Project Alternatives – Summary of Key Outcomes

A range of alternatives for plant, proposed location and water sources were considered. Operation of gas turbines in open cycle mode was found to be preferable to combined cycle gas turbines and coal fired generation for meeting peak electricity demand while renewable technologies are not conducive to meeting peak demand requirements. Natural gas is a clean burning fuel and has comparatively low greenhouse gas emissions. In terms of alternate power generation technologies, open cycle gas turbines present the best balance of outcomes between the imperatives of climate change mitigation and meeting peak electricity demand while managing the price of electricity for end use consumers.

NO_x emissions would be controlled through implementation of Dry Low NO_x technology, reducing NO_x emissions by about 88 %. Alternative NO_x emission control technologies such as catalytic combustion and selective catalytic reactor are not suitable for this application due to technology constraints. Other viable mechanisms for NO_x offset and reductions would be regulatory policy, namely a NO_x cap and trade scheme. Given the anticipated introduction of the Emission Trading Scheme to reduce greenhouse gas emissions, a similar framework for NO_x emissions would allow a consistent approach in addressing emissions reduction and also provide a 'level playing field' for all emission sources.

AGL has undertaken a comprehensive review of existing gas turbine developments in Australia and has also reviewed more than 12 alternative sites for the proposed development in NSW. Network connections, existing land uses and environmental constraints were reviewed as part of the Project's siting investigation, and the Dalton area remains the preferred region due to the proximity of the Site to demand, the existing concentration of infrastructure, and the appropriate site setback from neighbouring properties and communities.

The location of the proposed footprint (about 26 ha in size within a total Site area of approximately 508 ha) was determined as a balanced outcome between competing interests of various landowners, environmental considerations and cost considerations. Alternatives were also considered for the location of the access road and gas pipeline. The proposed location of this infrastructure balances the ecological and engineering constraints.

A number of water source and treatment have been considered. AGL is considering potential supply by one or a combination of options. This Environmental Assessment has considered the supply of some of the water requirements to the Site for the options by tanker. Further consideration would be given in the detailed design stage regarding piping from these sources, however, this Environmental Assessment does not address the broader environmental impacts associated with construction and operation of a water supply pipeline from these sources. Each of the potential pretreatment processes has an associated wastewater stream. The water supply would therefore need to accommodate these losses to meet the Facility demands. This Environmental Assessment has considered the water requirements for the identified pretreatment options.

3.1 Introduction

A number of alternatives to the Dalton Power Project were considered to determine how best to meet the project need described in **Chapter 2** *Project Need and Justification*. In addition to contextualising AGL's current operations and vision for Australia's energy future, this chapter addresses alternatives to the type, scale, location of the Dalton Power Project. Alternatives considered by AGL and presented in this chapter are discussed as follows:

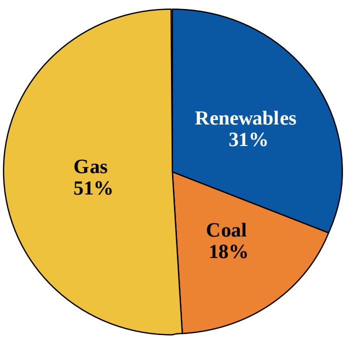
- power generation technology options;
- gas turbine technology options;
- site selection considerations;
- plant footprint options;
- access roads, services and pipeline infrastructure routes;
- communications tower and infrastructure placement options;
- plant technology options (including emissions reduction and control options; inlet air cooling and densifications; and water source and treatment alternatives); and
- the 'do nothing' scenario.

3.1.1 Context of AGL's Operations

AGL believes that Australia should renew efforts to address the challenge of climate change. Notwithstanding current policy uncertainties relating to carbon emissions trading, AGL incorporates a cost of carbon in its current business decision making. AGL is committed to working with the Commonwealth Government on implementing a Carbon Price that would evolve into an emissions trading scheme. This would require the national development and deployment of low emission technologies and an economy wide approach with greenhouse gas abatement implemented on a least cost basis. AGL has been committed to investing in low emission (including natural gas) technology and renewable energy projects for a number of years, and will remain committed to this into the future.

The installed capacity of AGL power generation assets is shown in **Figure 3-1**.

Figure 3-1 AGL Energy – Installed Capacity Generation (Source: AGL 2008)



AGL supports the establishment of a long-term greenhouse gas (GHG) emissions reduction target and the creation of market-based mechanisms to achieve this goal.

As part of AGL's commitment to sustainability, AGL is committed to, and has been for many years:

- at a minimum, meet all statutory requirements relating to reducing GHG emissions;
- quantify and publish the greenhouse gas impacts of their investments, operations and supply chain;
- seek to reduce the greenhouse gas intensity of energy across the supply chain by:
  - expanding investments in low emission and renewable generation, and through the development and commercialisation of technologies that assist in reducing greenhouse gas emissions; and
  - helping customers to reduce GHG emissions by providing practical and accurate information on energy use and offering and promoting green energy;
- improve the greenhouse gas efficiency of their operations, and those in which they have an influence; and
- work with customers, shareholders, governments and the community to progress policy options and initiatives to reduce GHG emissions.

AGL is committed and has been for years, to the following actions:

- Incorporating a forecast of future carbon pricing into all major business decisions.
- Publishing information about AGL's greenhouse gas impacts.
- Benchmarking AGL's performance (both using our supply chain intensity and AGL's generation intensity) against the overall industry.
- Working with all AGL's stakeholders to better understand their options for reducing greenhouse gas emissions.
- Continue to consider a suite of opportunities to expand AGL's low emission and renewable generation interests including the Macarthur wind farm, Oaklands Hill windfarm in Victoria, Ben Lomond windfarm in NSW and two further wind farm projects surrounding Hallett in South Australia;
- Continue to work with the Commonwealth and State Governments as they implement a carbon price that would evolve into an emissions trading scheme and effective Renewable Energy Target;
- Continue to offer to forward trade in Australian Emission Units (AEUs), promoting the scheme and providing liquidity in an emerging market;
- Continue to work with AGL's stakeholders to foster greater levels of shared understanding about the targets, pathways and costs associated with reducing greenhouse gas emissions;

- Provide expert advice on energy efficiency and carbon management services through AGL's new business offering for our major commercial and industrial customers called Carbon Management Services;
- Aim for AGL's state electricity supply intensity to be beneath state averages; and
- Continue to work with governments and agencies at all levels to foster understanding around energy markets and energy efficiency programs.

3.2 Power Generation Technology Options

3.2.1 Conventional Fossil Fuel Options

Coal-Fired Power Stations

Coal-fired power stations are a cost effective means of catering for base load demand. Coal-fired power stations can meet peak load demand by operating at over the rated capacity. However this practice is generally limited to very short periods of time due to additional stresses placed on the plant and a subsequent increase in maintenance requirements. This limits the capacity of these base load generators to service peak demand periods.

The relatively long start up and shut-down times for coal fired power stations also limits the ability of plant that is out of service to meet peak load demand and increases greenhouse gas emissions. A coal fired power station results in significantly greater greenhouse gas emissions and environmental impacts than a gas-fired power station, and so is not a preferred option for the Dalton Power project.

3.2.2 Renewable technology options

Hydro-electric power stations

Hydro-electric power stations can provide peak load supply to the NEM. The Snowy Mountains Hydro-Electric Scheme has traditionally provided peak power generation requirements to NSW and Victoria through its hydro assets. As electricity demand has grown, additional peak generation capacity is required. In NSW, the opportunities have been substantially exhausted to develop hydro-electric power stations for large scale electricity generation to meet the projected peak demand requirements identified by AEMO.

In Victoria, AGL has constructed the 140 MW Bogong hydro power station without building new dams or harvesting additional water by adding to the existing hydro assets AGL currently owns and operates. This asset will add to the over 1000 MW of renewable generation capacity already in the AGL portfolio. This demonstrates AGL's commitment to investment in renewable energy.

While the option of hydro generation is appealing as it utilises renewable energy, it is not a feasible alternative as a means of generating up to 1500 MW of electricity in NSW to meet peak demand supply.

Wind and Solar

Generation from solar and wind power is not suitable for peak load power stations due to the intermittent nature of the resource. Often weather conditions that provide a good wind resource correspond to times when electricity demand is low. For solar generation, the low capacity and high technology cost for electricity generation is such that it is not feasible even though weather conditions conducive to solar generation are often coincident with high electricity demand. In addition, AGL considers the storage technology is not sufficiently advanced to store large amounts of energy for later use. Therefore, AGL considers these technologies do not currently provide suitable alternatives that can service peak load demand.

AGL currently operates and maintains the 91 MW Wattle Point wind farm near Edithburgh, a 94.5 MW Hallett Stage 1 wind farm in South Australia, the 71.4 MW Hallett Stage 2 wind farm, also in South Australia and is constructing Hallet IV, V and Oaklands Hill windfarm in Victoria. Additionally, AGL also has plans to develop 80 MW at Hallett Stage 3. The Macarthur wind farm in Victoria is currently under construction and will have a capacity of about 330 MW.

These projects demonstrate that AGL will invest in renewable projects where the opportunity exists.

3.3 Gas Turbine Technology Options

In the absence of renewable technology options to meet the rising peak demand requirements of NSW, the best alternative is to implement low emission technology for power generation. Natural gas is clean burning and has between 30 % and 50 % lower carbon emissions than coal depending on the technology used.

3.3.1 Open Cycle Gas Turbines

Gas turbine power stations are referred to as operating in open cycle mode when no heat is recovered from the exhaust gas to drive a steam turbine. Open cycle gas turbines have a similar thermal efficiency to coal fired power stations but with 30 % lower greenhouse gas emissions. The typical establishment time for design and commissioning of open cycle gas turbine units is around two years which is significantly less than for a coal fired power station.

Open cycle gas turbine units can be operating at full capacity within thirty minutes following a cold start, compared to a minimum of eight hours for a coal fired power station. Rapid start up and shut down provides a further benefit in the saving on greenhouse gas emissions by responding to demand as it arises.

Given the relatively short start-up and shut down times for these systems, open cycle gas turbine units are ideal for operations to meet peak load demand and generally represent best practice technology for this type of use. Open-cycle gas turbine units are also ideally placed to respond to the short term variability in the generation capacity of wind farms as a result of variable wind conditions. This will become increasingly important as more wind-generated power is introduced into the system.

The capital cost per megawatt generated for open cycle turbine is lower than that for combined cycle gas turbines (see below) or coal fired generators making it more cost effective for short periods of operation during peak times. However the operating cost is higher than the other technologies such that gas turbines are less economic to run when the price of electricity is at average prices of less than $70 per megawatt hour. For this reason it is unlikely the operating hours of the gas turbine would increase over time as other power plants would be constructed to meet intermediate and base load demand.

Peaking gas turbines can operate with a liquid fuel source in the event of gas supply irregularities or interruption. Alternative liquid fuels for the turbines include methanol, kerosene, diesel and heating fuels. Where there is access to gas, the likelihood of gas supply irregularities or interruption is reduced. This would eliminate the requirement for storage and combustion of liquid fuel to fuel the turbines where natural gas constraints do not exist, further reducing potential emissions from the power station.

Increasing penetration of intermittent renewable energy sources such as wind into the grid increases the need for rapid response dispatchable generation facilities to ensure security of supply (for example, at times of low wind generation). In this way, the construction of peaking plants is seen as integral to support the introduction of renewable energy use in NSW.

3.3.2 Combined Cycle Gas Turbines

Combined cycle gas turbine power stations consist of one or more open cycle gas turbine units coupled to a steam turbine. Steam is generated using the residual heat from the open cycle gas turbine units that is then used to drive a steam turbine.

Combined cycle gas turbine units have the advantage of offering greater thermal efficiencies than open cycle gas turbine power stations and coal fired power stations. Combined cycle gas turbines are more suited to intermediate or base load operations as they require greater start-up and shut down periods than open cycle gas turbine units and have a lower operating cost.

As AGL is seeking to install peaking capacity this technology does not meet business requirements due to the long start times.

3.3.3 Selected Generation Technology

Open cycle gas turbines using natural gas as the only fuel source were selected as the best option for this project as they represent the best practice technology for peak load operations. Rigid frame (E class and F class) units were considered in this Environmental Assessment based on the objective of the Dalton Power Project to meet peak electricity demand.

This objective determined the type of gas turbine that can be used. The requirements are for turbine units that can be placed in service rapidly and can handle intermittent operation, tolerate a high number of starts and stops, and demonstrates reliable operation. As the plant would normally run during high peak times, it is essential that multiple gas turbines be installed to increase reliability. Rigid frame E and F class industrial turbines are suitable for this type of duty.

Aero-derivative gas turbines are turbines generally derived from aircraft applications and are similarly suited to peaking plant as the E and F class turbines. However, the generation capacity of these units is typically 10 to 50 MW although larger units in the order of up to 320MW have been developed more recently. The installation of many smaller turbines to meet the required output is not considered practical because of the larger footprint required and significant additional capital and maintenance costs.

The E class and F class type turbines are the best type of turbine as they reliably handle intermittent operation with a high number of starts and stops and the impacts of this technology type has been assessed within this current Environmental Assessment.

3.4 Site Selection Considerations

The NSW gas and electricity transmission networks were developed independently. The potential construction of gas-fired power generation was not considered in developing the separate networks. As construction of a commercially competitive gas-fired power station involves connection to high capacity electricity and gas networks, this leads to the identification of a limited number of corridors where gas and electricity networks are coincident.

AGL has identified these as:

- various locations between Young and Wilton;
- a corridor from Wilton through western Sydney;
- the Central Coast and Newcastle area;
- between Young and Culcairn;
- between Culcairn and Albury;
- south-west of Nowra;
- Nowra to Wollongong; and
- the Dalton / Gunning region.

The target sites identified in the areas nominated above were considered by AGL and a summary of their assessment is discussed in the following sections.

3.4.1 Site Selection Parameters

In identifying target sites in the identified corridors, AGL considered several parameters including network connection and land use. The basis for these selection parameters is set out in the following subsections.

Gas Network Connection

Gas-fired power generation is a substantial gas consumer as shown in **Table 3-1.**

Table 3-1 Consumption of Gas

Parameter*	1500 MW Peak Generation	Moomba Sydney Pipeline	Eastern Gas Pipeline
Daily Throughput	70-105 TJ	1000 – 2250 TJ	1000 TJ
Hourly Throughput	8.5 TJ	40 - 95 TJ	40 TJ

While a peaking power plant would take around 3-5 % of the maximum daily flow through the Moomba Sydney Pipeline, its instantaneous consumption could range between 20-40 % of flow. For the Eastern Gas Pipeline, the situation is more extreme. As a result, peaking plants are only suitable for installation on, or close to, main gas transmission lines where their impact on system pressure is mitigated by line pack. Line pack is the amount of gas in the pipeline system between the supply and delivery points. In contrast, locations at the end of a gas distribution network are not suitable because pipe sizes are smaller and line pack is negligible. Significant capital investment for a compressor is required to upgrade pipeline capacity to a level suitable for a peaking power plant.

In assessing sites, the costs of gas system connection and the ability to service demand have both been analysed. In general, sites in the immediate vicinity (approx 1 km) of a high-pressure pipeline were selected to minimise connection costs and access / easement issues.

There are also cost advantages if use is made of AGL's ongoing haulage commitments on each pipeline. Instead of purchasing gas and pipeline capacity at short notice for limited periods (which can be expensive), gas and pipeline capacity already purchased under long term contracts is used, thus reducing cost.

Electrical Network Connection

The NSW electricity transmission system was originally planned to deliver power from Snowy, Hunter Valley and Central Coast power stations to the greater Sydney area. Subsequently interconnectors were established to Queensland and South Australia (via Victoria). AGL has identified upgrade plans by TransGrid in the immediate vicinity of the Dalton Power Project, including upgrade of the Bannaby to Sydney West lines and Bannaby to Yass line to 500 kV. Upgrade of these lines would benefit the Dalton Power Project and allow expansion of the proposal beyond that proposed for Stage 1 to an ultimate capacity of up to 1500 MW. This would allow efficient introduction of additional capacity into the NSW network following these upgrades. In assessing sites, the costs of electrical system connection and the ability to service demand have both been assessed. In general, sites in the immediate vicinity (approximately 1 km) from a 330 kV high-voltage transmission line and preferably close to existing substations were selected to minimise connection costs and access / easement issues.

Availability of land

Based on known impacts of gas turbines and previous installations in Australia, when identifying target sites AGL assessed a number of land-related issues. These included:

- existence of adequate undeveloped land available for a power station site;
- land zoning compatible with proposed development; and
- adequate separation from sensitive neighbours such as existing residential housing.

These issues are generally satisfied by sites that:

- contain areas greater than 10 ha that are reasonably flat and level;
- zoned general industry or rural (most NSW zoning plans allow power generation in rural areas with consent); and
- are ideally more than 1 km from existing housing.

Availability of water

Relatively small quantities of water are required for cooling of air before it enters the gas turbines. Ideally the infrastructure for water supply would be located near a suitable site. While this is a consideration, it is noted that the plant can run without water. Potential water sources considered include potable water, raw water and treated effluent.

Altitude and climate

The capacity of a given gas turbine unit reduces as air density decreases. The density of air in turn decreases with increased temperature and altitude (reduced pressure). As a result, the sites most favourable to gas turbine development are relatively cool and at low altitude. As an example, increases of 100 m in altitude decrease the output and hence value of a typical industrial gas turbine by 1.25 %. Similarly, an increase in temperature of 1°C will reduce output by 0.8 %.

These effects were taken into account in calculating the performance of plant at given sites based on altitude and summer temperature data from the Bureau of Meteorology.

Potential Environmental Impacts

The main environmental concerns in relation to gas turbine power plants relate to potential impacts on air quality, noise, visual, water quality, traffic, flora and fauna and geotechnical conditions.

In conducting a site selection process, as potential impacts are similar, AGL focussed on local issues that may differentiate one region from another. For air quality, existing air quality and previous modelling is considered. Noise impacts are chiefly associated with distance to sensitive receptors and site selection criteria for setback generally addresses this issue.

Surrounding topography and location of sensitive receptors influences visual impact while the condition and status of local roads is reviewed for traffic issues during construction. The potential for flora and fauna issues based on adjoining vegetation (if any), is also reviewed while a relatively level and undisturbed site is optimal to suit geotechnical issues.

3.4.2 Alternative Site Assessment

AGL undertook a comprehensive site selection study in mid 2008 that examined a number of potential locations for a new gas fired peaking power station in NSW. The results of that study found that the Leafs Gully site in Appin was the preferable site for the development of a gas fired peaking power station. The site selection study directly informed AGL's decision to proceed with developing the Leafs Gully Power Project, and aspects of that study were incorporated into the detailed Environmental Assessment that supported AGL's application to the Department of Planning. The Leafs Gully Power Project was approved by the Minister for Planning in August 2009.

Whilst AGL gained approval for the Leafs Gully Gas Fired Peaking Power Plant, it is insufficient to meet AGL's peak generation needs and AGL does not currently have access to any peaking generation plant in NSW over which it has control. This significantly limits AGL's ability to mitigate its exposure to the volatile movements in wholesale electricity prices referred to in the Owen report and to also contribute to competition for customers in NSW.

The 2008 alternative site assessment was reviewed after the approval of the Leafs Gully Power Project to assess its validity and currency of its information. This review by AGL deemed that the sites that were originally assessed as being potential new locations for the development of another peaking power station were still worthy of consideration, and that the criteria used in that report were still valid in terms of site assessment evaluation.

In order to locate optimal sites for the development of a new peaking power station, target areas in the corridors containing electricity, gas and water infrastructure were identified. AGL evaluated the target areas identified on the basis of their proximity to gas and electrical infrastructure.

A number of sites within target areas were identified, visited and assessed by AGL. These included sites in the following locales:

- Dalton - Walshs Road;
- Nowra - Turpentine and Braidwood Roads, Tomerong;
- Wollongong – Dapto substation;
- Marulan – Marulan substation;
- Moss Vale – Wingecarribee Reservoir;
- Wagga Wagga – Bomen Industrial area and 330kV substation;
- Canberra – Hume Power Station proposal;

- Central Coast – Munmorah and Tomago proposals; and
- North Albury and Culcairn – generic area.

The sites were assessed against the key selection parameters identified above.

3.4.3 Dalton

The Dalton site was found to possess a number of locational advantages for the development of the proposed gas fired power station. The 330 kV Bannaby transmission line traverses the site, and the Moomba to Sydney Gas Pipeline is also located within close proximity . At this location, the gas and electricity infrastructure is capable of accommodating a power station development. AGL found available land within this area which is not constrained by surrounding development or zoning controls.

Furthermore, the site has been used for grazing and agricultural purposes for some time, reducing the area of native vegetation which would require removal from the site. The location is isolated enough to minimise negative environmental impacts, especially in terms of visual and noise effects.

Figure 3-2 presents the Dalton area considered by AGL during the 2008 alternative site assessment for the Leafs Gully Project.

Location

The Dalton site is located 3 km north of the small town of Dalton in the Southern Tablelands of NSW. The site is generally located between Goulburn and Yass and is approximately 12 km north-west of the town of Gunning.

Gas infrastructure

The Moomba to Sydney gas pipeline is within 2 km of the Dalton site. AGL considered connection to the pipeline at the existing offtake or via a new valve station.

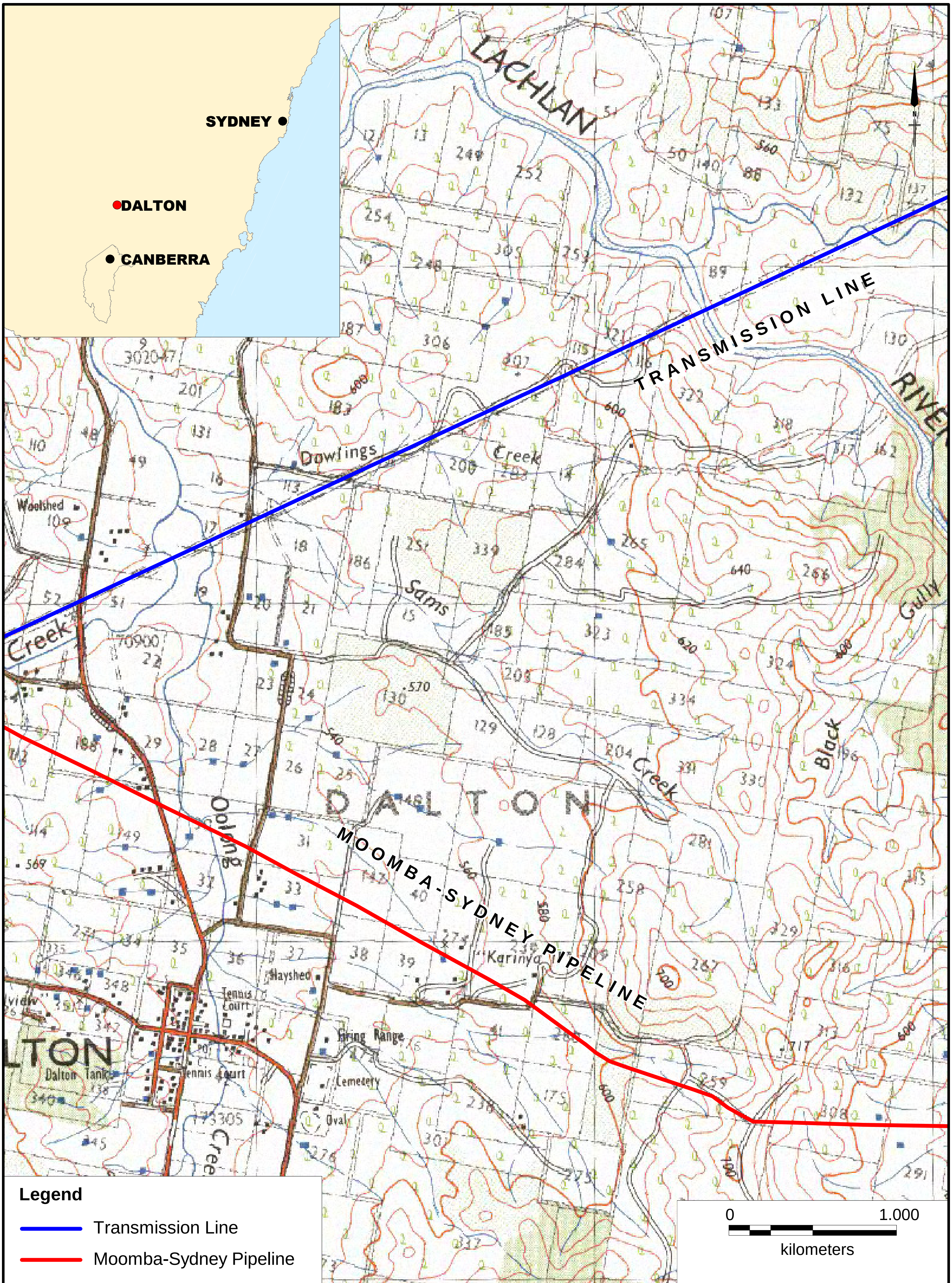
Performance

The effects of the local climate and altitude of Dalton on the potential performance of the proposed turbine units are listed in **Table 3-2**.

Table 3-2 Turbine Performance for Dalton locality

Feature	Value	Relative De-rating (%)
Altitude	530m	-5.0
Mean daily maximum	27 ^{o}C	+1.5
Total de-rating (%)[1]		**-3.5**

[1] Note: compared to notional reference site



Client	Project	Title
AGL	AGL DALTON POWER PROJECT	ASSESSMENT OF TARGET SITES - DALTON
URS	Drawn: AO/SB · Approved: LO · Date: 10/02/2011	Figure: 3-2
	Job No: 43177661 · File No: 43177661.021.wor	

Electricity infrastructure

The Dalton site is crossed by TransGrid's Yass to Bannaby's 330 kV feeder. TransGrid's response to AGL's connection inquiry indicates that the 330 kV line has a nominal capacity of at least 780 MW. However, this section of the feeder is likely to be upgraded as part of TransGrid's ongoing 500 kV Project, enabling the Project at this respective location to be upgraded to a total generating capacity of 1500 MW as proposed.

Water infrastructure

Preliminary investigations of the Dalton site highlighted some limitations in access to water from the adjacent Lachlan River as well as a groundwater extraction embargo covering the area. The low ongoing water requirements of the proposal as well as potential water sourcing opportunities elsewhere indicated that water access was not an unsurmountable challenge at this location. Water Management for the proposed Dalton Site is discussed in **Chapter 14** *Water Management*.

NEM regions and constraints

The Dalton site is located within the NSW region and is electrically close to the Sydney load centre.

Land and availability

There is significant land available at the Dalton site, with approximately 500 ha currently in AGL's ownership. Significant parts of the site have already been cleared for previous grazing and agricultural uses, and the site has favourable topography.

Permitting and regulatory

The Dalton site falls within the Upper Lachlan Shire, and is zoned 1A Rural under the provisions of the Gunning Local Environmental Plan 1997. Power generation is permissible with development consent.

Competing developments

Other proposed developments in NSW are unlikely to impact a gas turbine power station development at Dalton. A number of windfarms are under development but not committed to construction in the area. As described elsewhere in this assessment, the Dalton Power Project would complement rather than compete with windfarm developments.

Preliminary Environmental Assessment

Initial investigations of the Site highlighted a number of environmental considerations for further assessment. Potential impacts on flora and fauna, noise, air quality and greenhouse gas emissions, landscape and visual impacts, and impacts on cultural heritage were highlighted. Preliminary investigation into these issues indicated significant opportunities for AGL to manage and mitigate the potential negative impacts of the proposal at this location.

The site selection of the proposed Project Footprint within the wider Dalton Site is discussed in **Section 3.8**

3.4.4 Marulan

This area is traversed by the Moomba Sydney Pipeline and two 330 kV electricity transmission lines. Sites north of the Marulan substation are located in an area of the network that is less affected by constraints between NEM regions.

General

Marulan is located approximately 190 km south-west of Sydney, and around 30 km north east of Goulburn. The area is rural. Refer to **Figure 3-3** for the areas under consideration.

The area was considered due to its proximity to gas and electricity infrastructure. Two locations were considered.

Location A is just south of Brayton where the Brayton Road is crossed by 330 kV lines. This location is distant and south from the Marulan 330 kV substation.

Location B is adjacent to the Marulan 330 kV substation. This site offers potential electrical interconnection savings though gas connection costs are greater. This site is under development by other entities and as such is not available to AGL.

Further development beyond that of Delta and EnergyAustralia may be limited by transmission constraints.

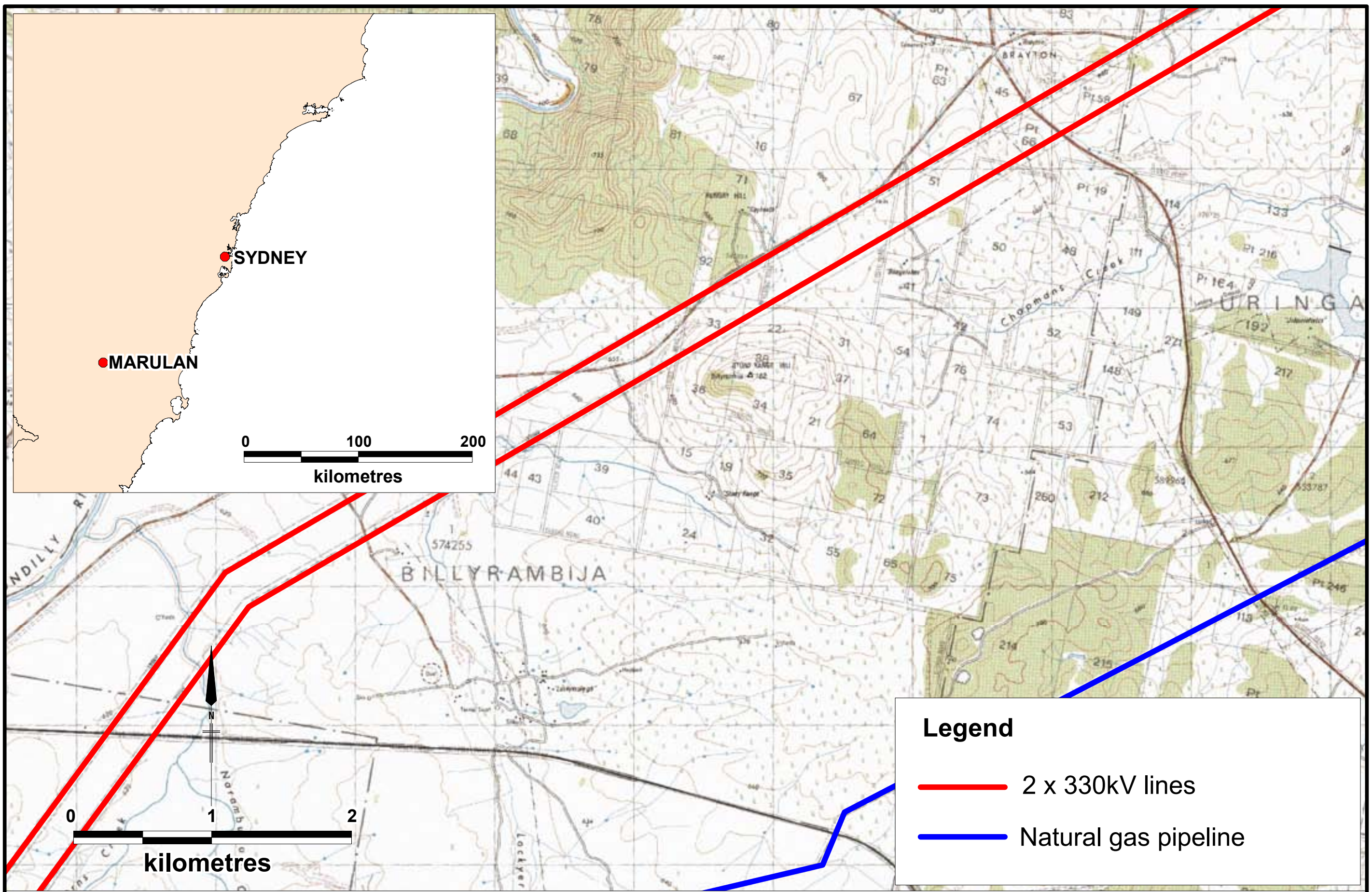
Performance

The effects of the local climate and altitude of Marulan on the performance of the turbines are listed in **Table 3-3**.

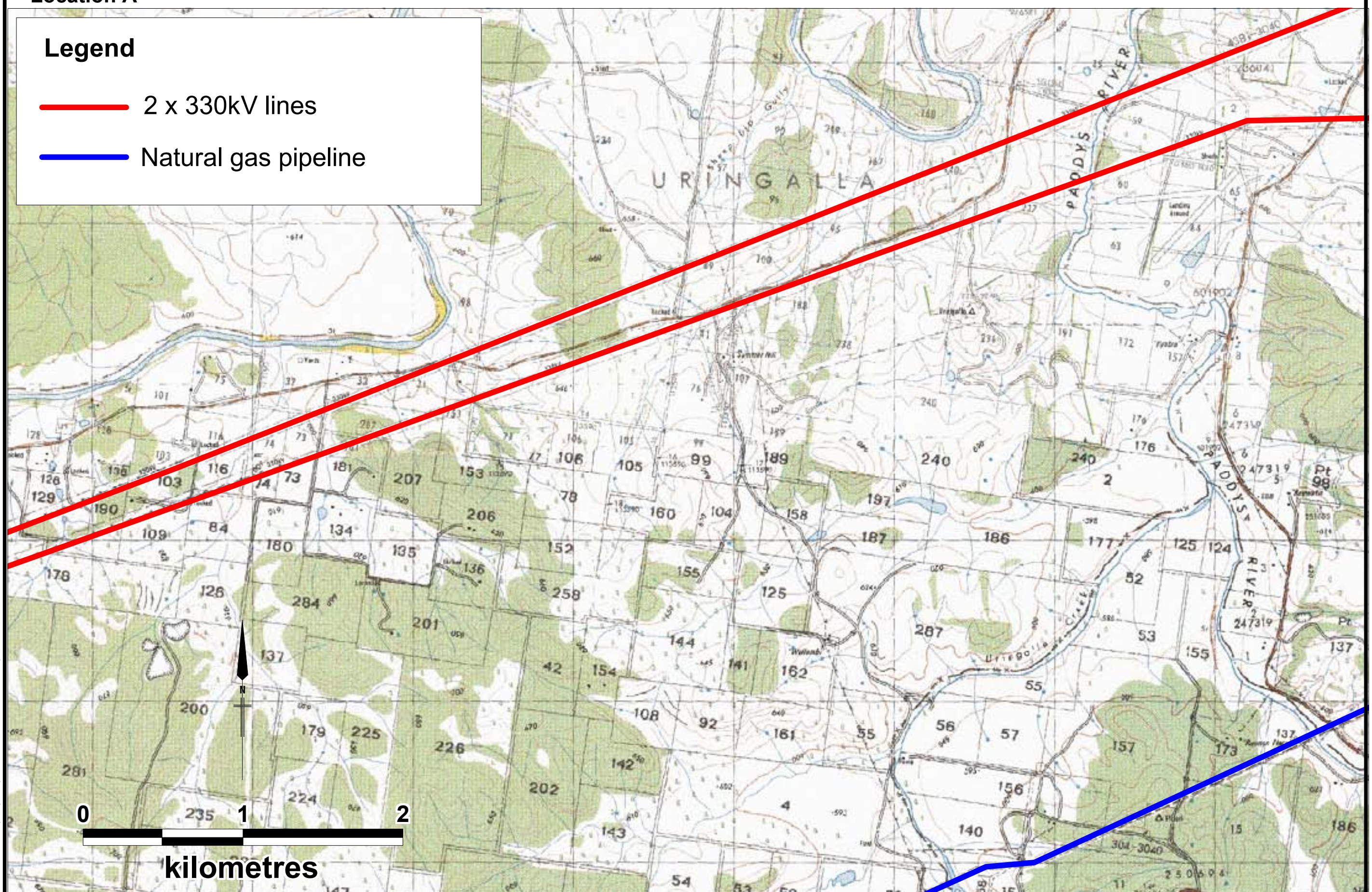
Table 3-3 Turbine Performance for Marulan locality

Feature	Value	Relative De-rating (%)
Altitude	660 m	- 6.5
Mean daily maximum	28.1 ^{o}C	+ 1.3
Total de-rating (%)[1]		**- 5.2**

[1] Note: compared to notional reference site



Location A



Location B

Client	Project	Title
AGL POWER GENERATION (NSW)	AGL DALTON POWER PROJECT	ASSESSMENT OF TARGET SITES - MARULAN
URS	Drawn: AJW / Approved: FINAL / Date: 26/02/10 / Job No: **43177401** / File No: 43177401-064.wor	Figure: **3-3**

Gas infrastructure

The Moomba Sydney Pipeline crosses the Marulan area. The pipeline is located around 5 km from Location A and 7 km from Location B. No modification or supplementary compression would be required to meet the gas needs of the proposed power station.

There is no competitive tension with other gas or pipeline operators.

Electricity infrastructure

Two TransGrid 330 kV feeders cross Location A and there is a major switching station (Marulan 330 kV) located nearby. Location B is located on TransGrid's Marulan to Dapto 330 kV line.

Line congestion is likely to restrict export from a power station south of the Marulan substation. This would have to be investigated by load flow studies.

It is anticipated that a power station could connect directly to the Marulan 330 kV substation at location B, and is hence less likely to be constrained.

Water infrastructure

No available or significant water resource is located near to these sites.

NEM regions and constraints

The Marulan Switchyard is an important node in the NEM and to ensure a peaking plant remains in the same zone as the Newcastle / Sydney / Wollongong load, a direct connection to the switchyard or connection to the north is preferred. The Marulan area is in the NSW region and this is unlikely to change as a result of foreshadowed changes to NEM regional boundaries in the future.

A study of the electricity network efficiency and reliability (ROAM, 2006) found that compared to sites selected in Tomago, Munmorah and Leafs Gully, a site at Marulan would perform significantly worse from a system losses and reliability perspective and has higher potential for overload. A site in this region is subsequently more likely to be constrained during peak demand periods.

Land and availability

Private individuals own the main target land packages that would be suitable. There are very few residential dwellings in the area of interest, with only one dwelling within a 1 km radius of the proposed site.

Permitting and regulatory

The area of interest falls within the Goulburn Mulwaree Council. The land is zoned 1(a) general rural. Power generation is a permissible use with consent.

Competing developments

Similar gas power proposals are under development within Marulan. The electrical and gas connections may be constrained with additional gas power plant located in the area.

Other proposed developments in NSW are unlikely to constrain or otherwise impact a development in Marulan.

Preliminary Environmental Assessment

No other environmental issues have been identified that differ significantly from alternate sites.

3.4.5 Wagga Wagga

Wagga Wagga was considered as a location with gas and electricity infrastructure available although potentially constrained. The area is also close to good supplies of water.

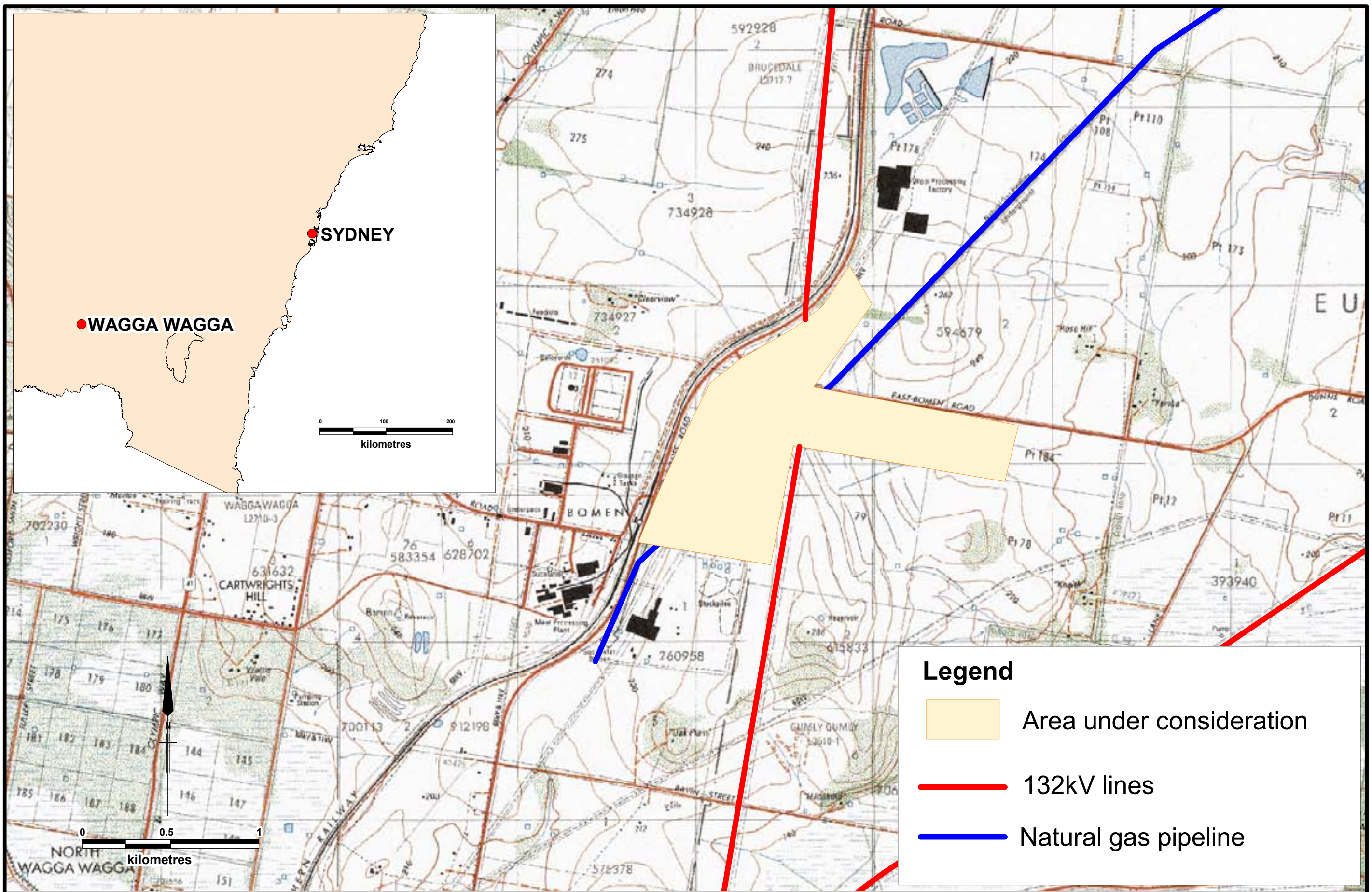
General

Wagga Wagga is located approximately 465 km southwest of Sydney. The area under consideration is within the industrial area at Bomen just north of Wagga Wagga. Refer to **Figure 3-4** for the areas under consideration.

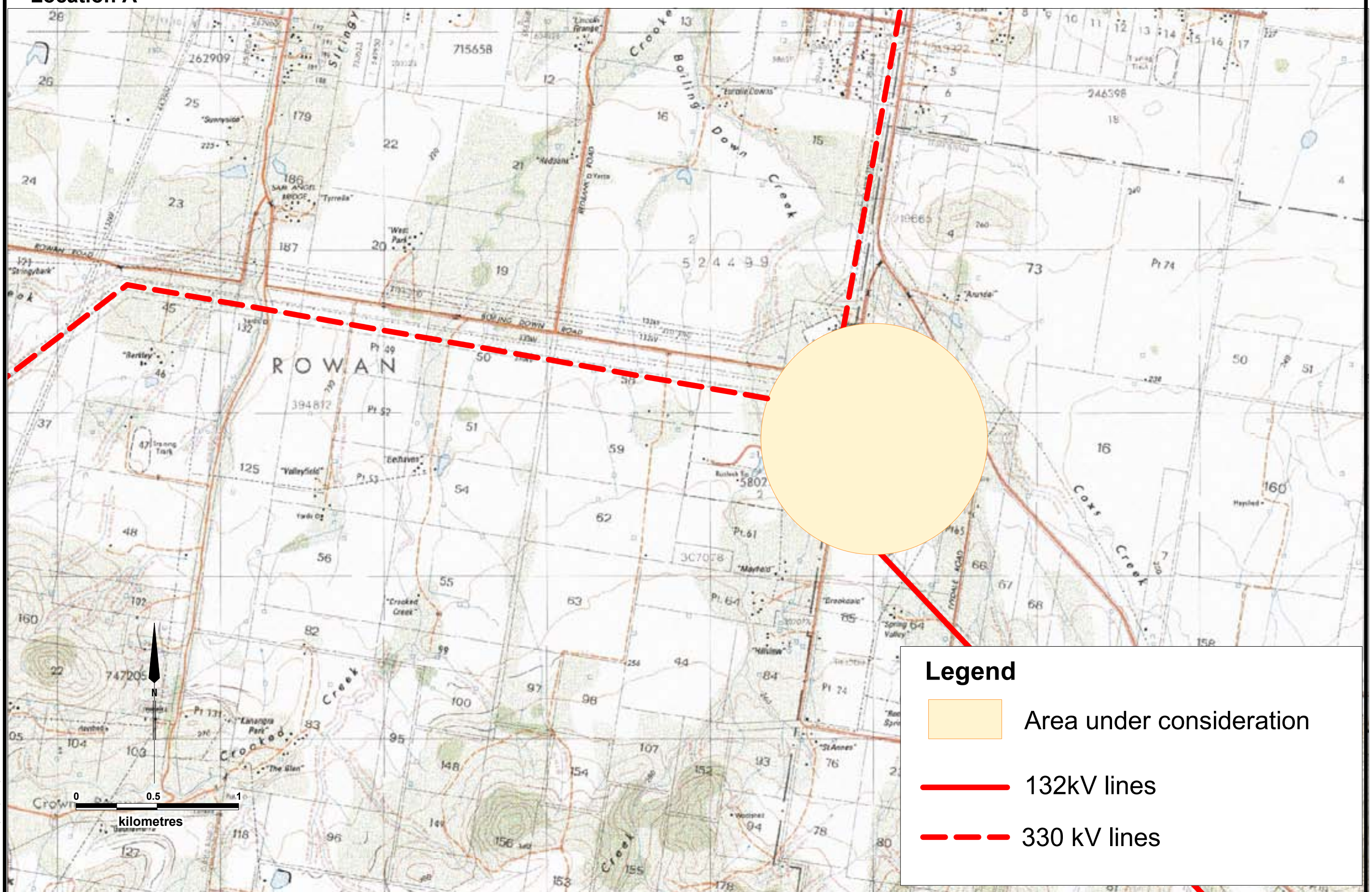
The area was considered due to its proximity to gas and electricity infrastructure, and the availability of water from the Murrumbidgee River.

Two locations have been identified as potential sites for development:

- Location A is in the Bomen industrial area; and
- Location B is adjacent to the Wagga Wagga 330 kV substation. This location has the potential to reduce electrical interconnection costs and increase export capacity, but requires additional expenditure for gas connection.



Location A



Location B

Client	Project	Title
AGL POWER GENERATION (NSW)	AGL DALTON POWER PROJECT	ASSESSMENT OF TARGET SITES - WAGGA WAGGA
	Drawn: AJW · Approved: FINAL · Date: 26/02/10	Figure: **3-4**
	Job No: **43177401** · File No: 43177401-065.wor	

Performance

The effects of the local climate and altitude of Wagga Wagga on the performance of the turbines are listed in **Table 3-4**.

Table 3-4 Turbine Performance for Wagga Wagga locality

Feature	Value	Relative De-rating (%)
Altitude	240 m	-1.6
Mean daily maximum	31.4 ^{o}C	-1.0
Total de-rating (%)[1]		-2.6

[1] Note: compared to notional reference site

Gas infrastructure

APA Group's Victorian interconnector crosses the target area at Location A. A 17 km gas lateral would be required to connect Location B to the Victorian interconnector. There is no competitive tension with other gas or pipeline operators.

The gas network in this area would not require any immediate modification or supplementary compression to meet the gas needs of the proposed power station. However, in some cases an enhanced pressure service may be required which would be charged on an 'as-needed' basis.

Electricity infrastructure

Electrical interconnection at Wagga Wagga is more complex than at other sites. This is due to its location in the electrical network and the lack of 330 kV connection points. The Wagga area is located along the major transmission lines that connect the NSW region to the Snowy region and there are times when these lines do not have any additional capacity. This situation would result in a generator located in the Wagga area being constrained, and unable to export its full capacity onto the grid.

In addition to the network constraints in the Wagga area, there are very few suitable locations at which to connect at 330 kV, however there are several suitable locations for a connection at 132 kV. 132 kV lines have a nominal capacity of around 110 MVA per circuit, and therefore would only suit a relatively small power station with no capacity for expansion.

Location A is within the Bomen industrial zone. The proposed connection point is into the 132 kV lines that run from the Wagga 330 kV substation. The connection would require a 3.5 km extension of the existing 132 kV lines. The connection point would have a nominal capacity of 150 MW.

Location B is located adjacent to the Wagga 330 kV substation. The connection at 330 kV would require an additional bay at this substation. A connection at this point could accommodate the size of development being considered subject to network constraints.

Water infrastructure

The Murrumbidgee River is located within 5 km of the Location A and within 12 km of Location B. A reasonably mature water trading and allocation market exists for securing water in the quantities required. Recycled water may also be available.

NEM regions and constraints

Whilst the Wagga Wagga area is currently in the NSW region this may change as a result of changes to NEM regional boundaries in the future. Wagga is a long distance from the demand centre of Newcastle / Sydney / Wollongong.

Land and availability

Wagga Wagga City Council owns the main target land packages. Very few residential dwellings are located within the area of interest.

Permitting and regulatory

The area of interest falls within Wagga Wagga City Council. The land is zoned rural. Power generation is permissible on land with this zoning with consent.

Competing developments

The AEMO Statement of Opportunities notes a publicly announced generation proposal in the Wagga Wagga area from Wambo Power Ventures (WPV) now known as NewGen. The proposed development is in the Uranquinty area south west of Wagga Wagga. This development could impose additional constraints on a development in this area.

Whilst no other specific developments are committed, it is understood that the Snowy Mountains Hydro Electric Scheme is considering repowering and developing additional hydro capacity. This could have a material impact on the ability of a development located in this area to export power. Additionally, development in this area is vulnerable to further development of electrical interconnectors and is reliant on ongoing development of the local transmission network and local load to secure its ability to export.

Preliminary Environmental Assessment

No other environmental issues have been identified that differ significantly from alternate sites.

3.4.6 Culcairn

Culcairn was considered as it is located at the end of APA Group's gas network and reasonable electrical infrastructure is available but no significant water sources. The site was assessed to see if it offered any advantages over Wagga Wagga or Albury.

General

Culcairn is located approximately 500 km southwest of Sydney, around halfway between Wagga Wagga and Albury. The area is rural. Refer to **Figure 3-5** for the area under consideration.

The area was considered due to its proximity to the Victorian interconnector, and was used to compare with Wagga Wagga and Albury. No specific location was identified for a development.

Performance

The effects of the local climate and altitude of the Culcairn locality on the performance of the turbines are listed in **Table 3-5**.

Table 3-5 Turbine Performance for Culcairn Locality

Feature	Value	Relative De-rating (%)
Altitude	210 m	-1.30
Mean daily maximum	31.2 ^{o}C	-0.80
Total de-rating (%)[1]		-2.10

[1] Note: compared to notional reference site

Gas infrastructure

The Culcairn area is the end of Australian Pipeline Trust's Victorian interconnector. The gas network at Culcairn would be subject to the same kinds of issues present at Wagga Wagga. An enhanced pressure service may be required to support a power station at this location.

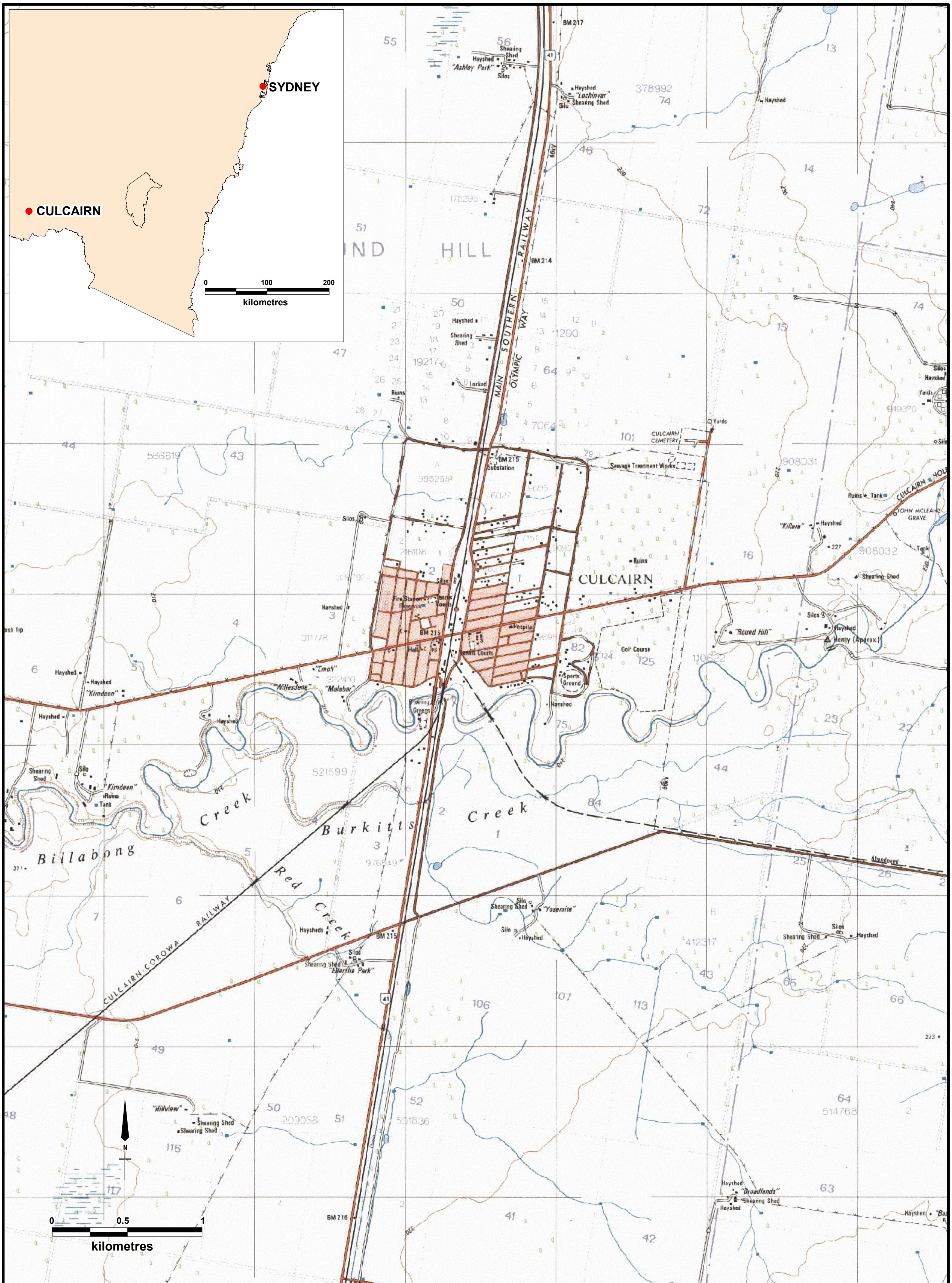
There is no competitive tension with other gas or pipeline operators.

Electricity infrastructure

132 kV transmission lines cross the Culcairn area. Nominal capacity of these lines is estimated at 110 MVA per circuit. A development at this location would be hampered both by a lack of capacity at the connection point, but also by network constraints that affect Wagga Wagga.

Water infrastructure

No significant water storage or rivers are located near this site.



Client

AGL POWER GENERATION (NSW)

URS

Project

AGL DALTON POWER PROJECT

Title

ASSESSMENT OF TARGET SITES - CULCAIRN

Drawn: AJW	Approved: FINAL	Date: 26/02/10
Job No: **43177401**	File No: 43177401-060.wor	

Figure: **3-5**

NEM regions and constraints

The comments that have been made for Wagga Wagga in **Section 3.5.3** apply, namely:

- further studies would need to be undertaken to ascertain whether or not a development at this location would affect other market participants, and what effect the development would have on interstate and intrastate energy flows;
- it is expected that there would be scenarios under which the development would be unable to export at full capacity as a result of network constraints;
- whilst the Culcairn is currently in the NSW region this may change as a result of foreshadowed changes to NEM regional boundaries in the future; and
- long distance from the key demand area of NSW.

Land and availability

No target area has been identified in the Culcairn area, as the site is low in the list of priorities. No land shortages are foreseen in this area.

Permitting and regulatory

The area of interest falls within the Culcairn Shire Local Government Area (LGA). It is assumed that any identified land would be zoned rural.

Competing developments

The AEMO Statement of Opportunities notes a publicly announced generation proposal in the Wagga Wagga area from Wambo Power Ventures (WPV). The proposed development is in the Uranquinty area south west of Wagga Wagga.

Whilst no other specific developments are committed, it is understood that the Snowy Mountains Hydro Electric Scheme is considering repowering and developing additional hydro capacity. This could have a material impact on the ability of a development located in this area to export power. Additionally, development in this area is vulnerable to further development of electrical interconnectors and is reliant on ongoing development of the local transmission network and local load to secure its ability to export.

Preliminary Environmental Assessment

No other environmental issues have been identified that differ significantly from alternate sites.

3.4.7 North Albury

North Albury was identified for reasons similar to Wagga Wagga. Gas, electrical infrastructure and water are all available.

General

Albury is located approximately 554 km southwest of Sydney. The area is industrial. Refer to **Figure 3-6** for the areas under consideration.

The area was considered due to its proximity to gas and electricity infrastructure, and the availability of water from Lake Hume and the Murray River.

Performance

The effects of the local climate and altitude of North Albury on the performance of the turbines are listed in **Table 3-6**.

Table 3-6 Turbine Performance for North Albury Locality

Feature	Value	Relative De-rating (%)
Altitude	250 m	-1.80
Mean daily maximum	30.9 °C	-0.60
Total de-rating (%)[1]		**-2.40**

[1] Note: compared to notional reference site

Gas infrastructure

The GPU GasNet pipeline feeds the Albury area. The GPU GasNet system can be constrained during winter as a result of a lack of compression at Wollert. It is expected that some additional compression would be required to deliver gas to Albury from Victoria. There is no competitive tension with other gas or pipeline operators.

Electricity infrastructure

TransGrid's Jindera – Norske Skog 132 kV transmission lines pass within approximately 14 km of the site. These lines have a capacity of around 220 MVA. Therefore, the 132 kV system would not allow for expansion of a power station.

It is possible to upgrade the existing 132 kV lines to 330 kV. This would enable expansion but carry a significant cost penalty.