

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 be result in the loss/generation of any significant volumes of water or fluids.

Further, long term protection of the subsurface environment from petroleum well operations is afforded by the installation and cementing of steel casing into the open hole once the well has reached total depth. Casing is left in place over the entire depth of the well further limiting the likelihood of fluid exchange and aquifer contamination.

4.2.6 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 DPI-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. In the event that the roads are excessively dry and soft and where mobilisation 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:

All of the equipment used for mobilisation and supply of power to the drill rig are modern, well maintained and have noise attenuation apparatus fitted as standard.

The drilling activity will occur across a 24 hour shift cycle with crew changes occurring at 12pm and 12am.

The location of the well sites at the proposed location is in excess of 7km from the nearest inhabitation and the mobilisation of equipment and personnel and its operation is unlikely to result in any measurable noise related impacts on existing point source receptors such as homes and businesses.

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 lateral pilot.

Mud containment onsite will involve an integrated mud sump/cuttings ditch with dimensions of approximately 6m x 3m x 3m. The sump will be located adjacent to the drilling rig and accept all mud returns and rock cuttings from the well during drilling (see section 5.8).

The issue of mud containment and potential risks of land and groundwater contamination (e.g. percolation thorough 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 Bibblewindi laterals. The review concludes:

- The risk of contamination of groundwater from the percolation of drilling fluids from the unlined surfaces of mud/cuttings sumps is very low. The use of natural clay products (Bentontite, Barites etc) during the early stages of drilling work as effective sealants of cut surfaces. Furthermore, the drilling fluids utilised during later drilling do not generally present a risk of contamination given the relative concentrations of salt (i.e. KCl, NaCl) additives of less than 5%;
- 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 pumpout where any danger of overtopping is identified by the drilling supervisor.

4.4.2 Source:

The estimated 50 – 100 m^3 of water used in the drilling of each well will be sourced from the Bibblewindi water treatment pilot located nearby the proposed lateral pilot and transported onsite 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

The basis for the assessment of impacts on the native flora species and vegetation communities posed by the lateral pilot is the existing knowledge base on flora impact assessments carried out to date. Survey reports from the following field surveys have been consulted and are considered sufficient to provide an understanding of the actual, likely and potential impacts associated with the proposed activity:

- ***Clements, A & Moore, R. (2002).*** *Review of Existing Flora Data: PEL238 Pilliga East Seismic Survey, Anne Clements & Associates Pty Ltd, North Sydney, NSW*
- ***Elks, G.N. (2005).*** *PEL238 Coal Seam Gas Flora Survey – Bibblewindi Nine Spot, Idyll Spaces Environmental Consultants, Bonville NSW*
- ***Elks, G.N. (2006).*** *PEL238 Coal Seam Gas Flora Survey – Water Management Facility, Idyll Spaces Environmental Consultants, Bonville NSW*
- ***Elks, G.N. (2007).*** *PEL238 Narrabri Coal Seam Gas Project Pipeline Flora Survey, Idyll Spaces Environmental Consultants, Bonville NSW*

4.5.1 Background Information

The various databases available suggest that a number of threatened communities and species have been identified within the Narrabri region and the Pilliga State Forests and Nature Reserve.

Elks (2006, 2007) provides a comprehensive review of existing threatened species records across various State and Commonwealth registers (**Table 2**).

Database Search	Threatened Community/Species/Habitat
EPBC (2000) Act threatened communities	**Brigalow** (*Acacia harpophylla* dominant and co-dominant). Endangered community known to occur with the study area **Grassy White Box Woodlands** endangered community may occur within area locality
EPBC (2000) Act threatened species	*Bertya sp.* Cobar Coolabah (v) *Cadellia pentastylis* (v) *Digitaria porrecta* (e) *Diuris sheaffiana* (v) Goodenia macbarronii (v) *Lepidium aschersonii* (v) *Philotheca ericifolia* (v) *Pterostylis cobarensis* (v) *Rulingia procumbens* (v)
NSW TSC Act Endangered Ecological Communities	- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes - Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions - Coolibah - Black Box Woodland of the northern riverine plains in the Darling Riverine Plains and Brigalow Belt South bioregions - Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions - Cadellia pentastylis (Ooline) community in the Nandewar and Brigalow Belt South IBRA regions - McKies Stringybark/Blackbutt Open Forest in the

	Nandewar and New England Tableland Bioregions - Semi-evergreen Vine Thicket in the Brigalow Belt South and Nandewar Bioregions - White Box Yellow Box Blakely's Red Gum Woodland
Threatened species records within 30km (centroid)	*Bertya sp*. Cobar-Coolabah Vulnerable *Lepidium aschersonii* Vulnerable *Philotheca ericifolia* Vulnerable *Rulingia procumbens* Vulnerable
Bionet search (TSC Act listed species) for Pilliga East and Bibblewindi SF	Goodenia macbarronii Vulnerable *Philotheca ericifolia* Vulnerable *Rulingia procumbens* Vulnerable
Threatened species known or predicted in the Pilliga Outwash CMA Subregion	*Cyperus conicus* (e) *Dichanthium setosum* (v) *Swainsona murrayana* (v) *Tylophora linearis* (e)

Table 2 Threatened communities, species and habitats occurring in the Narrabri region

In summary, communities listed as threatened under the relevant state and federal jurisdictions are known to occur on the relevant 1:100,000 mapsheets or likely to occur within the locality.

The dominant canopy species mapping sourced from Forestry NSW references two main and one sub communities, Narrow leaf Ironbark/Bull Oak/White Cypress (COP), White Cypress/Narrow leaf Ironbark/Bull Oak (PCO), as occurring at or around the proposed location, although as discussed in section 4.5, field verification of these communities indicates no consistent difference between the stated dominance of any one species. Table 3 summarises the community assemblage which has undergone field verification at various locations across PAL2.

Vegetation Community	Summary
Eucalyptus crebra Dry Open Forest	Narrow leaved Ironbark is always present and usually dominant. Other common species include White pine *Callitris glaucophylla* and bull oak Allocasuarina luehmannii. Midstratum of hopbushes *Dodonea spp, Calytrix tetragona*, wattles *Acacia spp*, broom and bitter pea *Daviesia genistifolia*. Ground layer most diverse, with mat-rushes *Lomandra spp*, sawsedge *Gahnia aspera*, flax lily *Dianalla longifolia*, wild onion *Bulbine semibarbata, Laxmannia gracilis, Calandrinia spp, Goodenia spp*, bluebells *Wahlenbergia spp*, cutleaf daisy *Brachycome multifida* and the fern *Cheilanthes austrotenuifolia* very common. Open stands of narrow leaved ironbark at around 20m tall with or without white cypress and bull oak over the midstratum with scattered stands or sparse individual sclerophyllous shrub. Sparse to mid-dense ground layer of forbs, grasses and graminoids. Community occurs on silty sand with adequate drainage.

Table 3 Summary of the *E. crebra* Dry Open Forest community

4.5.2 Assessment of Significant Effects

The assessment of significant effect on threatened species, populations or ecological communities or their habitats as per S5A (2) of the *Environmental Planning and Assessment Act 1979*, as applied to the Bibblewindi West lateral pilot are such that:

a) **In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,**

   Flora surveys conducted across the project area have found no evidence of any threatened species, populations, communities or critical habitat associate with the Narrow leafed Ironbark Dry Open Forest described by Elks (2007). Given the limited impact of the activity, it is unlikely that this proposal will have any adverse effects on the life cycle of any threatened species such that a viable local population is likely to be placed at risk of extinction.

b) **In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,**

   Flora surveys conducted across the project area have found no evidence of any threatened species, populations, communities or critical habitat associate with the Narrow leafed Ironbark Dry Open Forest described by Elks (2007). Given the limited impact of the activity, it is unlikely that this proposal will have any adverse effects on the life cycle of any threatened species such that a viable local population is likely to be placed at risk of extinction.

c) **In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

   (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

   (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

   No evidence of any endangered ecological community or critically endangered ecological community has been identified in this general area during the flora surveys,

(i) the proposed activity is not likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

The *E. crebra* dry open forest community within which the proposed activity is to occur is the dominant vegetation community in the Pilliga East and Bibblewindi State Forests and is the most widespread of the White cypress forestry types occupying around 40% of the total area of managed cypress forests (Forestry Commission in Elks, 2007).

d) In relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

Approximately 40,000 ha of area mapped as the vegetation class 'Pilliga Outwash Dry Sclerophyll Forest' and a further 20,000ha of the floristically similar 'Western Slopes Dry Sclerophyll Forest' occurs in the locality but the habitat has been modified by grazing, modified fire regimes, and forestry activities (Elks, 2006).

The area impacted by the proposed activity represents a very small percentage of the dominant vegetation community mapped within PAL2, and will impact on less than 0.001% of habitat of similar quality in the locality.

There is no discernible difference in ecological integrity between habitat to be affected and habitat to remain.

The small scale and spatial arrangement of the proposal is such that habitat is not likely to become fragmented or isolated from other areas of habitat.

The apparent absence of threatened flora species from the study area and the large areas of similar habitat in the region and locality suggest that the habitat to be removed is unlikely to be of importance for the long-term survival of the threatened species *Diuris tricolor*; *Goodenia macbarronii; Philotheca ericifolia; Rulingia procumbens* or *Tylophora linearis* in the locality.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

Critical habitat as listed in the Register of Critical Habitat kept by the Director-General of DECC does not occur in the study area. The proposed activity is unlikely to have any adverse effect on critical habitat, either directly or indirectly.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

No recovery plans or threat abatement plans are currently listed for *Diuris tricolor*; *Goodenia macbarronii; Philotheca ericifolia; Rulingia procumbens* or *Tylophora linearis.*

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g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed action will involve the key threatening process 'Clearing of native vegetation'. It has the potential to contribute to the impact of 'Invasion of native plant communities by exotic perennial grasses'. However this potential is likely to be low as most invasive exotic perennial grasses have been selected for their productive capacity in managed pasture and are likely to be poorly adapted for the relatively infertile sandy soils characteristic of forest in the study area. Clearing and weed competition are threats listed for *Philotheca ericifolia* and *Diuris tricolor*. Weed invasion is listed as a threat for *Goodenia macbarronii*, and soil disturbances area listed as a threat for *Rulingia procumbens*.

The importation of weed and pest species onto site via seed and vegetative material is mitigated through the wash down of vehicles in Narrabri prior to entry to Forestry Lands (see section 5.5.4).

4.5.3 Conclusions

Given consideration of the assessment carried out in section 5.5.2 in particular the area of vegetation to be removed, both in absolute terms and in terms of the habitat for threatened species in the locality and region, and the apparent absence of threatened flora species from the subject site and study area, it is concluded that a Species Impact Statement would not be required.

Endangered communities listed in the NSW Threatened Species Conservation Act and Environmental Protection and Biodiversity Conservation Act (Cwth) have yet to be detected in the area and are assessed as unlikely to occur there.

Habitat requirements for five threatened flora species may be met in the study area, but as threatened flora species have not been previously recorded in the study area and have not been were not detected in surveying carried out to date, the possibility that they do occur there is considered to be low.

Given that the clearing of vegetation has been reduced to the smallest area possible and is spread across the landscape at known locations, it is considered that:

- the proposed activities would not be likely to have an adverse effect on the life cycle of a threatened flora species such that a viable local population is likely to be placed at risk of extinction;
- the extent to which habitat is likely to be removed or modified as a result of the action proposed is not likely to be significant;
- habitat is not likely to become fragmented or isolated from other areas of habitat as a result of the proposed action;
- the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of Threatened flora species in the locality is not likely to be significant, and
- the action proposed is not inconsistent with the objectives or actions of a recovery plan or threat abatement plan.

4.5.4 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 any such material prior to any vehicles new to the Narrabri region.

4.6 Fauna

The assessment of impacts on the native fauna posed by the lateral pilot relies on the existing knowledge base on fauna impact assessments carried out to date. Survey reports from the following field surveys have been consulted and are considered sufficient to provide an understanding of the actual, likely and potential impacts associated with the proposed activity:

- ***Kendall, K. (2005).*** *Fauna Study PEL238 Coal Seam Gas Project - Bibblewindi Nine Spot, Kendall & Kendall Ecological Consultants, West Kempsey NSW*
- ***Kendall, K. (2006).*** *Fauna Study PEL238 Coal Seam Gas Project - Water Management Facility, Kendall & Kendall Ecological Consultants, West Kempsey NSW*
- ***Kendall, K. (2007).*** *Fauna Study PEL238 Narrabri Coal Seam Gas Project Pipeline, Kendall & Kendall Ecological Consultants, West Kempsey NSW*
- ***Smith, A. 2002.*** *PEL238 Pilliga East Seismic Survey: Fauna Review, AUSTECO Environmental Consultants, Armidale, NSW*

4.6.1 Background Information

Records of threatened species, populations or communities as listed under the *Threatened Species Conservation Act 1995* (TSC Act) known to occur within 5km of the study area were extracted from the New South Wales Wildlife Atlas database for the Baan Baa, Baradine, Narrabri and Wee Waa 1:100,000 map sheets. Under these search parameters, eight TSC Act threatened species recorded within 5km of the study area on the DEC wildlife atlas; they include:

- Glossy Black-Cockatoo *Calyptorhynchus lathami*
- Barking Owl *Ninox connivens*
- Brown Treecreeper *Climacteris picumnus*
- Speckled Warbler *Pyrrholaemus sagittatus*

- Painted Honeyeater *Grantiella picta*
- Hooded Robin *Melanodryas cucullata*
- Koala *Phascolarctos cinereus*
- Black-striped Wallaby *Macropus dorsalis*
- Pilliga Mouse *Pseudomys pilligaensis*

TSC Act threatened fauna species not recorded within 10km of the Study Area but known or predicted to occur in the Pilliga Outwash sub regions of the Namoi CMA and based on habitat requirements considered as possible or likely to occur on the study area

- Ninox connivens Barking Owl
- Hamirostra melanosternon Black-breasted Buzzard
- Melithreptus gularis gularis Black-chinned Honeyeater (eastern subspecies)
- Macropus dorsalis Black-striped Wallaby
- Burhinus grallarius Bush Stone-curlew
- Stagonopleura guttata Diamond Firetail
- Cercartetus nanus Eastern Pygmy-possum
- Anomalopus mackayi Five-clawed Worm-skink
- Pachycephala inornata Gilbert's Whistler
- Calyptorhynchus lathami Glossy Black-cockatoo
- Nyctophilus timoriensis Greater Long-eared Bat (south eastern form)
- Falco hypoleucos Grey Falcon
- Pomatostomus temporalis temporalis Grey-crowned Babbler (eastern subspecies)
- Melanodryas cucullata cucullata Hooded Robin (south-eastern form)
- Phascolarctos cinereus Koala
- Chalinolobus picatus Little Pied Bat
- Tyto novaehollandiae Masked Owl
- Grantiella picta Painted Honeyeater
- Hoplocephalus bitorquatus Pale-headed Snake
- Pseudomys pilligaensis Pilliga Mouse
- Aepyprymnus rufescens Rufous Bettong
- Dasyurus maculatus Spotted-tailed Quoll
- Lophoictinia isura Square-tailed Kite
- Petaurus norfolcensis Squirrel Glider
- Neophema pulchella Turquoise Parrot

EPBC Act significant species whose mapped habitat may occur within 10km of the study area and have been subsequently assessed as possibly occurring within the study area:

Birds

- Swift Parrot Lathamus discolor
- Superb Parrot Polytelis swainsonii
- Regent Honeyeater Xanthomyza phrygia
- White-throated Needletail Hirundapus caudacutus
- Rainbow Bee-eater Merops ornatus
- Regent Honeyeater Xanthomyza phrygia

Mammals

- Large Pied Bat Chalinolobus dwyeri
- Eastern Long-eared Bat Nyctophilus timoriensis
- Pilliga Mouse Pseudomys pilligaensis

Reptiles

- Five-clawed Worm-skink Anomalopus mackayi

4.6.2 Field Surveying and Assessment Reporting

Field surveys carried out to date in PAL2 have occurred on four separate occasions, the full results of which are contained within the aforementioned impact assessment reports. In summary, the impact assessments conducted to date conclude that:

- Critical habitat as listed in the Register of Critical Habitat kept by the Director General of Department of Environment and Conservation does not occur in the study area;
- No threatened ecological fauna communities or fauna populations listed on the schedules of the TSC Act occur in the study area;
- The cumulative study area is not potential habitat as defined in SEPP44 (Koala Habitat Protection);
- Many of the species identified during surveying are avian species with sufficiently large home ranges that, when combined with the extent of the regionally common *E. crebra* dry open forest habitat identified by Elks, is unlikely to result in any long term, significant impacts any species or community in the Pilliga East State Forests;
- Activities on this scale are such that habitat is not likely to become fragmented or isolated from other areas of habitat within the Pilliga Scrub;
- Sufficient mitigative action can be taken to limit the impact of the proposal on the hollow dependant species identified by Kendall;

- The proposed activity will not impact on habitat favoured by the Pilliga Mouse *Pseudomys pilligaensis* which includes recently burnt gullies, areas containing an understorey of kurricabah (*Acacia burrowii*) with a bloodwood (*Corymbia trachyphloia*) overstorey; and
- Habitat for the listed microbats is widespread and common in the study area, locality, and region.

4.6.3 Assessment of Significance

The assessment of significant effect on threatened species, populations or ecological communities or their habitats as per S5A (2) of the *Environmental Planning and Assessment Act 1979*, as applied to the lateral pilot are such that

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Fauna surveys conducted across the project area suggest that no threatened species, populations, communities or critical habitat are at risk from the proposed activity. Given the limited impact of the activity, it is unlikely that this proposal will have any adverse effects on the life cycle of any threatened species such that a viable local population is likely to be placed at risk of extinction.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

Flora and fauna surveys conducted across the project area have found no evidence of any threatened species, populations, communities or critical habitat or species/partial remnants that constitute a threatened, population, community or critical habitat. Given the limited impact of the activity, it is unlikely that this proposal will have any adverse effects on the life cycle of any threatened species such that a viable local population is likely to be placed at risk of extinction.

(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

As all endangered ecological communities are vegetation communities see section 5.5.2 (c) for consideration of this factor.

(d) In relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

Approximately 40,000ha of area mapped as the vegetation class 'Pilliga Outwash Dry Sclerophyll Forest' and a further 20,000ha of the floristically similar 'Western Slopes Dry Sclerophyll Forest' occurs in the locality but the habitat has been modified by grazing, modified fire regimes, and forestry activities (Elks, 2006).

The area impacted by the proposed activity represents a very small percentage of the dominant vegetation community mapped within PAL2, and will impact on less than 0.001% of habitat of similar quality in the locality.

There is no discernible difference in ecological integrity between habitat to be affected and habitat to remain.

The small scale and spatial arrangement of the proposal is such that habitat is not likely to become fragmented or isolated from other areas of habitat.

The apparent absence of threatened flora species from the study area and the large areas of similar habitat in the region and locality suggest that the habitat to be removed is unlikely to be of importance for the long-term survival of the threatened species *Diuris tricolor*; *Goodenia macbarronii; Philotheca ericifolia; Rulingia procumbens* or *Tylophora linearis* in the locality.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

Critical habitat as listed in the Register of Critical Habitat kept by the Director-General of DECC does not occur in the study area. The proposed activity is unlikely to have any adverse effect on critical habitat, either directly or indirectly.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

Fauna surveys conducted across the project area have found no evidence of any threatened species, populations, communities or critical habitat in terms of the action being inconsistent with the objectives or actions of recovery and threat abatement plans.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

With respect to fauna, the removal of vegetation would not be likely significantly impact on the habitat of TSC Act threatened fauna species known to occur within the Study Area or considered as possible occurrences within the Study Area.

4.6.4 Conclusions

Based upon the assessment reports from the various fauna surveying and the available data from State and Commonwealth databases, the likelihood that the proposed activity will impact on a species of significance is negligible. Furthermore, the extent of removal, modification and fragmentation of vegetation associated with this activity is not considered significant; the cumulative total area cleared within the Pilliga State Forests as a result of the exploration activity to date approximates 40ha which represents just 0.0015 % of the current 265 km^2 project area.

Various strategies for the mitigation of threats to these species are discussed in the survey reports many of which are feasible for incorporation into the operational plans for the lateral pilot program. They include:

- Finalising the sites for drill pads and routes for access ways that avoid environmentally sensitive areas and habitat elements,

- Large (>40cm a.b.h.) living or standing dead trees will be left undisturbed unless no practical alternative exists. Pre-felling surveys of habitat trees to occur should this be required.

ESG is confident that the planned activity will not introduce any long term impacts on threatened species or the habitat favoured by them. All attempts to minimise the overall footprint of the activity have been made to date and will continue to be an integral part of the planning process.

4.7 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 Eastern Star commenced the active development of PEL238's significant coal seam gas reserves in 2004.

Eastern Star Gas has previously engaged representatives of the Pilliga Forest Aboriginal Management Committee (PFAMC) to assist in the conduct of Aboriginal heritage investigations across the PAL2. The objectives of the surveys are to quantify the likely impacts an activity will have on known and previously undiscovered heritage places.

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

To date, the survey efforts have located one site of Aboriginal heritage significance in the Pilliga East State Forest; a possible scarred tree was located during surveying for the proposed CSG pipeline linking the Bibblewindi and Bohena CSG pilot with the Wilga Park Power Station; however its location is significantly remote from the locations discussed in this document. No other places or items of significance have been identified during the survey efforts.

Figure 13 AHIMS Database results for the area surrounding the proposed lateral wells.

The low number of sites identified during this survey is generally thought to be related to a range of environmental factors, primarily:

- a lack of permanent or semi-permanent water around which places (e.g. campsites) of cultural significance may have been based;
- the lack of landforms such as rocky outcrop or exposed rocks that would have provided shelter and a potential materials resources;

- the lack of sufficiently mature old growth trees from which definite or possible scars could be located; and
- the frequency of bushfire across much of the Project Site and there impact on indigenous vegetation.

Assessing the proposed activity for likely and actual impacts on Aboriginal heritage, sufficient evidence on the distribution and frequency of sites across PAL2 exists that indicates that the proposal carries no potential for direct impacts on the cultural heritage values of the project area or the wider Pilliga State Forests System.

A search of the DEC (NPWS) AHIMS database indicates that no sites of cultural heritage significance are located within the vicinity of the proposed sites.

A search of the Pilliga Forest Aboriginal Management Committee/Forestry NSW Aboriginal Site Register indicates that no sites of significance are likely to be impacted by the proposed activities.

To further reduce the risks of impact on the Aboriginal heritage values of the region, ESG will undertake site specific surveys of the proposed locations under the direction of the PFAMC and its cultural heritage advisors.

Based upon the information collated from previous heritage assessments and field surveying efforts, the following recommendations have been made by the PFAMC to account for any residual risks:

- The PFAMC are consulted when any changes are made to the proposed locations or where the project scope is altered in any significant way;
- Where changes are made to the project plans in regard to the proposed disturbance zones, further field based surveying is carried out; and
- If any potential places, sites or items of cultural significance are identified, all activities are to cease until such time as the appropriate representatives of the PFAMC have assessed the site and adequate site management plans have been devised.

4.8 Waste Management

4.8.1 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 pond at Bohena 3. This process will assist in the natural drying out of muds settling in the pits, at which time the excavation will be backfilled. The cuttings generated during drilling will be left *in situ*.

The term ‘drill cutting’ describes the material generated from the drilling activity once removed from the drilling fluids. Varying is size depending on the type of drill bit employed, the cuttings can range in size from coarse sand like material to >5mm in diameter. ESG exclusively uses PDC (polycrystalline diamond compact) bits that generate cuttings of a size similar to very coarse sand (<3mm) as shown in figure 10. Note the sieve being used to collect the cuttings from the fluid return.

Figure 14 Drilling fluid and drill cuttings exiting the mud system (PEL433 Allambi-1C)

4.8.2 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.

4.9 Greenhouse Gas Impacts

ESG, 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 Powerstation 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. Similarly, it is ESG's intention to collect all gas produced at this lateral pilot for consumption *in situ* (surface and subsurface equipment) or transportation via gathering system back to Bibblewindi and into the main pipeline to Wilga Park.

4.10 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 LICENCES, PERMITS AND CONSULTATION

5.1 Drilling Proposal:

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

5.2 Additional Licencing

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

5.3 Landholder Permitting:

Approval to conduct the proposed activity at the stated location will be sought from Forests NSW as the landholder. The surface rights of Forests NSW in the Pilliga East State Forest will be honoured and traffic and fire management plans implemented based upon recommendations of the Senior Forester, Baradine. Forests NSW will be notified prior to the commencement of operations and be kept informed as to the status of those operations.

5.4 Consultation

The planning of this drilling program will include consultation with the following Government and non government agencies with a view to obtaining an endorsement of the proposed activity from each. They include:

- NSW Department of Primary Industries (Minerals and Petroleum)
- NSW Department of Primary Industries - Forests NSW
- Pilliga Forest Aboriginal Land Management Committee

6 EVALUATION OF CUMULATIVE ENVIRONMENTAL IMPACTS

The assessment of the proposed activity and the characterisation of the cumulative impacts occur in response 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 lateral pilot installation illustrated in **Figure 3** to which the REF refers includes the following activities (in general order of occurrence):

- The installation of appropriately sized and located access from Blue Nobby Rd to each wellsite;
- The preparation of five (5) drill pads to a maximum of 80m x 80m at the locations indicated;
- The drilling of one (1) Pressure Control Wells (PCW) at Bibblewindi 22;
- The drilling of three (3) Production Wells at Bibblewindi 23, 24 & 25;
- The drilling of one (1) lateral well originating at Bibblewindi 26 and intersecting Bibblewindi 22 before diverging towards each of the production wells at Bibblewindi 23, 24 & 25;
- The operation of the CSG production pilot; and
- The management of CSG production water under a revised water management plan based on that currently in effect for the Bibblewindi CSG Pilot and Bibblewindi Lateral Pilot (dated 29/10/08).

The biophysical receptors that are likely to or have the potential to be impacted upon include biodiversity (flora & fauna).

The socioeconomic receptors likely to or have the potential to be impacted upon include the local economy and cultural heritage.

6.1 Cumulative Biophysical Impacts

The cumulative impacts on the biodiversity of the area are considered insignificant. The clearance of adequate access tracks (≈ 2.5-3ha) and five drill pads each 80m x 80m (cumulative total 3.2 ha) is considered a relatively minor impact due to the widespread and common nature of the Ironbark/White

Cypress vegetation community across the region. No threatened species of flora have been identified during in this area during field assessment conducted thus far and the risk of impact on unknown threatened species or communities is negligible.

The direct impact of the activity on threatened species of fauna is considered small; the species identified during the fauna surveying programs in the area are highly motile avian and chiropteran species whose home range is significantly large that the disturbance of actual or potential habitat will not introduce impacts deleterious to the localised populations of the species.

The impact of soil resources is able to be accurately quantified and for the most part mitigated. The conservation of topsoil stocks is designed to maximise the effectiveness of the rehabilitation program. By doing so, the probability of regenerating the indigenous vegetation *in situ* from the existing genetic base is significantly increased.

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 site.

6.2 Cumulative Socioeconomic Impacts

The scope for cumulative 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. The predictive modelling carried out for the proposed CSG pipeline project indicates a clear link between water and shelter availability and the frequency of culturally significant sites. Further site specific heritage surveying will be completed on each site to account for residual risks of impacting unknown sites of significance.

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 be expected to approach $200 000 for the program, with all earthworks, site preparation and rehabilitation activity completed with the assistance of local contractors.

6.3 Cumulative Greenhouse Impacts of the CSG Projects

The operation of the CSG project has the potential to impact considerably on the environment in terms of greenhouse gases. Heggies (2007) conducted a comprehensive review of the potential impacts of the current situation should no action be taken to consume methane being vented to atmosphere from the Bibblewindi and Bohena CSG Pilots. CSG gas vented directly to the atmosphere has a greater global warming potential than combusted CSG due to the high (≈88%) methane content of the gas, coupled with the GWP of methane (21 times the GWP of CO_2). Calculations of greenhouse gases from venting, in terms of CO_2-e were calculated by Heggies from modeled throughput values (12 production wells) and thence compared in terms of State and National totals.

Comparison Emissions Figures on the 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 that the proposed combustion of the produced CSG at the Wilga Park Power Station would represent an increase of approximately 0.0365% the total baseline Australian emissions for 2005 or 0.265% from the venting of the CSG to atmosphere. A comparison of the two options demonstrates that equivalent emissions would be in the order of 7.2 times greater if the gas was vented to atmosphere preferentially over its collecting and combustion 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 these two pilots suggest that considerable environmental and economic benefits can be gained from the proposal. Similarly, it is ESG's intention, as described in the water and operations management plan (appendix 1), to collect all gas produced at the lateral pilot for consumption *in situ* (surface and subsurface equipment) or transportation via the gathering system back to Bibblewindi and into the main pipeline to Wilga Park. Therefore in terms of the potential greenhouse impacts of the gases produced at the lateral pilot, it is planned to capture and consume 100% of production for the life of the project.

7 PROJECT JUSTIFICATION

7.1 Environmental Impact:

The aim is to explore for petroleum by acquiring seismic data and if that work is successful in defining a hydrocarbon prospect an exploration well will possibly test that target. The most likely hydrocarbons in this area are likely to be natural gas and CSG.

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. CSG 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 allowing additional coal to be released export and at the same time significantly reducing 'greenhouse gas' emissions (see section 8.3) whilst promoting new economic development in regional NSW.

7.2 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.

7.3 Economic Impact:

NSW 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 PJ/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. CSG 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.

8 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 Bibblewindi anticline by more effectively dewatering the target coal seams underlying the area.

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.

The completion of flora, fauna and cultural heritage surveys suggests that the proposed activities for can be completed without any long term impacts on species or communities of significance and items of Aboriginal heritage. ESG 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. In addition the majority of operations will be conducted a significant distance away from any habitation, town or workplace so that the impacts of activity will be minimised.

The provision of this document fulfills 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 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.

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