NEM regions and constraints

It is expected that a power station development in this region would be constrained at times due to interstate or inter-regional power flows. Canberra is some distance from the key demand area of NSW.

Land and availability

Land is available at Location A. Land has not been selected at Location B.

Permitting and regulatory

Within the ACT, the permitting process should only require the usual development approvals through the Department of Planning and Land Management.

Competing developments

Whilst no other specific developments are known, it is understood that the Snowy Mountains Hydro Electric Scheme is considering re-powering and developing additional hydro capacity. This could have a material impact on the ability of a development located in this area to export power.

Preliminary Environmental Assessment

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

3.4.12 Nowra (Tomerong)

Tomerong is located south west of Nowra. In this vicinity, the EGP and 330 kV transmission are in close proximity in an area with few residences surrounded by national parks. Refer to **Figure 3-11** for area under consideration.

General

The area assessed is south west of Nowra, which is located, approximately 135 km south of Sydney.

The area of interest is located west of Tomerong at the junction of Turpentine and Braidwood roads. Water is not readily available at this site.

Performance

The effects of the local climate and altitude of Nowra (Tomerong) on the performance of the turbines are listed in **Table 3-11**.

Table 3-11 Turbine Performance for Nowra (Tomerong) Locality

Feature	Value	Relative De-rating (%)
Altitude	300 m	- 2.3
Mean daily maximum	25.8 °C	+ 2.9
Total de-rating (%)[1]		+ 0.6

[1] Note: compared to notional reference site

Gas infrastructure

The Eastern Gas Pipeline passes through the areas of interest. There is no competitive tension with other gas or pipeline operators.

Electricity infrastructure

The Nowra area is crossed by TransGrid's Canberra to Kangaroo Valley 330 kV feeder. No connection inquiry has been submitted but the feeder is lightly loaded and should have a capacity for up to 600 MW.

Water infrastructure

Tomerong is not located close to a ready supply of water although there is potential to connect to the Shoalhaven Water Reclaimed Effluent Management Scheme (REMS).

NEM regions and constraints

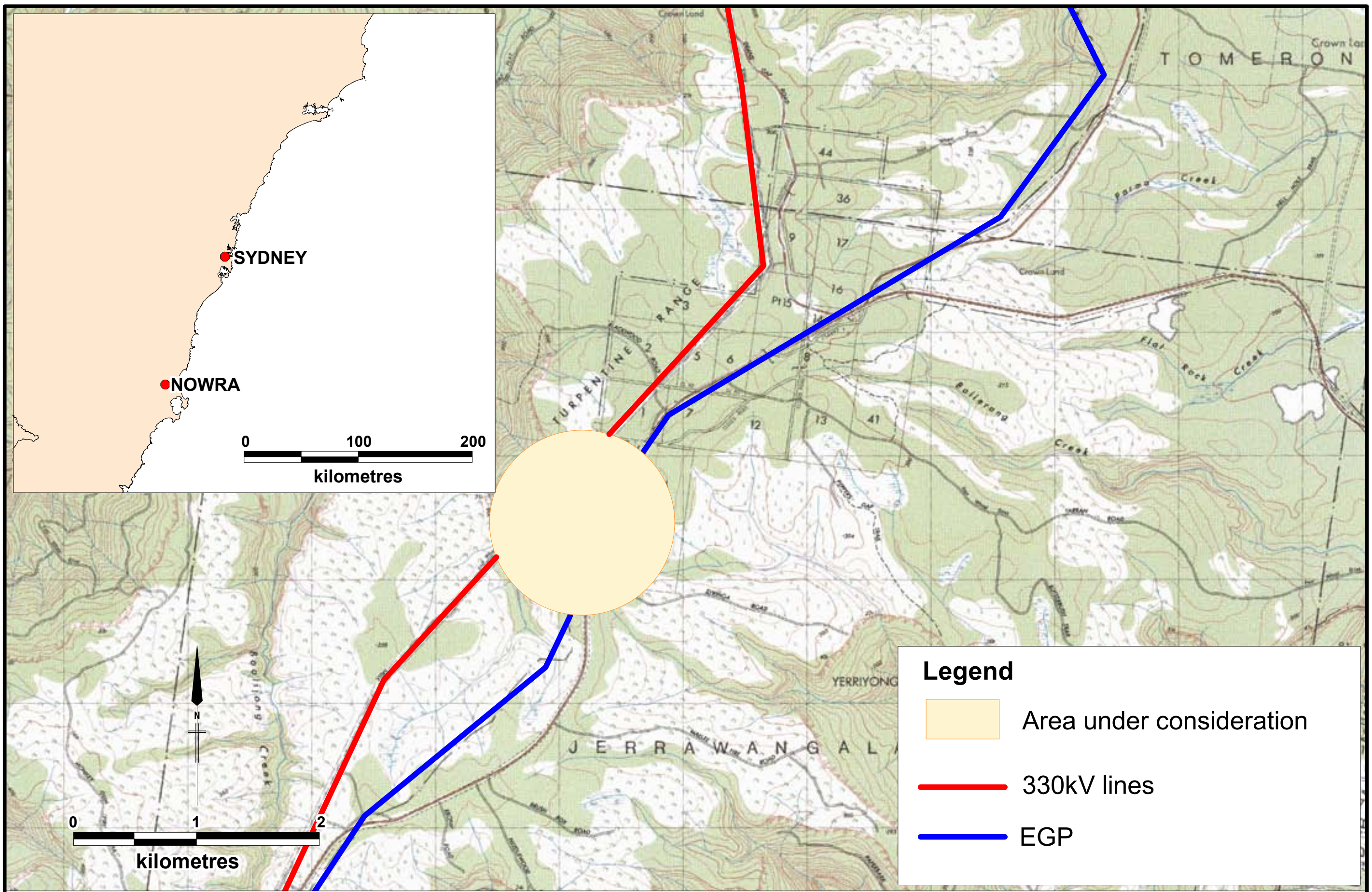
Impacts on interstate or intrastate energy flows, and on other participants, are not anticipated. The Nowra area is reasonably close to Wollongong and Sydney load centres, and its NEM region is extremely unlikely to change as a result of foreshadowed changes to NEM regional boundaries in the future.

Land and availability

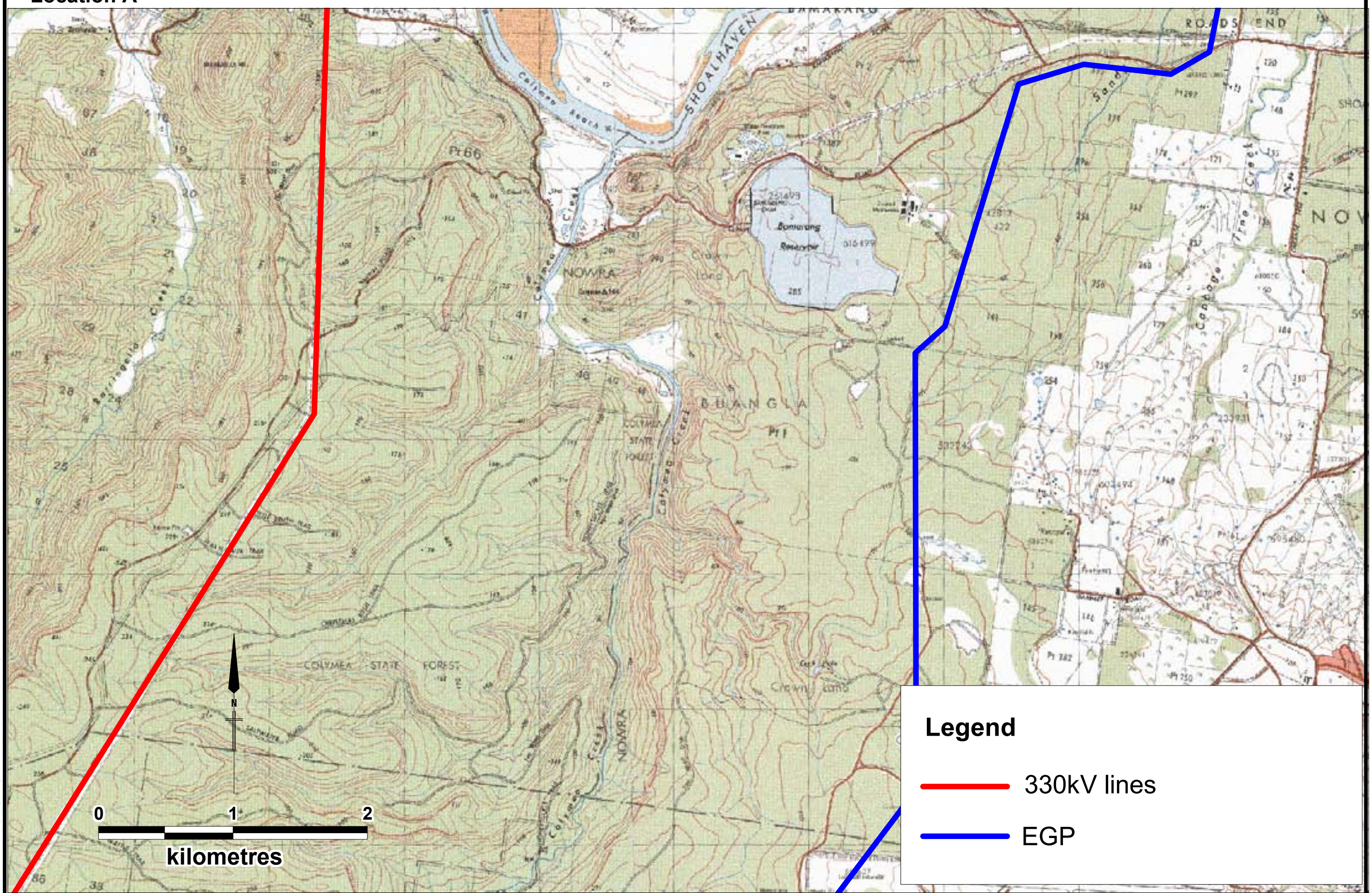
NSW State Forests is the owner of the majority of land around Tomerong that is not part of National Parks reserves. Procurement of crown land is complicated and the outcome is uncertain. Native title issues arise in this area and while not insurmountable, these issues take time to resolve. Easements across National Parks land for the transmission and gas connections are required plus substantial land clearing.

Permitting and regulatory

The area of interest falls within the Shoalhaven City LGA. Zoning allows utility installations with development consent.



Location A



Location B

Client	Project	Title
AGL POWER GENERATION (NSW)	**AGL DALTON POWER PROJECT**	**ASSESSMENT OF TARGET SITES - NOWRA**
URS	Drawn: AJW; Approved: FINAL; Date: 26/02/10	Figure: **3-11**
	Job No: **43177401**; File No: 43177401-069.wor	

Competing developments

A site to the north adjacent to Bamarang Reservoir has been proposed for a gas-fired power station. The transmission connection for Bamarang is to the 132 kV network and does not constrain a development on the 330 kV network. The gas connection of Bamarang and the TRUenergy facility at Tallawarra may restrict the availability of gas at the site and supplementary compression may be required.

Preliminary Environmental Assessment

Due to potential sites being vegetated and proximity to national parks and reserves, a flora and fauna study will be required before seeking to procure a site in the area.

Existing access is via dirt/gravel roads although Main Road 92 is being upgraded. The impact on these roads will need review.

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

3.4.13 Wollongong

The transmission substation that the Tallawarra proposal by TRUenergy would connect to is in Dapto. The Eastern Gas Pipeline and Alinta Gas Networks trunk line are in the vicinity.

General

The area of interest is south of Wollongong near Dapto. Refer to **Figure 3-12** for the general area under consideration.

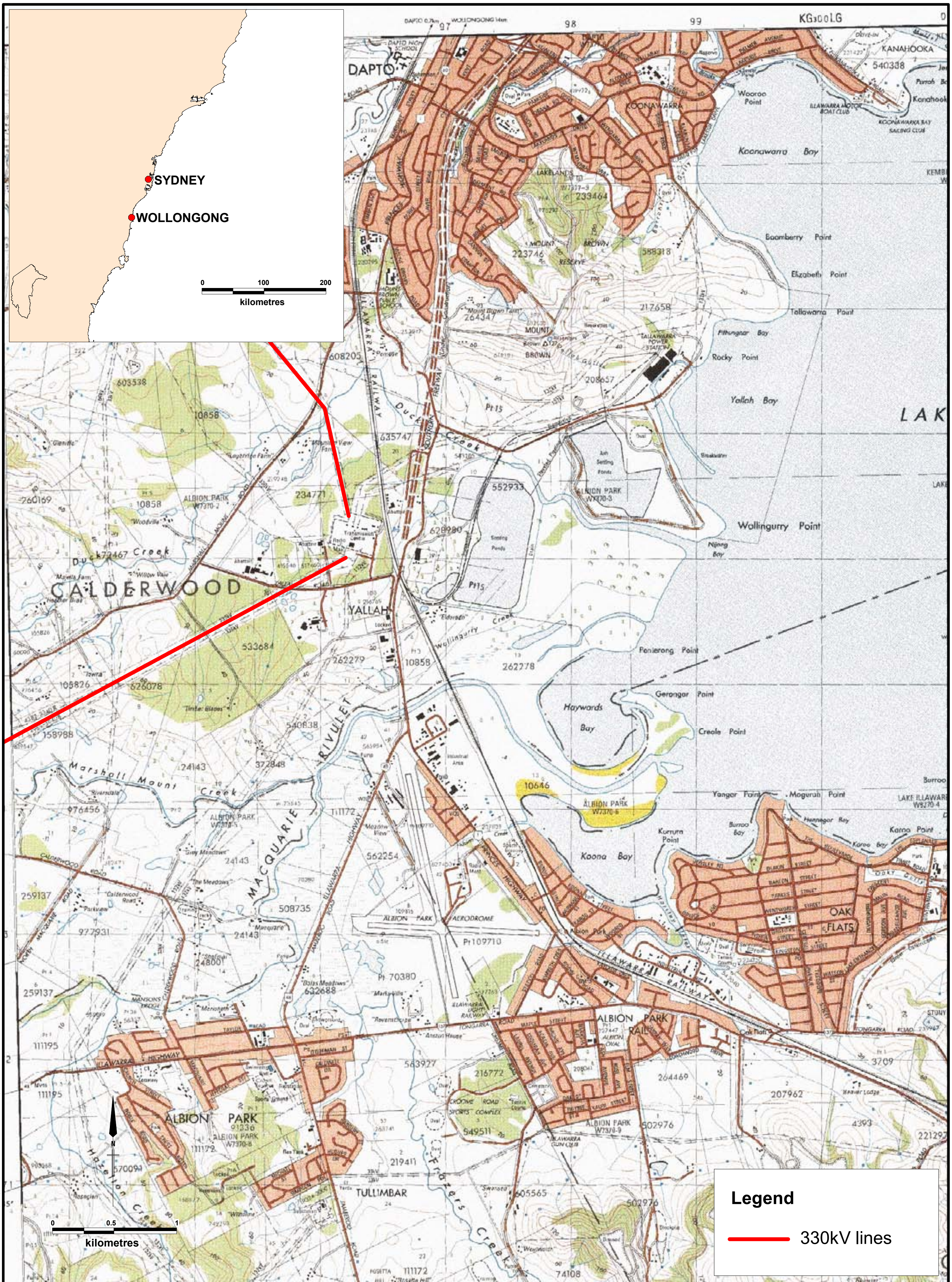
Performance

The effects of the local climate and altitude of Wollongong on the performance of the turbines are listed in **Table 3-12**.

Table 3-12 Turbine Performance Wollongong locality

Feature	Value	Relative De-rating (%)
Altitude	25 m	+ 0.0
Mean daily maximum	25.6 ^{o}C	+ 2.9
Total de-rating (%)[1]		+ 2.9

[1] Note: compared to notional reference site



Client	Project	Title
AGL POWER GENERATION (NSW)	AGL DALTON POWER PROJECT	ASSESSMENT OF TARGET SITES - WOLLONGONG
URS	Drawn: AJW / Approved: FINAL / Date: 26/02/10	Figure: 3-12
	Job No: 43177401 / File No: 43177401-068.wor	

Gas infrastructure

Both the Alinta Gas Network and the Eastern Gas Pipeline cross the Dapto / Wollongong area. This potentially provides gas on gas competition. However while the EGP is adjacent to the 330 kV Dapto substation the AGN pipeline is 12 km to the north in dense urban areas.

The gas network in the area would not require any modification or supplementary compression to meet the gas needs of the proposed power station.

Electricity infrastructure

The Dapto substation is in the vicinity of the gas pipelines with 330 kV incoming lines from Avon, Marulan and Kangaroo Valley. No connection inquiry has been submitted but connection direct to the substation is preferable in light of competing generators at Tallawarra and Kangaroo Valley and future development at Bamarang.

Water infrastructure

There is potential for water, recycled or potable, for a development in the area although existing recycled water capacity may already be allocated.

NEM regions and constraints

Impacts on intrastate energy flows, and on other participants, may occur with competing generators at Tallawarra, Kangaroo Valley and potentially Bamarang. Direct connection to the substation would be required to ensure no constraints to a plant's ability to export power occur, although this will need to be confirmed by studies.

The area is close to Wollongong and Sydney load centres, and its NEM region is unlikely to change as a result of foreshadowed changes to NEM regional boundaries in the future.

Land and availability

Existing rural residential development may constrain power generation as residences generally exist at most within 500 m of each other. The Wollongong region is mostly dense urban development between the Pacific Ocean and the Illawarra escarpment with extensive rural residential development around the Dapto substation making the locating of a suitable site unlikely given the number of sensitive receptors. Site procurement would be made more difficult as a number of small lots would have to be acquired plus easements for gas and transmission access.

Permitting and regulatory

The area of interest to the west of the Dapto substation falls within the Wollongong City LGA. The land is zoned non urban. This zoning allows utility installations with development consent.

Competing developments

The transmission connection for Tallawarra, Kangaroo Valley and Bamarang is to the Dapto substation. During peak times when load flows head north towards Sydney there is potential for transmission constraints. The gas connection of Bamarang and Tallawarra may restrict the availability of gas at the site and supplementary compression may be required.

Preliminary Environmental Assessment

Due to proximity of residential receivers, noise and visual impact will require additional mitigation to that normally anticipated for such a development.

The Illawarra is considered to be part of the Greater Metropolitan Region and the air shed interacts with Sydney. Impact on existing air quality will be scrutinised although as for Appin, air quality impacts are expected to comply with regulations.

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

3.4.14 Site Assessment

Assessment Classification

All sites identified were assessed by AGL using a consistent methodology. Four factors were assessed on a qualitative basis (**Table 3-13**). AGL then presented these on a “traffic light” basis as follows.

Table 3-13 Assessment Classification

Site Status		
Feasible, full project needs able to be supplied with no significant costs over reference case	Feasible, but potential constraints or significant costs over reference case	Not feasible even with significant expenditure
GO ✓	***CAUTION*** ●	*STOP* ✗

From the analysis for each site in previous sections, AGL compiled a summary in **Table 3-14**.

Table 3-14 Site Assessment Summary

Site	Gas Conn'n	Electrical Connection Feasibility	Land	Water	NEM Region Change Risk	Installed Capital Cost	Rank
Dalton	✓ MSP	✓	✓	✓	✓	102%	1
Nowra	✓ EGP	✓	●	●	✓	100%	2
Moss Vale	✓ MSP	✓	●	●	✓	109%	3
Wagga Wagga	✓ MSP	●	✓	✓	✓	104%	4
Central Coast	● Alinta	●	✓	✓	✓	108%	5
Canberra	● MSP offtake	✓	✓	●	●	106%	6
Culcairn	✓ MSP	●	✓	●	●	N/A	7
North Albury	● GPU	●	✓	✓	●	N/A	8
Wollongong	✓ EGP ✓ Alinta	✓	✗	●	✓	100%	N/A
Marulan	✓ MSP	✓	✓	✗	✓	104%	N/A
Lithgow	✗ Alinta	✓	✓	●	✓	N/A	N/A

This assessment highlights that for the majority of sites, capital costs are similar. In part, this arises from factors such as lower output being balanced by reduced gas transmission distances at some locations or higher land costs balanced by lower transmission connection costs. The main conclusion reached was that the assessment of ongoing costs and availability of infrastructure was important in assessing the viability of a site. Ongoing costs mainly relate to fuel costs and the ability to generate and benefit from competitive pressure on gas supply.

For the five top ranking sites, a qualitative assessment of environmental factors was conducted to ensure that all issues which may constrain the development were identified (**Table 3-15**).

Table 3-15 Alternate Site Preliminary Environmental Assessment

Site	Air Quality	Noise	Visual	Water Quality	Traffic	Flora and Fauna	Geotech
Dalton	✓	✓	✓	✓	✓	✓	●
Nowra	✓	✓	✓	✓	●	●	✓
Moss Vale	✓	●	✓	✓	✓	✓	✓
Wagga Wagga	✓	✓	✓	✓	✓	✓	✓
Central Coast	✓	✓	✓	✓	✓	✓	✓

Due to the large cost between the second and third ranked sites and constraints in infrastructure access for the fourth ranked site, Dalton and Nowra emerged as the two preferred sites in the AGL analysis.

3.4.15 Preferred Site Location

The key features of these two preferred sites are outlined in **Table 3-16**.

Table 3-16 Summary of Features of Preferred Sites

Infrastructure	Proposed Site	
	Dalton	Nowra - Tomerong
Electricity	On site connection to 330 kV to Bannaby. Direct connection to load centre. Future additional load connection up to 500kV.	Off site connection required to 330 kV to Kangaroo Valley.
Gas	Moomba Sydney pipeline connection within close proximity to site. Reliable, secure connection to a gas supply.	Off site connection to EGP pipeline connection only. Ahead of other loads such as Tallawarra.
Water	Variety of water options available upon preliminary analysis including connection to reticulated scheme, groundwater and rainfall storage.	20 km connection to recycled water supply.
Land	Large rural site. 1km to nearest house, 3km km to Dalton. Approx 1km to public road with topography and vegetation for screening. Expensive land. Some vegetation clearing required.	Adequate site, no urban areas nearby. Dirt road access, extensive vegetation clearing required for power station and easements. Relatively cheap land.

The area around the Nowra - Tomerong locale is primarily state forest or national park. As the potential Tomerong development corridor is up to 10 km, a site with broad acceptance may be achievable. However, land availability is restricted to Crown Land, requiring cooperation from the State Government. Native title claims exist in the area and may materially impact upon the acquisition of Crown Land.

Based on the factors listed in the above table, the Dalton area was ranked as the superior location for a gas-fired power station. Dalton is unique in that there is a corridor along which it is possible to locate a gas-fired power station where the necessary electricity network and a gas transmission pipeline within close proximity to the site. Additionally, the Dalton site is well screened in terms of exposure to possible noise and visual receptors, and the site is relatively flat with little native vegetation needing to be removed to construct and operate the facility.

All other locations investigated required either transmission or pipeline easements or were located such that impacts on the surrounding community would be unacceptable. As such, Dalton remains the preferred site.

The Dalton Site

Before settling on Dalton as the optimal site, AGL conducted a site study to verify that environmental impacts associated with the Dalton Power Project would be acceptable.

The study was conducted prior to securing the site and included:

- a flora and fauna preliminary assessment;
- planning review;
- water supply analysis; and
- geotechnical analysis.

These preliminary studies along with a review of surrounding land uses confirmed that the Dalton Site is the most appropriate location for a new AGL gas fired peaking power station. Detailed investigations into the potential environmental impact have been conducted as part of this Environmental Assessment.

3.5 Plant Footprint Considerations

As the Facility footprint would require a small portion (less than 5 %) of the site, positioning the power station within the wider site was addressed in detail. A Siting Study (Aurecon, 2009) was carried out in June 2009. A summary is presented below.

The Site Study considered seven development footprint locations with an approximate area of 450 x 350 m within the wider Site. The seven potential footprint locations are shown in **Figure 3-13**. The seven potential locations were assessed in terms of:

- land topography and aspect;
- ongoing land use and geotechnical suitability;
- accessibility for construction and operation;
- proximity to nearby structures and services;
- noise transmission;
- visual impacts;
- potential water supplies;
- water management;
- vegetation coverage; and
- waste management and handling.

As the Site is large in area, it has the potential for a number of potential sites for the proposed Facility. However it also has locations on the property where a power station would not be located as they are unsuitable for obvious reasons, such as the ground being too steep, when there are more suitable and gently sloping locations. The assessment then focussed on determining:

- if the potential site was practical and cost effective for the construction and operation of a power plant; and
- if the potential site minimises the likelihood of objections to the Project that may result in major - delays or not obtaining approval at all.

A summary of the key features of the site comparison for the seven alternative footprint locations is presented in **Table 3-17**.

Table 3-17 Site Assessment for Facility location within the Site

Criteria	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7
Disadvantages of the Site in comparison with alternatives	Access challenges. Close proximity to river. Visibility from surro**unding hills.	Proximity to boundary of wider Site.	Proximity to boundary. Potentially high visibility.	Proximity to boundary and Walshs Road. Proximity to neighbouring properties.	NIL	Proximity to River. Visibility from surrounding hills.	This location has the highest percentage of vegetation on the Site.
Main advantages of the Site	No advantages over other sites.	Close to level site, well screened except for adjacent property towards the South. Requires shortest gas pipeline. Access is good.	Reasonably level with easy access.	Easy access.	Easy access, well screened and reasonably level.	Reasonably level with low proportion of tree cover.	Likely to be well screened.

The assessment did not determine a distinguishable advantage of any site over the alternatives for water and geology, the existing on-site and neighbouring land use, or potential air emissions implications for neighbours in the region. The assessment results were determined to a large extent by the existence of sensitive receptors (residences) in proximity to each site, the distances from closest structures, and the comparative number of potentially affected neighbours within a 1, 2 and 3 km radius of the proposed footprint location.

The preferred Dalton site (Site 5) was found to have ideal topography and aspect. The site is well screened from potential visual and aural receptors and no disadvantages were identified with the site in comparison to the alternative footprint locations assessed.

Impacts on biodiversity have been avoided where possible, through the following means.

- Locating the proposed development footprint to feature in areas where native vegetation is of poor condition.
- The development footprint has been located in previously and currently grazed areas that have lower ecological value.
- The boundary of the south-western portion of the footprint (adjacent to existing transmission lines) has been defined to avoid identified areas of Native Temperate Grassland EEC.

3.6 Access Road and Gas Pipeline Easement

The route for the access road and gas pipeline were developed iteratively through the process of the Environmental Assessment.

The considerations for routing the gas pipeline include:

- direct route between Facility and Moomba to Sydney Gas Pipeline to minimise cost and land disturbance and the number of bends required;
- engineering design feasibility considerations; and
- shortest length to minimise cost and land disturbance;
- land availability; and
- minimising vegetation clearance.

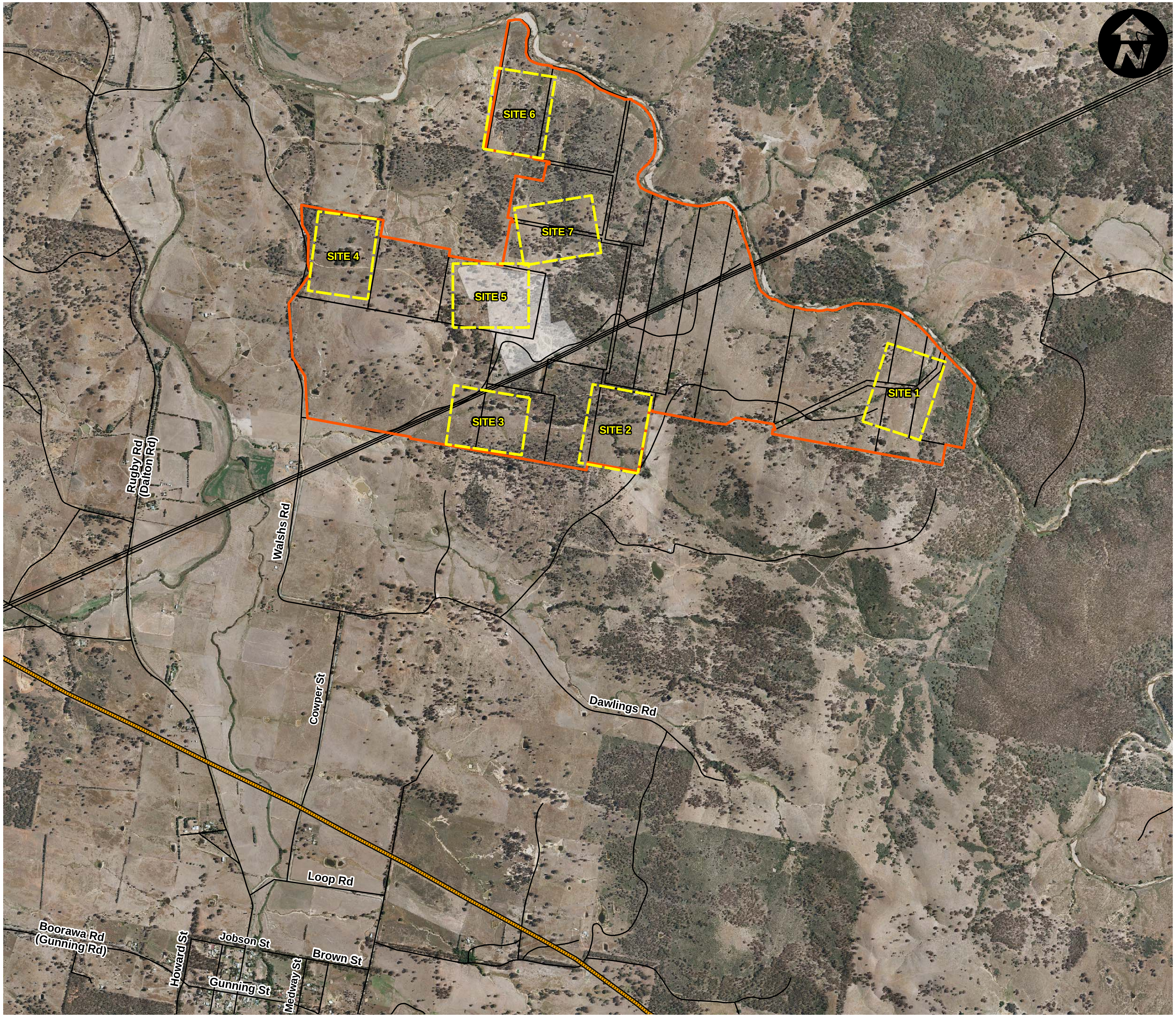
The considerations for routing the access road include:

- engineering design feasibility considerations; and
- minimising vegetation clearance.

The following options for the access road and gas pipeline were considered:

- Access Road Option 1;
- Gas Pipeline (northern portion) and Access Road Option 1;
- Gas Pipeline (northern portion) and Access Road Option 2;
- Gas Pipeline (southern portion) Option 1;
- Gas Pipeline (southern portion) Option 2; and
- Gas Pipeline (southern portion) Option 3.

Refer to **Figure 3-14** for the infrastructure options.



Source: AGL

Drawn: AO/SB	Approved: LO	Date: 15/06/2010
Job No.: 43177661	File No.: 43177661.022.mxd	

Client

AGL

Project

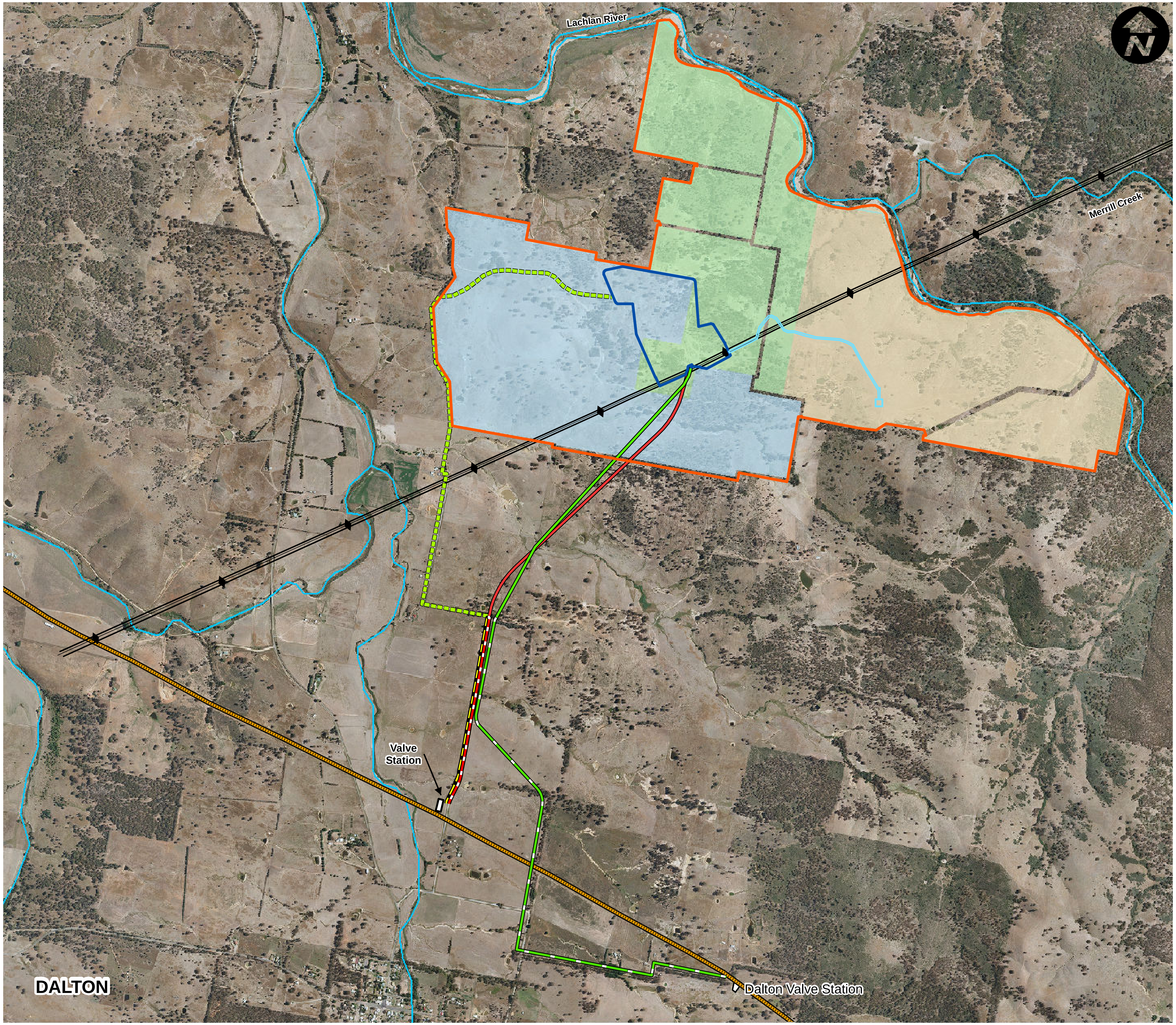
DALTON POWER PROJECT

Title

ALTERNATIVE FACILITY LOCATIONS WITHIN DALTON SITE

Figure: 3-13

URS



Legend

- AGL Site Boundary
- Plant Footprint
- Communications Tower and Hut Footprint
- Communications Tower Services and Access Track
- Moomba-Sydney Pipeline
- Transmission Line
- Riverview
- Holmes
- The Elms

Infrastructures Options:

- Option 1 - Access Road
- Option 1 - Gas Pipeline
- Option 2 - Gas Pipeline
- Option 3 - Gas Pipeline
- Option 1 - Gas Pipeline and Access Road
- Option 2 - Gas Pipeline and Access Road

0 1
Kilometres

Source: Aerial Image from AGL

Drawn: AO/SB	Approved: NB	Date: 24/02/2011
Job No.: 43177661	File No.: 43177661.062.mxd	

Client

AGL

Project

DALTON POWER PROJECT

Title

INFRASTRUCTURE OPTIONS

Figure: 3-14

URS

3.6.1 Access Road Option 1

The initial access option investigated for the Project utilised the existing private road within the Site off Walshs Road to the west of the proposed Facility (refer **Figure 3-14**). Construction and operation traffic generated by the Project would access the Site by travelling north along Starrs Rd, turning west, then north into Walshs Road, then following this road as it turns and heads north. The existing private road within the Site approaches the Facility from the west. This option would require widening of Walshs Road at the northern end nearing the intersection with the private road into the Site.

Engineering investigation identified design difficulties with Option 1, particularly for the portion within the Site.

Vegetation mapping and surveys for this option identified the presence of two endangered ecological communities along this route:

- EPBC listed Natural Temperate Grassland; and
- TSC listed Box Gum Woodland.

Table 3-18 shows the areas of impact for Option 1 (Refer to **Figure 3-15**).

Table 3-18 Access Road Option 1 – Vegetation Areas

Endangered Ecological Community	Access Road Option 1
EPBC listed Natural Temperate Grassland	1 ha
TSC listed Box Gum Woodland	0.8 ha

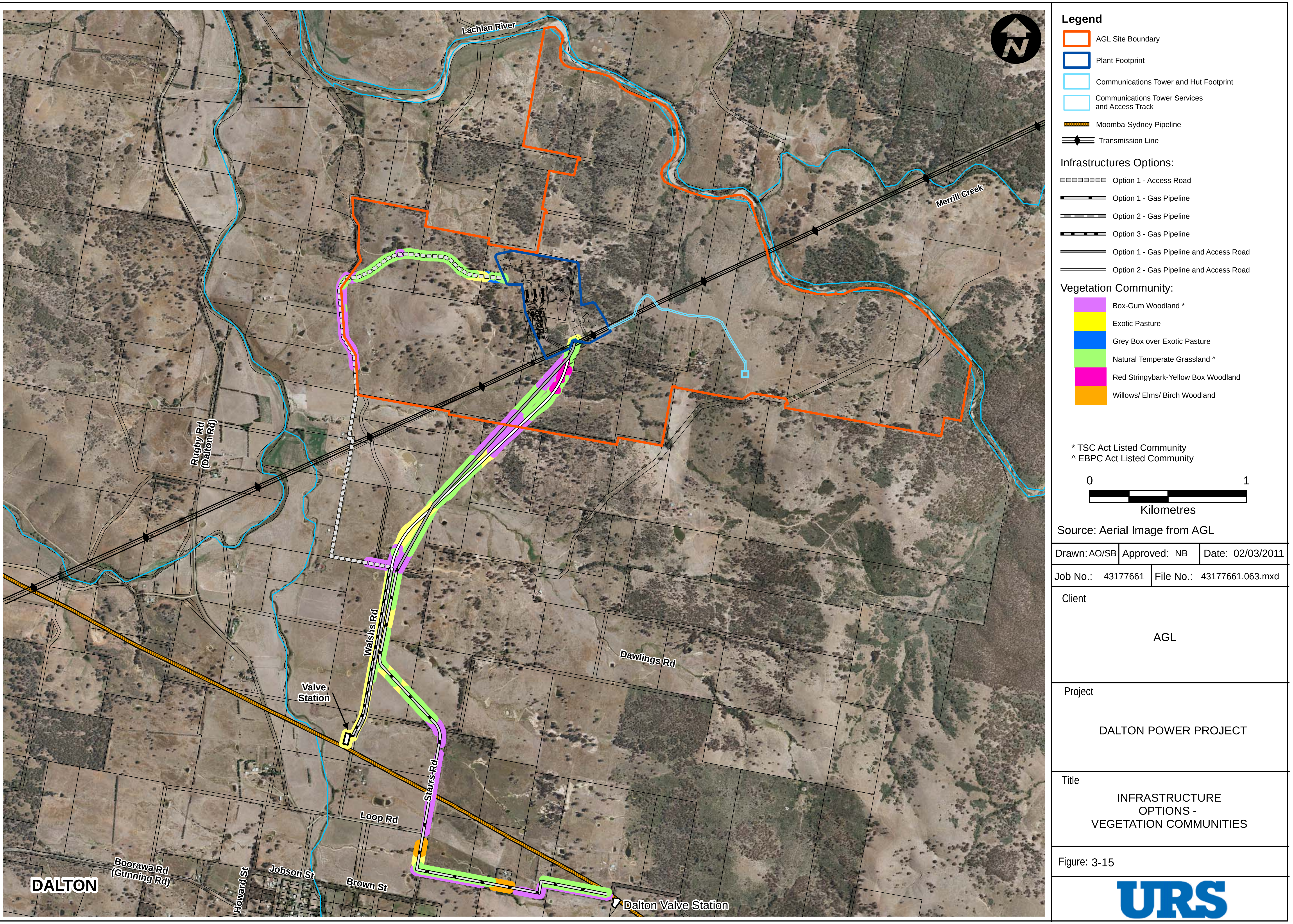
Note: Areas rounded to one significant figure

Therefore, based on design considerations and reducing the amount of clearing required, AGL considered alternative Site access options to reduce the area of permanent vegetation clearing required for the necessary road upgrade works.

It is noted that Access Road Option 1 would still require an additional area of impact to be considered for a gas pipeline in order to address the infrastructure requirements.

As the Gas Pipeline (northern section) would require an easement from the Moomba to Sydney Gas Pipeline to the Facility, AGL investigated an alternative option for the access road to be collocated with the gas pipeline. This would be achieved by widening the required easement from the intersection of Walshs Road (where this road turns west at a right-angle) to the Facility to facilitate both the pipeline and access road infrastructure.

It was considered that collocating the access road and Gas Pipeline (northern section) provided benefits in reducing the areas of clearing required and addressing the engineering constraints identified with Access Road Option 1.



Source: Aerial Image from AGL

Drawn: AO/SB	Approved: NB	Date: 02/03/2011
Job No.: 43177661	File No.: 43177661.063.mxd	

Client

AGL

Project

DALTON POWER PROJECT

Title

INFRASTRUCTURE OPTIONS - VEGETATION COMMUNITIES

Figure: 3-15

URS

3.6.2 Gas Pipeline (northern portion) and Access Road Option 1

The Gas Pipeline (northern portion) alignment was developed with consideration to the most direct gas pipeline route to minimise the number of bends and land availability. Option 1 extends from the Facility footprint to the intersection where Walshs Road takes a 90^{o} turn west. Additionally, this option considered the width required in order to co-locate the access road. The length of this option is 1.9 km and considered a 30 m wide easement.

Vegetation mapping and surveys for this option identified the presence of two endangered ecological communities along this route:

- EPBC listed Natural Temperate Grassland;
- EPBC listed Red Stringybark Woodland; and
- TSC listed Box Gum Woodland.

Table 3-19 shows the areas of impact for Option 1 (Refer to **Figure 3-15**).

Table 3-19 Gas Pipeline (northern portion) and Access Road Option 1 – Vegetation Areas

Endangered Ecological Community	Gas Pipeline (northern portion) and Access Road Option 1
EPBC listed Natural Temperate Grassland	3.2 ha
EPBC listed Red Stringybark Woodland	0.03 ha
TSC listed Box Gum Woodland	2.2 ha

Note: Areas rounded to one decimal place

As this option was developed initially only for the gas pipeline (northern portion), consideration of collocation with the access road identified engineering design constraints. Additionally, AGL considered that based on the areas of clearing, more refinement was required of the likely footprint rather than an assumed footprint.

Based on these considerations, AGL investigated an alternative option.

3.6.3 Gas Pipeline (northern portion) and Access Road Option 2

Gas Pipeline (northern portion) and Access Road Option 2 was considered in preliminary engineering design to refine Gas Pipeline (northern portion) and Access Road Option 1. Option 2 similarly extends from the Facility footprint to the intersection where Walshs Road takes a 90^{o} turn west with a modified alignment. The length of this option is 1.9 km. This option considered the likely footprint as an easement ranging between 10 and 45 m to account for areas of cut and fill. This differs from Option 1 which considered an overall 30 m width.

Vegetation mapping and surveys for this option identified the presence of two endangered ecological communities along this route:

- EPBC listed Natural Temperate Grassland;
- EPBC listed Red Stringybark Woodland; and
- TSC listed Box Gum Woodland.

Table 3-20 shows the areas of impact for Option 2 (Refer to **Figure 3-15**).

Table 3-20 Gas Pipeline (northern portion) and Access Road Option 2 - Vegetation Areas

Endangered Ecological Community	Gas Pipeline (northern portion) and Access Road Option 2
EPBC listed Natural Temperate Grassland	1.8 ha
EPBC listed Red Stringybark Woodland	0.02 ha
TSC listed Box Gum Woodland	1.2 ha

Note: Areas rounded to one decimal place

Option 2 was considered advantageous in light of the engineering design constraints identified for Option 1 as well as the reducing the areas of clearing of significant vegetation.

3.6.4 Gas Pipeline (southern portion) Option 1

AGL's initial preference was to utilise the existing valve station at Dalton as the off-take point from the Moomba to Sydney Gas Pipeline. The initial gas pipeline option investigated for the Project involved utilising the existing Dalton Valve Station located off Bush Lane. As shown in **Figure 3-14**, Option 1 followed the Bush Lane road reserve west to Starrs Road, where it continued along the eastern side of Walshs Road to the intersection where Walshs Road takes a 90^{o} turn west where it then meets the Gas Pipeline (northern portion). The total length of the pipeline for Option 1 is approximately 3.4 km and considered an easement width of 30 m.

Vegetation mapping and surveys for this option identified the presence of two endangered ecological communities along this route:

- EPBC listed Natural Temperate Grassland; and
- TSC listed Box Gum Woodland.

Table 3-21 shows the areas of impact for Option 1 (Refer to **Figure 3-15**).

Table 3-21 Gas Pipeline (southern portion) Option 1 - Vegetation Areas

Endangered Ecological Community	Gas Pipeline (southern portion)- Option 1
EPBC listed Natural Temperate Grassland	3.1 ha
TSC listed Box Gum Woodland	1.7 ha
Exotic Pasture	0.9 ha

Note: Areas rounded to one decimal place

Due to large areas of significant vegetation required for this option particularly the EPBC listed Natural Temperate Grasslands, AGL considered alternative routes and investigated options requiring a new off-take and valve station on the Moomba to Sydney pipeline.

3.6.5 Gas Pipeline (southern portion) Option 2

In order to avoid the endangered ecological communities as much as possible, AGL investigated the possibility of creating a new off-take and valve station on the Moomba to Sydney Gas Pipeline. AGL confirmed the technical and commercial feasibility of providing a new connection point. This led to AGL considering constructing a new purpose built valve station further west along the Moomba to Sydney Gas Pipeline. Although there would be additional cost involved with a new valve station, Option 2 has the advantage of avoiding endangered ecological communities as much as possible and reducing the pipeline length to further reduce areas of clearing.

Option 2 extends from a new off-take and valve station from the Moomba to Sydney Gas Pipeline. The valve station is located adjacent to Walshs Road. Option 2 is located in the eastern roadside easement of Walshes Road to the intersection where Walshs Road takes a 90^{o} turn west to meet the Gas Pipeline (northern portion). Option 2 is 1.1 km and considers an easement of 5 m.

Vegetation mapping and surveys for this option route identified the presence of one endangered ecological communities along this route:

- EPBC listed Natural Temperate Grassland.

However, the area of clearing of Natural Temperate Grassland was less than for Option 1. This option also eliminated the need for clearing TSC listed Box Gum Woodland.

Table 3-22 shows the areas of impact for Option 2 (Refer to **Figure 3-15**).

Table 3-22 Gas Pipeline (southern portion) Option 2 - Vegetation Areas

Endangered Ecological Community	Gas Pipeline (southern portion)- Option 2
EPBC listed Natural Temperate Grassland	0.1 ha
TSC listed Box Gum Woodland	0.0 ha
Exotic Pasture	0.4 ha

Note: Areas rounded to one decimal place

Although this option required a reduced area of clearing of Natural Temperate Grassland, alternative options were considered to reduce this further.

3.6.6 Gas Pipeline (southern portion) Option 3

Gas Pipeline (southern portion) Option 3 utilised the new valve station considered in Option 2. In order to avoid vegetation in the eastern roadside easement of Walshs Road, Option 3 is located in the western side roadside easement of Walshs Road. Option 3 is 1.1 km and considers an easement width of 5 m.

This option eliminated the need for clearing EPBC Natural Temperate Grassland.

Table 3-23 shows the areas of impact for Option 3 (Refer to **Figure 3-15**).

Table 3-23 Gas Pipeline (southern portion) Option 3 - Vegetation Areas

Endangered Ecological Community	Gas Pipeline (southern portion)- Option 3
EPBC listed Natural Temperate Grassland	0 ha
TSC listed Box Gum Woodland	0 ha
Exotic Pasture	0.8 ha

Note: Areas rounded to one decimal place

Option 3 was considered optimal for the Gas Pipeline (southern portion) as it contained the largest areas of exotic pasture and eliminated the need for clearing Natural Temperate Grassland.

3.6.7 Conclusion

The access road and gas pipeline route were developed iteratively over through the process of the Environmental Assessment.

Table 3-23 provides a summary of the areas of vegetation for each option considered. The preferred option is shown shaded.

Table 3-24 Summary of infrastructure options

Option	Area (ha)					
	Natural Temperate Grassland	Red S'Yellow Box Woodland	Box Gum Woodland	Exotic Pasture	Grey Box over Exotic Pasture	Willow / Elms/ Birch Woodland
Listing	**EPBC**	**EPBC**	**TSC**	**-**	**-**	**-**
Access Road Option 1	1	0.8		0.1	0.2	
Northern portion						
Gas Pipeline (northern portion) and Access Road - Option 1	3.2	2.2	0.03	0.2		
Gas Pipeline (northern portion) and Access Road - Option 2	1.8	1.2	0.02	1.2		
Southern Portion						
Gas Pipeline (southern portion) Option 1	3.1	1.7		0.9		0.5
Gas Pipeline (southern portion) Option 2	0.1	0		0.4		
Gas Pipeline (southern portion) Option 3				0.8		

Note: Areas rounded to one decimal place

Table 3-24 shows that as the options were refined, the area of EPBC listed Natural Temperate Grassland and TSC listed Box Gum Woodland reduced in the following areas of note:

- For the Gas Pipeline (northern portion) and Access Road, the area of EPBC listed Natural Temperate Grassland was reduced significantly and TSC listed Box Gum Woodland was reduced to a lesser extent.
- For the Gas Pipeline (southern portion), the area of EPBC listed Natural Temperate Grassland was reduced to zero.

Impacts on biodiversity have been avoided where possible, through the following means.

- Positioning of the valve station and gas pipeline to avoid EECs where possible.
- Positioning of the gas pipeline and access road to reduce overall impact in terms of vegetation clearance.

Gas Pipeline (northern portion) and Access Road Option 2 and Gas Pipeline (southern portion) Option 3 were chosen as the preferred alignments as it had the following benefits:

- reducing the areas of clearing of
  - EPBC listed Natural Temperate Grassland; and
  - TSC listed Box Gum Woodland.
- advantages of collocating the road and the gas pipeline together; and
- addressing engineering design constraints.

Gas Pipeline (northern portion) and Access Road Option 2 and Gas Pipeline (southern portion) Option 3 is the alignment assessed in **Chapters 7-18** of this Environmental Assessment. It is noted that beyond this chapter these options are referred to as Gas Pipeline (northern portion) and Access Road and Gas Pipeline (southern portion).

3.7 Communications Tower and Infrastructure

3.7.1 Communications Tower

The proposed Communications Tower is required to be located in an area of elevated topography with respect to topography immediately surrounding the Site (ie. It needs to be on a hill).

Based on this consideration, two areas alternative sites were identified as suitable as possible locations for the tower (refer to **Figure 3-16**):

- A site east of the Facility footprint (Location 1); and
- A site west of the Facility footprint (Location 2).

The site west of the Facility footprint contains significant areas of endangered ecological communities (Box Gum Woodland and Natural Temperate Grassland). Additionally, this area is proposed to be used by AGL as a Biodiversity Offset Area for this Project.

In light of these considerations, the Communications Tower was located to the east of the Facility footprint (Location 1 on **Figure 3-16**). This is the location that has been used throughout this Environmental Assessment.

3.7.2 Infrastructure associated with the Communications Tower

The communications tower requires a number of associated infrastructure elements including underground services and an all weather access track. This infrastructure requires a 4-6 m wide route from the Power Plant site to the Communications Tower. This would be located wholly within a 10 m wide corridor considered as part of this environmental assessment. The considerations for locating the infrastructure included:

- utilising existing tracks where possible to reduce works required;
- preliminary engineering consideration including topography;
- avoidance of significant areas of vegetation.

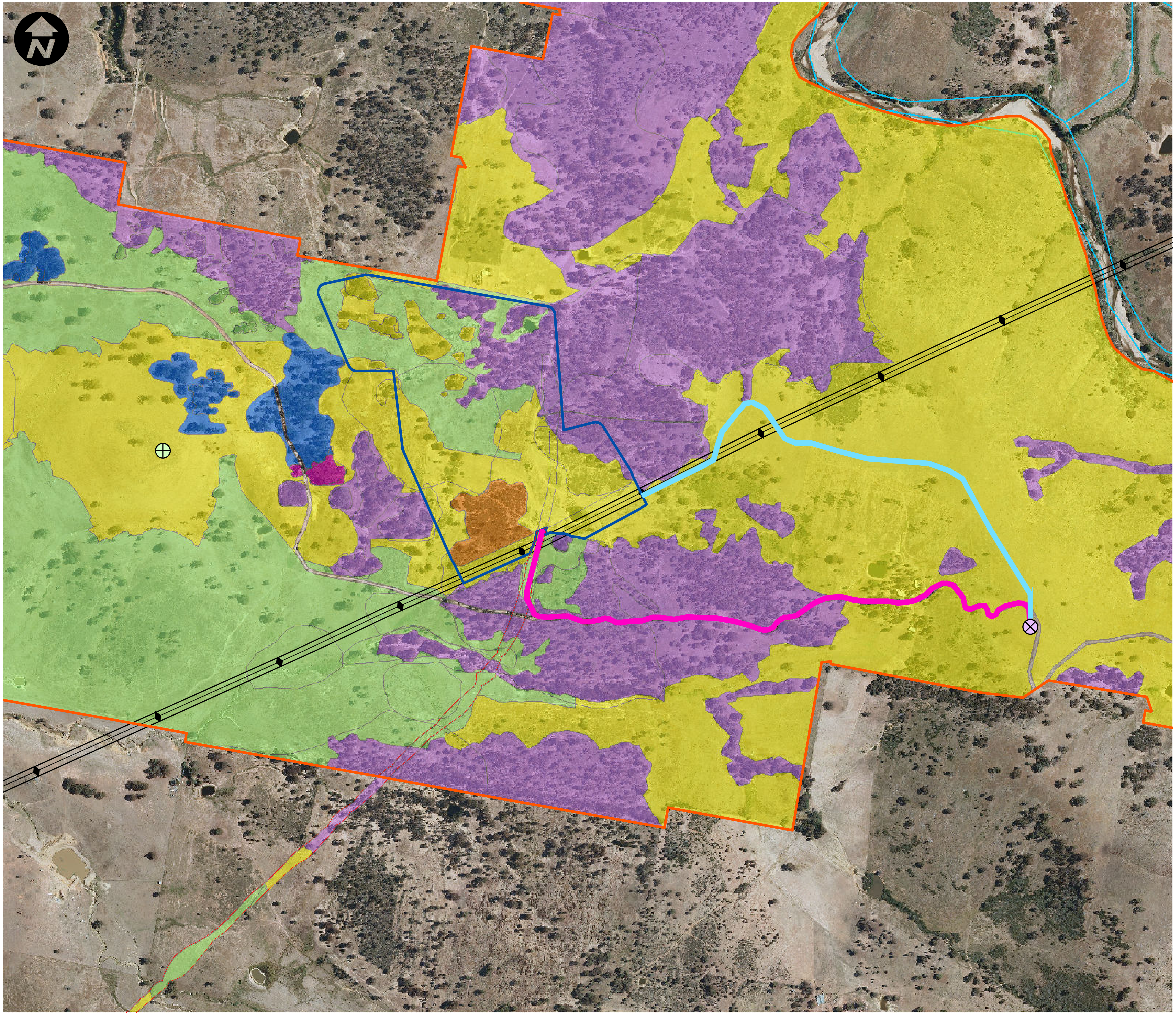
Based on these considerations, two potential routes were identified (refer to **Figure 3-16**):

- northern route; and
- southern route.

The southern route is located along an existing track and has the advantage of requiring less earthworks for road grading for the access road although requiring some vegetation clearing to widen the existing track. However, as shown on **Figure 3-16,** the route passes through areas of endangered ecological communities (Box Gum Woodland and Natural Temperate Grassland).

As the works for the southern route would require vegetation clearing, the northern route was the preferred location to avoid clearing these endangered ecological communities. Although the northern route requires additional road grading as it is not a currently formed track, the northern route is located wholly within exotic pasture as shown on **Figure 3-16**.

In light of these considerations, the infrastructure (access track and underground services) for the Communications Tower would be located in the northern route (refer to **Figure 3-16**). This is the location that has been considered throughout this Environmental Assessment.



Legend

- AGL Site Boundary
- Plant Footprint
- Gas Pipeline (northern) and Access Road
- Gas Pipeline (southern)
- Moomba-Sydney Pipeline
- Transmission Line
- Communications Tower Location Option 1
- Communications Tower Location Option 2

Communications Tower Services and Access track Options:

- Northern Route
- Southern Route

Vegetation Communities (URS):

- Natural Temperate Grassland^
- Box Gum Woodland*
- Grey Box over Exotic Pasture
- Red Stringybark over Exotic Pasture
- Disturbed Shrubland
- Exotic Pasture

* TSC Act Listed Community
^ EBPC Act Listed Community

0 100 200 400
Metres

Source: Aerial Image from AGL

Drawn: SB	Approved: RCS	Date: 27/06/2011
Job No.: 43177661	File No.: 43177661.076.mxd	

Client

AGL

Project

DALTON POWER PROJECT

Title

COMMUNICATION TOWER ALTERNATIVES

Figure: 3-16

URS

3.8 Plant Technology Options

3.8.1 Emission Reduction and Control Options

Opportunities for NO_X Reduction and Offsetting

Photochemical smog is associated with elevated concentrations of nitrogen oxides (NO_x) and ozone. Whilst reduction in NO_x emissions from the proposed development can be directly related to reduction in ground level concentrations of NO_x, the same relationship cannot be expanded to ozone. This is because ozone is formed through reactions associated with NO_x and volatile organic compounds (VOCs) under the influence of ultraviolet light. The formation of ozone can potentially be mitigated through the reduction of NO_x and / or VOC emissions in the local airshed, but the priority pollutant in terms of mitigation strategy is dependent on whether the oxidative capacity of the specific airshed is NO_x or VOC limited.

Avenues for viable mitigation and offsetting of these compounds have been investigated. Research has presented the following possible scenarios for the proposed development broadly relating to the following two categories:

- NO_x emission source control options; and
- other NO_x control options.

Options researched within each of these areas are discussed below.

NO_x Emission Source Control Options

Emissions from gas turbines are discussed in detail in **Chapter 7** *Air Quality*. The discussion of emission control options in this section has focussed on NO_x control technologies. Uncontrolled NO_x emissions from gas turbine technology are typically around 200 ppm. Various emission control technologies to reduce NO_x emissions below this level are discussed below.

- **Water / steam Injection**

One of the earlier forms of NO_x control is the injection of water or steam into the flame area of the combustor to lower the flame temperature and reduce thermal NO_x formation. Emissions of NO_x for this technology are approximately 42 ppm. The application of this technology for this project is limited by limited NO_x reduction compared to other technology available, the cost of purification of water; and the requirement to conserve water where possible.

- **Dry Low NO_x (DLN) Combustors**

DLN combustor technology premixes air and a lean fuel mixture that significantly reduces peak flame temperature and thermal NO_x formation. Conventional combustors are diffusion controlled where fuel and air are injected separately. When DLN technology is implemented NO_x emissions range from 9 to 25 ppm depending on plant and operating conditions. All gas turbine manufacturers guarantee emissions of 25 ppm when operating conditions are reached at over 50 % load. DLN technology is widely used for the gas turbine technology being considered for the Dalton Power Project and is constantly being developed.

- **Catalytic Combustion**

Development of catalytic combustion is not yet commercialised in the marketplace for the gas turbines with generation capacity greater than 15 MW. Catalytic technology features “flameless” combustion that occurs in a series of catalytic reactions to limit the temperature in the combustor. Catalytic combustion reduces NO_x emissions to 3 ppm. This technology is not suitable for Dalton Power Project as each of the turbines would require a capacity between 125 and 300 MW.

- **Selective Catalytic Reduction**

Post-combustion NO_x control can be achieved using selective catalytic reduction (SCR) to achieve NO_x emissions of as low as 3 ppm in some situations.

Ammonia is injected into the flue gas and reacts with NO_x in the presence of a catalyst to produce nitrogen and water. However, this process also produces exhaust emissions of ammonia (known as ammonia slip), and has potential for accidental release of stored ammonia and issues with disposal of spent catalyst. This creates another potential environmental impact in the form of particulate emissions along with transport and storage of ammonia at a site adjacent to the Lachlan River.

When operated in simple cycle mode the use of high temperature SCR or dilution to air to reduce exhaust temperature is required. SCR is generally not applied to the large frame turbines in open cycle mode due to the high temperature mode of operation. It is technically feasible to use high temperature SCR technology but to date this has only been successfully implemented on turbines less than 50 MW in generation capacity. This is achieved by mixing the high temperature exhaust with fan forced cool air and often water to reduce the temperature at the SCR to within the operating limit of the catalyst used. AGL has contacted gas turbine suppliers and associations and has identified that there was a single large frame open cycle gas turbine (Alstom 13E2) test plant in Japan installed in 1994. This plant had a horizontal exhaust stack and a very large ducting system was constructed to allow large volumes of cool air and spray water to be injected to reduce the exhaust temperature to levels that could be managed by the SCR system. It is believed no further attempts to install SCR systems on large frame turbine units in open cycle applications have been made since then.

AGL received a budget quotation for the supply only of SCR technology for a 600 MW, four unit plant for $25 million local supply to Texas in the United States, but was unable to receive any quotations for a complete installed system with a performance guarantee of NO_x reduction to 5 ppm (or any other performance guarantee). Very conservatively assuming the total cost of a complete installed system to be $25 million with $0 per annum operating cost, amortised over the life of the plant, and allowing for 0.5 % operating losses, the annualised cost of SCR technology to achieve further NO_x reduction is over $7,000 per tonne of NO_x removed. This is based on 15 % operation every year, which is unlikely.

If the peaking plant operated on average for only 5 % of the time the cost rises dramatically to $20,000 per tonne of NO_x removed. Anecdotal advice from those with SCR experience indicates the cost is more likely to be closer to $50,000 per tonne of NO_x removed, if a SCR system could be proven functional on large OCGT frame turbines.

In considering this technology AGL has referred to the NSW Government's Action for Air Plan (1998) that states a *"commitment to achieve NO_x reductions with the least cost to industry and maximum flexibility"* while recognising the *"complexity of the air chemistry involved in the production of ozone and nitrogen dioxide, which makes it extremely difficult to specify appropriate levels of NO_x for any airshed"*.

The NSW Government, through OEH, charges a load based licensing fee for emissions such as NO_x that is intended to reflect the cost to the environment of pollutant emissions. The OEH booklet on load based licensing states *"Operators are now free to decide how to manage their own pollution control affairs. Government is imposing environmental performance standards (and a fee structure) but not defining the specific pollution control mechanism."* (NSW EPA 2001). For NO_x emissions, AGL determined the load based licensing fee that would apply to this development is $220 per tonne (higher in summer months).

Furthermore, AGL sought advice from OCGT suppliers and determined that SCR was not installed on any of the turbines of the same type proposed for Dalton in open cycle peaking applications operating internationally or nationally.

- **Other NO_x Control Options**

The following NO_x control options (other than source control) were researched for their potential applicability to the Project:

NO_x Cap and Trade Scheme.

Offsetting VOC emissions through vapour recovery units.

Third party Selective Catalytic Reduction (SCR).

Retrofitting or replacing vehicles.

a) NO_x Cap and Trade Scheme

Currently, offsetting of NO_x emissions is undertaken overseas through cap and trade schemes, emission credit schemes and other similar programs. Participation in a NO_x cap and trade scheme, or similar, would be appropriate in reducing NO_x and ozone levels within the regional air shed. However AGL considers that such a program would need to exist at a state or regional level, be regulatory policy, and also be government driven.

NO_x cap and trade type schemes may be a more feasible option. Currently NO_x trading schemes exist throughout the world. Research was undertaken on these schemes in the United States of America and Europe.

The United States has established “The NO_x Budget Trading Program” which focuses on addressing the NO_x emissions in the north-eastern and mid-western states. These emissions are transported across state lines and contribute to ozone pollution problems in neighbouring states. The USEPA has allocated a “NO_x Budget” to states under a rule called the NO_x State Implementation Plan (SIP). Each state was required to achieve this cap by 2007. The plan allowed the states to meet the goal through interstate trading programs or management of their own state-wide sources. Through the program, “*…states have achieved significant reductions in ozone season NO_x emissions since the baseline years 1990 and 2000. All states have achieved reductions since 1990 as a result of programs implemented under the Clean Air Act Amendments, with many states reducing their emissions by more that half since 1990*”[1]. Similar cap and trade, or NO_x tax systems are also being implemented on a state basis.

The South Coast Air Quality Management District (SCAQMD) in Southern California participates in an emission credit scheme. Proponents can purchase Emission Reduction Credits (ERCs) to offset emissions of either NO_x or VOCs. Proponents that reduce their emissions can sell their credits back, thus giving an incentive to actively reduce emissions. Grants are also available in areas such as California to help proponents deal with the cost of emission reduction. The Carl Moyer Programprovides grants to proponents to retrofit, or replace diesel engines with cleaner ones. In its first seven years, the program provided $170 million to fund the clean-up of about 7,500 engines, *“resulting in about 24 tons per day of NO_X emissions reduction throughout California[2]”*.

Europe has offsetting schemes that include NO_x funds to combat the heavy cost of NO_x offsetting (i.e. Gothenburg Protocol (1999)). Europe also has a focus on vehicle emissions and the use of Selective Catalytic Combustion for vehicles.

In its position in implementing an offset program, AGL considers it more appropriate that a state or regional system be implemented, rather than tackling individual proponents and proposals. Such a scheme could give NSW (or an airshed within) an allowable NO_x emission limit, and decide what constraints would be imposed on individual businesses. AGL would be supportive towards participation in such a system provided there was government leadership and contribution, so as to ensure that the most practicable and reasonable solution is achieved.

In a manner similar to the proposed emissions trading scheme for greenhouse gases[3], a NO_x cap and trade or similar program would provide a potentially effective means of reducing / offsetting NO_x emissions, i.e. it is considered ineffective to address regional issues on a proposal by proposal basis.

By providing a new scheme incorporated at a state or regional level, a mechanism (which provides an economic signal for emission reduction) could be implemented. AGL considers that such a scheme would require being policy and government driven in order to ensure an effective program is implemented.

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[1] US EPA, NO_x Budget Trading Program: 2005 Program Compliance and Environmental Results
[2] Carl Moyer Program Guidelines, Air Resources Board California Environmental Protection Agency, 2008
[3] Australian Government, *Carbon Pollution Reduction Scheme Green Paper,* July 2008 http://www.climatechange.gov.au/greenpaper/summary/pubs/greenpaper-summary.pdf

b) Offsetting VOC Emissions through Vapour Recovery Units

Given that both NO_x and VOC emissions contribute to ozone levels within the local air shed, offsetting of VOC emissions could also be proposed. Offsetting VOC emissions could be achieved through the installation of Vapour Recovery Units (VRUs) at local fuel stations / depots. As outlined in the (then) DEC discussion paper: *Action for Air: Improving Air Quality through Vapour Recovery at Service Stations* (August, 2007), Sydney already has Stage 1 vapour recovery at most service stations, and the evaluation of Stage 2 vapour recovery technology has been considered since 2002. It is uncertain how much contribution AGL could have through this mechanism, given that the mechanism is already being conducted. Further, if this program is already anticipated to be completed and has already been included in an offsetting program, then if AGL were to contribute and allocate its contribution as an offset, it would be considered as double counting.

Alternatively VOC offsetting could be achieved through retrofitting existing large VOC storage tanks or fuel storage tanks with vapour recovery units. However given that there are no regulatory obligations for AGL to reduce other parties' emissions, such an option is voluntary. Implementing this option would be commercially difficult for AGL to administer and track effectiveness of implementation.

c) Third Party Selective Catalytic Reduction (SCR)

Given the limitations on the application of SCR at Dalton, offsetting third party NO_x emissions through the installation of a SCR unit at another suitable facility is another identified option. However, given that no viable AGL facilities are available within the local area, this measure would need to be implemented outside of AGL. This is considered outside of the typical scope for offsetting, and given external commercial interests, the offset provided has limitations in its accountability.

d) Retrofitting or Replacing Vehicles

NO_x and / or VOC offsetting could be conducted through participation in a scheme or program to retrofit or remove vehicle fleets with appropriate control technology or emission reduction technology (i.e. new engines, new emission standards or conversion from petroleum to natural gas or LPG). Offsetting through removing or retrofitting vehicles may appear to be a viable option, however given the differing nature of car exhaust fumes and gas turbine emissions, there is no guarantee or evidence that this will effectively offset or reduce NO_x levels.

The retrofitting of vehicle pollution controls to meet appropriate new emissions standards is not necessarily going to result in a net reduction or offset in local NO_x (or ozone) levels. The European Conference of Ministers of Transport (ECMT) published a document titled *Reducing NO_x Emission on the Road* (ECMT 2006), detailing NO_x emissions in relation to European standards. The European standards are currently adopted within Australia, and are anticipated to be updated consistently to keep in line with new European releases. ECMT (2006 p.3) states "*Air quality, however, has not improved as much as predicted with the tightening of emissions standards, especially in respect of nitrogen oxides (NO_x). One reason for this is the gap between the performance of emission control measures during type approval tests and their effectiveness under real operating conditions*". This offsetting scheme presents significant risk given that significant financial resources would be required.

Furthermore, as outlined by the European Federation for Transport and Environment (T&E Bulletin No. 146, European Federation for Transport and Environment, Brussels Belgium), although there has been a reduction in NO_x emissions under test cycle conditions, there has not been a significant reduction in NO_x emissions in “real world” conditions.

Additionally, there are potential differences in the dispersive nature of gas turbine emissions, as compared to vehicle emissions, which may have implications for the amount of emissions offset.

Replacing inefficient vehicles has also been considered. In September 1994, the Cogeneration Plant at Smithfield proposed by Smithfield Power Partnership, was the subject of a Commission of Inquiry where NO_x offsets were raised[4]. The report of the Commission of Inquiry stated that:

> *“The EPA also refer to potential offset schemes such as car pooling, public transport, alternative technologies, and economic incentives to reduce nitrogen dioxide emissions. I discuss these matters in this report concluding that the offset schemes will either have very limited effect, or increase hazard and risk above guideline levels, or they require further assessment as to their potential environmental, developmental and economic impacts. However, I recommend that the DoP consider requiring Pratt Industries to reduce its nitrogen oxide emissions by installing suitable burners in its Ruston gas turbine when such burners are available possibly in 1996. The nitrogen dioxides emissions from the integrated facility can be reduced by 10 % using this approach and it appears the most cost effective means to reduce nitrogen oxides.”*

> Further comment is made:

> *“The EPA also suggested the Company could reduce NO_x emissions at other industries or purchase old cars (cash for clunkers) to reduce vehicle pollution. These latter schemes are referred to as economic incentives by the EPA…*

> *I am not persuaded that the economic strategies put forward by the EPA are appropriate at this time. The evidence does not establish their environmental or cost effectiveness nor does it canvass potential social and commercial implications. I do not support a requirement that the Company be subject to such economic incentives in the absence of policy and comprehensive analyses and strategies for their implementation”.*[5]

3.8.2 Selected NO_x Control Mechanism

In some limited international jurisdictions requirements to consider what is Best Available Control Technology (BACT) for a particular installation have been required and regulators have published guidelines on how this requirement is to be considered.

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[4] Office of the Commissioners of Inquiry for Environment and Planning, Report to the Honourable Robert Webster Minster for Planning and Minister for Housing – Cogeneration Plant at Smithfield proposed by Smithfield Power Partnership, Kevin Cleland Commissioner Commissioners of Inquiry for Environment and Planning, September 1994, page iv.
[5] *Ibid,* page 22.

In NSW, regulations, guidelines or definitions, are not available for BACT. In those jurisdictions that do define BACT it is generally considered to be the best performing cost effective control technique that has been achieved in practice for the category or class of source.

While SCR technology may result in slightly lower NO_x emissions, the implementation of catalyst technology to reduce NO_x will correspond to a rise in airborne emissions of ammonia. This is considered to be a pollutant in its own right by forming additional particulate pollution. In essence, with SCR technology, one pollutant is reduced while another is increased.

It is not considered that SCR technology would be determined BACT at Dalton on the basis that:

- there are no additional exceedances of air quality criteria additional to that already experienced will occur as a result of this proposal;
- the high cost of implementation is disproportionate to the benefit;
- infrequent operation of a peaking power plant results in a low annual emission level of NO_x which is below that legislated in most parts of the world where such regulations exist;
- SCR technology has not practically been achieved on large simple cycle gas turbine units such as those proposed for Dalton;
- DLN has been accepted on smaller open cycle gas turbine units (with standard emission of 25 ppm @ 15 % O_2) in areas where BACT is legislated; and
- the potential for increased particulate emissions when using SCR technology.

This conclusion is supported by the understanding that no gas turbine development in Australia has been required to implement SCR technology, even those in metropolitan areas.

Dry Low NO_x (DLN) emission technology presents the most viable NO_x emission technology and is widely used on turbines of the size proposed for Dalton Power Project and is considered BACT for such turbines. All gas turbine manufacturers will guarantee emissions of 25 ppm at operating conditions over 50 % load, which also ensures that regulatory emissions limits are complied with. It is also of note that while not guaranteed, depending on plant and operation conditions, NO_x emissions down to 9 ppm may be achieved. DLN technology was proposed for the recently approved Leafs Gully Power Project.

Whilst DLN technology is considered the most appropriate technology for the Project, emissions of NO_x will still occur and consideration has been given to further reduce or offset these emissions. Other than source control, further reductions at the source would only be achievable if AGL was committed to develop further technological improvements beyond commercially available and proven technologies. Based on the options for NO_x reduction (other than source control) presented, it is considered that the most effective NO_x offset and reduction scheme, would be regulatory policy, namely a NO_x cap and trade scheme. Given the consideration of the Emission Trading Scheme to reduce greenhouse gas emissions, a similar framework for NO_x emissions would allow industry a consistency in approach in addressing emission reduction and also provide a ‘level playing field’ for all industry participants.

3.8.3 Inlet Air Cooling and Densification

AGL has considered the following options for inlet air cooling and densification:

- evaporative cooling of the gas turbine inlet air cooling; and
- high fogging, for densification of gas turbine inlet air.

Overview of Inlet Air Cooling and Densification

The ambient conditions under which a gas turbine operates have a noticeable effect on the power output. At elevated inlet air temperatures, the power output decreases. The power output decreases due to the decreased air flow mass rate or density (the density of air declines as temperature increases). Conversely, the power output increases when the inlet air temperature is reduced. At inlet air temperatures of near 38°C, power output can drop to as low as 90 % of ISO-rated power for typical gas turbines.

At cooler temperatures of about 4 to 10°C, power can increase to as high as 105% of ISO-rated power. ISO-rated power refers to the power rating of the turbine at an ambient temperature of 15 °C, relative humidity of 60% and ambient pressure at sea level.

The density of air also decreases at altitudes above sea level. Consequently, power output decreases with an increase in altitude.

The decreased power output of gas turbines at high ambient temperatures means that gas turbine performance is at its lowest at the times power is often in greatest demand and most valued (in the local context). Cooling the air entering the turbine by 4 to 10°C on a hot day, thus increasing the air density, can increase power output by approximately 1 to 3%. The decreased power resulting from high ambient air temperatures can be mitigated by inlet-air cooling, including evaporative cooling.

The density of the inlet air can also be increased by directly spraying very finely dispersed water (‘fog’) into the inlet air stream. This is referred to as ‘high fogging’.

Evaporative Cooling

Water flows over baffles and air is drawn into the gas turbine inlet through the baffles. The air is cooled by evaporation as it passes over the baffles. Evaporation of the water reduces the temperature and increases the density of the air, allowing the gas turbine to operate at a higher output. After traversing the baffles the remaining water is collected in a sump and then recycled to the top of the baffles. Water is continually added to replace the evaporated water.

As water evaporates there is an increase in the concentration of dissolved salts (total dissolved solids or TDS). To control the salt concentration and to prevent scaling of the system (precipitation of salts), some water is continually bled off or ‘blown down’ from the sump. The blow down rate is adjusted to keep the concentration of dissolved salts below the threshold for scaling to occur. The blow down water is proposed to be discharged to an evaporation pond.

The operation of inlet air coolers is generally only required in warmer weather, typically in summer and to a lesser extent in spring and autumn. However, the lack of availability to supply process water beyond the nominated demand would not affect the ability of the plant to operate and supply power, merely the efficiency of that generation.

High Fogging

Inlet air densification by high fogging, if installed, would provide power generation efficiency benefits over and above inlet air cooling alone. This has benefits independent of air temperature and, if high fogging is installed, would be applied all year round. The extremely fine water droplets are entrained with the turbine inlet air and thus enter the turbine. The water therefore needs to be of extremely high quality, i.e. very low dissolved solids (TDS) concentration, referred to as deionised water, to prevent erosion and deposition of scale on the surfaces within turbines.

Ion-exchange (I-X) or electro-deionisation (EDI) would be required as one of the pretreatment processes (regardless of the supply source) if high fogging is applied. High fogging has a higher water demand and if this option is selected, a brine concentrator would be required in the process to reduce the wastewater output and reduce the resultant evaporation pond size.

3.8.4 Conclusion

AGL is currently considering both options for inlet air cooling and densification. These options have differing water demands with high fogging having a higher water demand. Both options are discussed further in **Chapter 14** *Water Management*. For the purposes of this Environmental Assessment, it is currently proposed that the site water supply would be on-Site groundwater extraction, supplemented by offsite tankering. The final arrangements would be subject to further feasibility assessment. Further consideration, if necessary, may 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.

3.8.5 Water Source and Treatment Alternatives

A number of potential water sources for the Dalton Power Project have been considered. The possible options may include one or a combination of:

- utilising existing Upper Lachlan Council water supply;
  - Dalton potable supply;
  - Gunning potable water supply; and
  - Gunning Sewage Treatment Plant.
- Lachlan River off take via a new offtake;

- local groundwater (via extraction bores);
- delivering water to site by truck; and
- harvesting and recycling water;
  - stormwater runoff harvesting;
  - roof runoff harvesting; and
  - water use minimisation and recycling.

The power plant water supply is likely to require a treatment plant on site to provide the different levels of water quality necessary for a power plant and ancillary purposes including drinking water for the site staff. It should be noted that the Facility can operate without water, other than for domestic purposes, during period of water shortage or where there are restrictions.

Potential water sources include securing supply from existing Upper Lachlan Council, accessing groundwater resources, and bringing water to site in large tankers have been considered. The final water supply arrangement for the site may be a hybrid of different sources.

Water Supply

A summary of the water supply options is presented in **Table 3-25**. More detailed discussion of each option is provided in **Chapter 14.**

Table 3-25 Summary of Water Supply Options

Water Supply Options	Advantages	Disadvantages	Conclusion
Dalton potable water supply (groundwater)	Existing water supply in reasonable proximity to site	Likely to be insufficient excess capacity to be the main water supply for the site Marginal water quality as a potable water supply without further treatment (though fine for further treatment to process water)	May be an option as a supplementary supply but unlikely to be sufficiently available excess capacity to be the main supply.
Gunning potable water supply (Lachlan River offtake)	Council extraction entitlement held, which is well in excess of site needs.	Source is 15 km from the site (if piping). There is a suggestion that there is potential water supply constraints associated with the available water from the river.	Potential option as a primary water supply source but further investigation is required to determine feasibility.
Gunning treated sewage effluent (recycle water)	Initial indications are that there may of the order of 40ML of excess effluent, which is sufficient for all of or a reasonable proportion of site needs	Source is 15 km from the site (if piping). Recycled water quality is not yet clear, but there is likely to be a higher pretreatment requirement. Microbiological quality risks will need to be managed.	Potential option as a supplementary water supply source but further investigation is required to determine feasibility.
Direct Lachlan River offtake	River in reasonable proximity to the site.	Suggestions that the supply may be seasonally constrained. Entitlement would need to be acquired. Diversion infrastructure required. Marginal water quality as a potable water supply without further treatment (though fine for further treatment to process water)	Not initially attractive relative to other options and would only be considered further if primary options prove unviable.
Groundwater extraction	Groundwater is available in the area. Although, relatively, local aquifers are not high yielding it is reasonably possible that the sufficient groundwater supply could be acquired from a number of bores on or nearby the site.	Entitlement would need to be acquired within the existing cap. Further investigations, including drilling, would be required to locate extraction bores, with no guarantee of success. Groundwater TDS may be higher than other potential supplies.	Potential option as a primary water supply source but further investigation is required to determine feasibility.

Water Supply Options	Advantages	Disadvantages	Conclusion
Tankered water (from sources identified above or another source beyond the immediate region)	Water can be sourced and is a guaranteed supply	Relatively large overall water demand to supply by tankering. Therefore large number of trips per year and potentially relatively expensive.	This is currently the only guaranteed water supply, and although other options would be considered and may be implemented, provision will be made for receiving tankered water.
Roof runoff harvesting	Reasonably good quality water.	Yield small relative to over water demand	This would be implemented as part of the design to provide supplementary water.
Stormwater runoff harvesting	Available onsite.	Could impact on downstream waterways, which has not been assessed. Objective to retain post development hydrology as close as possible to pre-development.	Not currently proposed.

For the purposes of this Environmental Assessment, it is currently proposed that the site water supply would be on-site groundwater extraction, supplemented by offsite tankering. AGL is currently investigating options for obtaining the relevant permits and licensing arrangements for the transfer of existing groundwater entitlements for the Project. AGL has located numerous water licences for sale and therefore has a high level of certainty that sufficient water licencing requirements could be met for the project.

The final water sourcing arrangements would be subject to further feasibility assessment, and further consideration would be given during the detailed design stage regarding piping from these sources. This Environmental Assessment does not address the broader environmental impacts associated with construction and operation of a water supply pipeline from these sources.

Water Treatment

As discussed previously, the overall water supply requirement to meet the water demands nominated in **Chapter 4** and **14** is a function of the pretreatment requirements of the water supply and of any wastewater treatment and recycling proposed. The potential levels of pretreatment for different supply options is summarised in **Table 3-26.** More detailed discussion of each option is provided in **Chapter 14.**

Table 3-26 Summary of Potential Pretreatment Requirements for Water Supply Options

Indicative Pretreatment Requirement	Water Supply Source			
	Groundwater	Surface Water	Recycled Sewage Effluent	Potable Water
Prefiltration - multimedia pressure filters - gravity sand filters - membrane filters - cartridge filters Possibly after pre-aeration/oxidations and/or coagulant and flocculant dosing	✓	✓	✓ (high level of prefiltration)	
Desalination - reverse osmosis (RO) - elecro-dialysis reversal (EDR)	✓	Possible but unlikely	Possible but unlikely	
Deionisation (for process water supply only) - ion-exchange - electro-deionisation (EDI)	✓	✓	✓	✓

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 above pretreatment options.

3.9 Do Nothing Scenario

Both AEMO in its SOO and the NSW Government in its Green Paper have demonstrated an ongoing need for additional electricity generation in NSW. Furthermore, as the time approaches where new generation is required, AGL is experiencing rising costs of wholesale electricity while managing electricity sales to consumers at a fixed, regulated price. This brings forward for AGL the need for new peaking generation compared to the AEMO SOO forecast that is based on the timely delivery of new generation to the market to avoid supply disruptions.

As Australia’s largest energy retailer, AGL is well positioned to develop new peak generation capacity that, in addition to ensuring reliable supplies of electricity during peak demand times, manages the costs and risks of its retail portfolio.

3.10 Project Alternatives Conclusion

In summary:

- Of the options considered for power generation, open cycle gas turbines are ideal to meet peak load demand and generally represent best practice technology for this type of use. The turbine would be fired by natural gas only.
- AGL has undertaken a comprehensive review of alternative sites in NSW at Dalton, Marulan, Moss Vale, Wollongong, Nowra, Wagga Wagga, Canberra, Lithgow, Albury and the Central Coast. No other region has the same concentration of gas pipelines, transmission and water as has the Dalton site. Although it is possible to build connections to electricity, gas and water infrastructure these normally impose a burden on the community through which they pass and are cost prohibitive.
- The proposed footprint within the Dalton Site was assessed as the favourable facility footprint from seven alternatives due to ideal topography and aspect. The site is well screened from potential visual and aural receptors.
- The proposed access road and pipeline infrastructure options and the location of the communications tower and associated infrastructure represent the best alternatives for the Project in terms of minimising the potential area of disturbance and in consideration of engineering constraints.
- Dry Low NO_x (DLN) technology has been selected as the most appropriate technology to limit NO_x emissions.

Within the Dalton area, the Dalton Site was found to be most favourable as connection to the 330 kV transmission line and Moomba to Sydney Gas Pipeline are both located within close proximity to the Development Site. The Site is well removed from public viewing points and has sufficient extent to allow adequate buffer distances between the plant and from neighbouring boundaries.