3.4 Existing Traffic Flows

Existing traffic volumes were obtained from RMS data or from Council (where available). Data along the northern access route was provided by Mid Western Regional Council, while Bathurst Regional Council provided data along the southern access route. RMS data is generally in the form of average annual daily traffic (AADT) and has been adjusted to represent vehicle volumes.

RMS data is predominantly based on traffic volumes from 2005 counts for two-way flows. However, site traffic count surveys (one-hour counts during peak travel periods) and observations were undertaken along the most critical road sections to confirm that current 2011 traffic flows were of the same order as those recorded in previous years. Peak hour traffic flows have been assumed to be between 10% and 15% of daily traffic flows for the more heavily trafficked roads.

Existing traffic volumes in vehicles per day (vpd) and vehicles per (peak) hour (vph) for the surrounding road network are shown in *Table 3.1* below.

Table 3.1: Existing Traffic Volumes

Road	Vehicles Per Day (vpd)	Vehicles Per Hour (vph)	Traffic Volume Source
Northern Access Route			
Castlereagh Highway – north of Hill End Road (MR216)	3,751	450	Council data (2005) Similar numbers confirmed by traffic count survey
Hill End Road – west of Castlereagh Highway	1,444	200	Council data (January 2007) Similar numbers confirmed by traffic count survey
Hill End Road – 900 m north of Old Grattai Road	1,195	150	Council data (April 2009)
Windeyer Road – east of Hill End Road	229	<50	RMS counting station 99.461 (1992). Similar numbers confirmed by on-site observations and spot counts.
Pyramul Road (north) (south)	54 80	<20 <20	Council data (August 2004 & June 2002). Similar numbers confirmed by on-site observations and spot counts.

Road	Vehicles Per Day (vpd)	Vehicles Per Hour (vph)	Traffic Volume Source
Crudine Road Bombandi Road	<100 <50	<10 <10	Estimates from on-site observations and spot counts.
Aarons Pass Road – 50 m east of Pyramul Road	23	<10	Council data (May 2004). Similar numbers confirmed by on-site observations and spot counts.
Southern Access Route			
Great Western Highway at Raglan Creek, Bathurst	22,849	2,300	Council data (2010)
Great Western Highway, 1.5 km west of Glanmire	6,770	750	RMS counting station 99.921 (2005). Similar numbers confirmed by traffic count survey.
Mid Western Highway, west of Stewart Street	3,782	450	RMS counting station 99.847 (2005). Similar numbers confirmed by traffic count survey.
Stewart Street, east of Vittoria Street	13,896 (axle pair)	1,500	RMS counting station 99.722 (2005). Similar numbers confirmed by traffic count survey.
Gilmour Street, north of Great Western Highway	5,218	600	Council data (2006). Similar numbers confirmed by traffic count survey.
Eleven Mile Drive	1,480	200	Council data (2006). Similar numbers confirmed by traffic count survey.
Wellington Street, between Duramana Rd and Alexander St	2,197	300	Council data (2006). Similar numbers confirmed by traffic count survey.
Durham Street, between Hope Street and Mitre Street	10,445	1,200	Council data (2011)
Eglinton Road at Rankens Bridge	4,634	550	Council data (2005)

Road	Vehicles Per Day (vpd)	Vehicles Per Hour (vph)	Traffic Volume Source
Hamilton Street, north of Cox St	2,290	300	Council data (1999)
Duramana Road at 1.49 km	549	<100	Council data (2001). Similar numbers confirmed by on-site observations and spot counts.
Turondale Road			
– at 1.82 km	279	<50	Council data (2009)
– at 22.0 km	156	<30	Council data (2009) Similar numbers confirmed by on-site observations and spot counts.
Hill End Road			
– at Evans Shire Boundary	75	<20	RMS counting station 99.305 (2005)
– west of Sofala	86	<20	RMS counting station 99.342 (2005)
– at 3800 Hill End Road	113	<30	Council data (2009) Similar numbers confirmed by on-site observations and spot counts.

4. Impact Assessment

In general, construction of the wind farm will include the following activities:

- Transport of construction machinery and labour to the Project site.
- On-site civil works for internal access roads, crane pads, lay-down areas, wind turbine footings and cable trenching.
- Road upgrade works (as required) to the public road network to allow over-size and over-mass transportation.
- Transport of wind turbine infrastructure to the Project site.
- Installation of wind turbines on site using cranes.
- Construction of electrical substations.
- Construction of site control room and operations and maintenance facilities.
- Construction of electrical transmission lines.
- Restoration and revegetation of disturbed areas.

In general, construction will be limited to the following times:

- Monday to Friday, 7:00 am to 6:00 pm;
- Saturday, 8:00 am to 1:00 pm; and
- No construction on Sundays or public holidays.

4.1 Construction Vehicle Types

The type of construction vehicles proposed to access the Project site depends on the equipment and/or personnel being transported and their function on the site. Access to construction site offices and facilities buildings would generally be available for conventional two-wheel drive vehicles. Access to individual wind turbine locations may be restricted to four-wheel drive or multiple wheel drive vehicles depending on the internal road network conditions.

Due to the size and weight of the wind turbine components it is expected that many of the delivery vehicles will be ‘over-size’ (width and/or length), ‘over-mass’ or both. These vehicles will be regarded as restricted access vehicles (RAVs) and will require special RMS operating permits to allow them to travel on public roads.

‘Over-mass’ loads will be carried on trailers, or combinations of trailers, with sufficient axle groups to ensure compliance with point load and overall load limits for the road surface. As a point of reference, the heaviest load based on an assessment of current turbine specifications from a variety of turbine manufacturers is 125 tonnes (comprising the entire nacelle / gearbox configuration in one unit). Such loads are typically carried on trailers with 10-plus axles, with each axle having up to 8 tyres. Allowing for the weight of the trailers themselves, typical axle weights under such configurations are in the range of 12 to 13 tonnes, or less than 2 tonnes per tyre. This is less than a typical semi-trailer with 11 tonnes per axle but only 4 tyres per axle, resulting in 2.75 tonnes per tyre.

Over-dimensional vehicles therefore incur less loading stress on the road surface, especially when run under escort with limited speed, than normal heavy vehicle traffic. Furthermore, both ‘over-size’ and ’over-mass’ vehicles feature trailers with steering on some or all rear axles. This technology ensures improved manoeuvrability, minimises stress on the equipment and the load, and reduces or eliminates tyre scrubbing and the associated stresses on the road surface when cornering.

The fleet of vehicles engaged to deliver oversize components will typically consist of:

- Extendable blade trailers of standard semi-trailer width (2.5 m) with the ability to extend to 45 m with up to 4 rear axles, some or all of which will be steerable;
- Heavy duty low loaders, with up to 10-plus rear axles and with each axle having 8 or more tyres to spread the load of the heavier WTG components. These low loaders may have the ability to carry loads up to 30 m in length, and may widen up to 5 m to reduce pressures on the road surface. Depending on the extendable length of these trailers, some of the rear axles may be self-steering;
- Dolly / jinker arrangements to carry loads longer than 30 m, where permitted to do so by permits and the WTG supplier. The rear axle groups on the jinker arrangements are steerable; and
- A variety of high power prime movers, typically rated 130 to 200 tonnes gross combination mass (GCM), as required depending on the total combination weight, ie. WTG load + trailer + prime mover.

Over-size vehicles are those over 19 metres in length, 2.5 metres in width and/or 4.3 metres in height and their operating permits will require one or more escort vehicles to accompany them. Over-mass vehicles are those with a gross mass greater than 42.5 tonnes.

As mentioned previously, each wind turbine generator comprises a nacelle (approximately 75 tonnes), hub (approximately 25 tonnes), three blades (approximately 7 tonnes each and up to 63 m long) and three to five tower sections (approximately 50 tonnes each).

The components would typically be carried on specially designed trailers with axles that extend up to 4.2 metres in total width to carry the hubs and nacelles. The blades, which may be up to 63 m long are carried on specialised trailers which have steerable rear axles allowing negotiation of relatively small radius curves provided that the inside of the curve is clear of obstacles.

The standard design vehicle for swept path adequacy in the provision of intersections and the design of parking and turning areas would generally be (as a minimum) the Austroads single unit truck / bus of 12.2 m length. However, provision would be made, where possible, to allow for a ‘B-double’ swept path, which requires a wider area allowing for manoeuvring by semi trailers and over-size vehicles.

The design of access roads and junctions would need to allow for widths of up to 4.5 metres and weights complying with Roads and Traffic Authority maximum loading.

4.2 Construction Phase Traffic Generation

During the construction phase, several tasks would generate traffic. These are categorised as follows:

- Wind farm component delivery

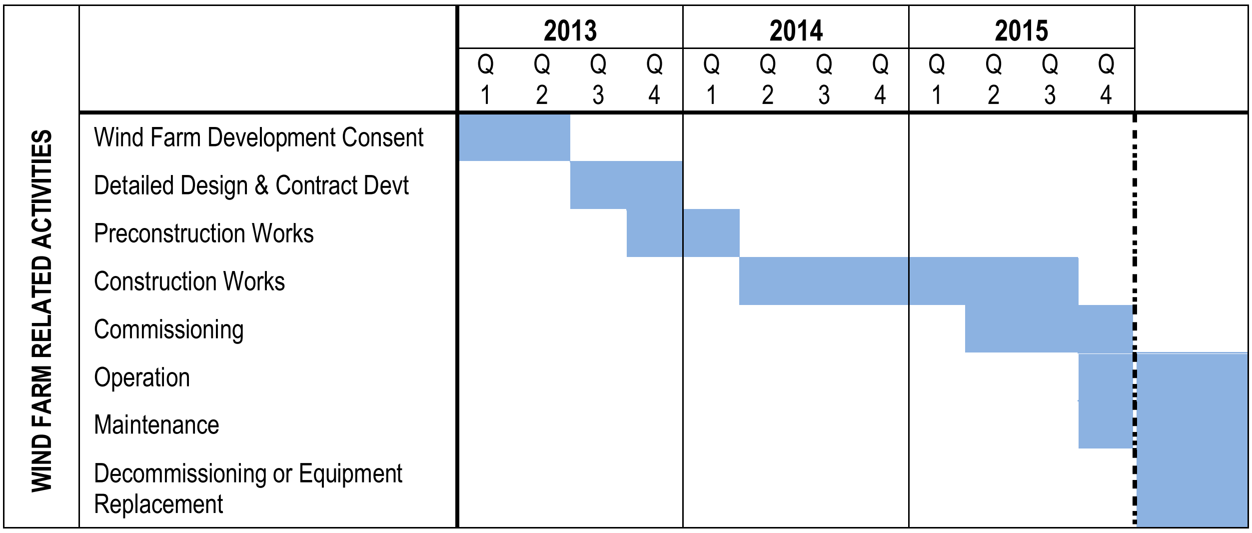
- Construction material delivery
- Construction staff transport

Traffic-generating tasks include:

- initial site set-up and access construction during the pre-construction period;
- construction staff movements, wind farm component deliveries (including over-size transport), concrete material deliveries and other general deliveries during construction works;
- operational staff movements during operation and maintenance; and
- decommissioning and reinstatement construction activities.

These tasks are proposed to occur over the following general Project timeline shown in *Figure 4.1* below.

Figure 4.1: Anticipated Project Timeline



4.2.1 *Transport of Wind Farm Components*

The transport of the various wind farm components would generate traffic as shown in *Table 4.1* below.

Table 4.1: Wind Farm Component Transportation

Wind farm Component	Characteristics	Traffic Generation
Nacelle	Weight is up to 125 tonnes, one per wind turbine: single load with installed drive trains.	Traffic generation for 1 wind turbine: 1 over-size (mass) vehicle Traffic generation for 106 wind turbines: 106 over-size vehicles
Blades	Three blades per wind turbine: up to 63 m long, single blade per vehicle.	Traffic generation for 1 wind turbine: 3 over-size (length) vehicles Traffic generation for 106 wind turbines: 318 over-size vehicles

Wind farm Component	Characteristics	Traffic Generation
Hub	Typical weight is approximately 40 tonnes, one per wind turbine in single load. Sometimes the hub 'capping', which is a lightweight fibreglass piece, is stacked into groups of 3 and sent in a single load to site.	Traffic generation for 1 wind turbine: 1 low-loader vehicle Traffic generation for 106 wind turbines: 106 low-loader vehicles
Tower	Typically three to five sections, each weighing between 20 and 65 tonnes depending on the section and measuring between approximately 20 m to 25 m long. An additional section for insert into the foundation weighs 10 tonnes and is typically 4 m in diameter and 5 m long. Typically 3 to 4 sections per tower, plus the foundation ring. Tower sections range from 15 m (lower sections) up to 30 m (top section).	Traffic generation for 1 wind turbine: 5 low-loader (over-mass) vehicles + 1 semi-trailer truck Traffic generation for 106 wind turbines: 530 low-loader (over-mass) vehicles + 106 semi-trailer trucks
Additional Materials	Typically for each wind turbine, additional miscellaneous equipment to be delivered to the site would require approximately one container (semi-trailer) truck.	Traffic generation for 1 wind turbine: 1 semi-trailer truck Traffic generation for 106 wind turbines: 106 semi-trailer trucks
Sub-station Transformers	The main and secondary collector substation transformers would have a typical weight of up to 90 tonnes. Transportation of up to five transformers would be by road and would involve direct loading onto a platform trailer.	Traffic generation: 5 over-size (mass) vehicle + 10 semi-trailers of support equipment.
Switching Station	Semi-trailer for transportation of switching station components at the point of connection.	Traffic generation: 10 semi-trailers of components and associated equipment.
Overhead Transmission Lines	Semi-trailer for transportation of power poles, conductors, wires and other materials.	Traffic generation: dependant on final details of pole numbers, spacing and location but assume a minimum 20 semi-trailers of poles and associated transmission line equipment.
Site Cranes	Assume four cranes (2 main cranes and 2 tailing cranes) moving between wind turbine sites. These would travel to the preferred site access point at the start of construction and then leave at the end.	Traffic generation: 4 over-size (mass) vehicle + 12 semi-trailers of support equipment.

As a worst case, based on delivery of a total of three whole wind turbines per week and working on a six-day week, some five oversize loads per day would be generated. With the addition of a maximum of two semi-trailer loads of other equipment / components in the one day, it is assumed that the delivery of wind farm components would generate a maximum 14 trips per day, inclusive of 10 oversize vehicle trips per day.

With respect to traffic distribution of wind farm component transport, this would largely depend on the origin of component manufacture. A reasonable scenario is for WTG cargo to be imported to Newcastle because there is no local manufacturing capability in Australia for these components. Therefore, the northern route would be most likely used for transport of blades, nacelles and hubs.

All tower sections are likely to come from the southern route if sourced from KPE (Portland) or RPG (Adelaide or Dandenong), KPE and RPG being the two recognised manufacturers of WTG towers Australia.

Switching station equipment and some overhead transmission line equipment would also arrive via Castlereagh Highway onto the minor accesses at Bombandi Road and Crudine Road.

4.2.2 Transport of Construction Materials

The major construction materials to be transported include gravel/road base for construction of site access roads, constituent materials for the on-site concrete batch plant, steel reinforcement deliveries for foundation construction, steel strands and cabling for the transmission lines, and other miscellaneous materials deliveries for site offices and the like. Construction material delivery would typically generate the following traffic generation.

Concrete

Assuming the use of slab (gravity) foundations, each tower would require approximately 250 m^3 of reinforced concrete. Concrete would be delivered to the wind turbine bases via the internal site road network from on-site batching plants proposed to be located at or near the two site access locations. From there, they would travel along the internal site road network to access each wind turbine location. At 6 m^3 per load, some 42 truck loads or 84 truck movements per foundation site would be required during a single day pour. All these movements would be within the site and not be required to travel along the external public road network.

As a contingency, if the on-site concrete batching plants are unable to provide the available concrete, pre-mixed concrete would need to be sourced from local businesses in either the Mudgee or Bathurst areas or other nearby centres. If pre-mixed concrete is to be transported from off-site, the above traffic generation would use the public road network. It is assumed that pre-mixed concrete deliveries from off-site would be split equally to the two site access locations via the northern and southern access routes. This would result in a daily peak of 42 truck movements of pre-mixed concrete along each of the northern and southern access routes.

Delivery of constituent materials (eg. cement, sand, aggregate, water) for the on-site batching plant is assumed to be 20 truck loads per week resulting in 40 truck movements per week. This may be reduced if suitable local material such as aggregate and sand is able to be sourced on-site. In addition, it is assumed that some ten truck loads per week (or 20 truck movements per week) would be required to deliver steel reinforcement material.

Concrete material and foundation deliveries are assumed to be split equally to the two site access locations from surrounding areas via the northern and southern access routes. This would result in 20 truck movements of concrete materials and 10 truck movements of steel reinforcement per week along each of the northern and southern access routes.

The above truck movements would reduce by approximately 90% if mono-pile foundations were able to be used and generally reduced if a combination of foundation designs (combined slab plus rock anchor design) is implemented.

Gravel/road base

It is anticipated that some road upgrade works (mainly widening on inside of some tighter curves) would be required along Windeyer Road / Pyramul Road as a minimum. In addition, the on-site road network and hardstand areas for cranes are proposed to be constructed using a compacted road base or similar.

The public road upgrades and construction of on-site road network and hardstand areas would result in an estimated 50 km length of road construction. Assuming a 6.0 m wide road formation and 250 mm depth of material, approximately 75,000 m^3 of material would be required. It is assumed that approximately half of this material could be sourced on-site from foundation excavations or on-site borrow pits (approximately 37,500 m^3) while the remainder would need to be sourced from external (off-site) locations[11].

Transport of off-site material to site is assumed to be equally split between the southern and northern access routes.

Assuming the use of 'truck'n'dog' vehicles with an average 25 m^3 capacity, some 1,500 truck loads over the course of the project or 250 truck loads per month (over an initial 6-month construction period: say, months 2 to 7) would be required. In summary, based on the sourcing splits above, the following truck loads and two-way movements would eventuate:

- Northern access route – 125 truck loads or 250 two-way truck movements per month (60 two-way truck movements per week)
- Southern access route – 125 truck loads or 250 two-way truck movements per month (60 two-way truck movements per week)

Inter-turbine cabling

It is anticipated that approximately 100 cable drums of 700 m capacity for inter-turbine cabling would be required for the Project. These would be transported by semi-trailer with two drums per load. The resulting traffic generation would be some 50 truck loads over the course of the project. It is anticipated that during peak periods when cabling is required, some 20 truck loads per month (five truck loads or 10 two-way truck movements per week) would deliver these materials to site.

Cable deliveries are assumed to be split equally to the two site access locations from surrounding areas via the northern and southern access routes. This would result in 5 truck movements of cable per week along each of the northern and southern access routes.

Water

Water delivery for use in the on-site concrete batching plants, dust suppression and

11 This figure would be clarified by the construction environmental management plan (CEMP).

other miscellaneous activities is assumed to be sourced from a combination of on-site bores and other water sources, commercial water sources and/or nearby dam storages. An estimated 20 mega-litres (ML) of water for construction activities is anticipated to be required should slab foundations be required.

Transport of off-site water to site is estimated be an average of some 50 truck loads per week (or 100 two-way truck movements per week) throughout the construction period.

Water deliveries are assumed to be split equally to the two site access locations from surrounding areas via the northern and southern access routes. This would result in 50 truck movements of water per week along each of the northern and southern access routes.

The above water transport would be approximately halved if mono-pile foundations are able to be used, and generally reduced if a combination of foundation designs (combined slab plus rock anchor design) is implemented.

Other miscellaneous deliveries

Other miscellaneous deliveries include general construction materials and equipment as well as site office operations equipment. It is estimated that some 20 delivery loads per week (or 40 two-way vehicle movements per week) would be required throughout the construction period.

These miscellaneous deliveries are all assumed to be sourced from nearby centres such as Mudgee and Bathurst and would be transported equally to the two site access locations from surrounding areas via the northern and southern access routes. This would result in 20 vehicle movements of miscellaneous deliveries per week along each of the northern and southern access routes.

Given the scale of the Project, it is anticipated that there will be no need for waste material to be exported from the site during construction. Top soil cleared from surfaces during the construction phase will be used for remediation, and rock excavated for turbine footing preparations will be used for road base, back fill for foundations and/or erosion control purposes, as far as practicable.

4.2.3 Construction Staff Traffic

For the majority (10 months) of the 18 month construction period, it is anticipated that construction staff numbers would be up to approximately 50 staff. During peak construction periods, it is anticipated that construction staff numbers would increase up to 100 staff for an approximate eight month period coinciding with the turbine installation phase.

Assuming there will be some shared journey-to-work trips by construction staff (resulting from car pooling and similar initiatives), an average of 1.25 persons/car has been adopted for traffic generation purposes. During general staffing periods, traffic generation would be some 40 light vehicles (cars) or 80 light vehicle trips/day. During peak staffing periods, traffic generation would be some 80 light vehicles (cars) or 160 light vehicle trips/day along the surrounding road network.

It is assumed that construction staff trip distribution would be split equally between the north (Mudgee area) and south (Bathurst area), resulting in 40 (80) construction staff vehicle movements per day along each of the northern and southern access routes.

4.2.4 *Total Traffic Generation*

The above sections provide the basis for estimating the average total traffic generation over the construction period. Traffic generation used in this transport assessment ranges from a moderate (average) scenario, that would apply for the great majority of the 18 month construction period, to a conservative (high) scenario, which assumes that peak construction staff numbers would coincide with other peak traffic generating activities such as concrete pours and access road construction, as well as delivery of wind turbine components.

While the conservative (high) scenario could potentially occur, it is more likely that peak access road construction activities would be undertaken during the earlier stages of the construction program and not necessarily coincide with peak construction staff numbers and other peak construction activities such as concrete foundation pours. Nonetheless, this conservative overlap of activities has been adopted to consider a 'worst-case' scenario as well as the more applicable and relevant moderate (average) scenario.

Typically, the conservative (high) traffic generation scenario would apply for only some four months out of the total 18 month construction period. This four months would coincide with construction of WTG foundations and delivery of WTG components. It should be noted that it would not necessarily be a continuous four months.

For the remaining 14 months, a moderate (average) traffic generation scenario has been assumed, although realistically there would be at least one month at either end of the construction period where a low traffic generation period would apply, eg. during pre-construction tasks and pre-commissioning.

Traffic generation for both moderate and conservative (in brackets) scenarios is shown in *Table 4.2* below and has been classified into daily movement trips (ie. two-way trips), shown as vehicles per day (vpd) and peak hour trips (where applicable), shown as vehicles per hour (vph).

Table 4.2: Project Traffic Generation

Traffic Generating Activity		Northern Access Route	Southern Access Route
Wind farm component delivery (heavy and over-size vehicles)	vpd vph	0 (14) 0 (2)	0 (14) 0 (2)
Pre-mix concrete deliveries (heavy vehicles)	vpd vph	0 (42) 0 (8)	0 (42) 0 (8)
Concrete batch plant materials deliveries (heavy vehicles)	vpd vph	0 (20) 0 (4)	0 (20) 0 (4)
Steel reinforcement deliveries (heavy vehicles)	vpd vph	5 (10) 1 (2)	5 (10) 1 (2)
Gravel / road base deliveries (heavy vehicles)	vpd vph	6 (12) 1 (2)	6 (12) 1 (2)

Traffic Generating Activity		Northern Access Route	Southern Access Route
Inter-turbine cabling delivery (heavy vehicles)	vpd	1	1
	vph	1	1
Water deliveries (heavy vehicles)	vpd	5 (10)	5 (10)
	vph	1 (2)	1 (2)
Other miscellaneous construction deliveries (heavy vehicles)	vpd	4	4
	vph	1	1
Construction staff (light vehicles only)	vpd	40 (80)	40 (80)
	vph	20 (40)	20 (40)
TOTAL Light vehicles	**vpd**	**40 (80)**	**40 (80)**
	vph	**20 (40)**	**20 (40)**
Standard heavy vehicles	**vpd**	**21 (103)**	**21 (103)**
	vph	**5 (22)**	**5 (22)**
Over-size vehicles	**vpd**	**0 (10)**	**0 (10)**
	vph	**na**	**na**

4.3 Effect of Construction Phase Traffic Generation

4.3.1 Road Capacity

In order to assess the potential impacts on road capacity, the traffic generation of heavy vehicles and the staff traffic generation (refer to *Table 4.2* above) have been added to existing daily and peak hour traffic flows to obtain future traffic flows (for both moderate and conservative traffic generation scenarios) along the affected road network.

Future traffic volumes in vehicles per day and vehicles per hour for roads along the northern and southern access routes are shown in *Table 4.3* and *Table 4.4* following. The traffic volumes are broken up into light vehicles (LV) and heavy vehicles (HV) with the heavy vehicle proportion assumed to be between 10% and 15% of the total traffic volume. The figures in brackets are for the conservative (high) traffic generation scenario.

Table 4.3: Future Traffic Volumes – Northern Access Route

Traffic Scenario		Castlereagh Highway	Hill End Road	Windeyer Road	Pyramul Road	Aarons Pass Road
Daily Traffic – vehicles per day						
Existing traffic[1]	LV	3,350	1,300	200	70	20
	HV	400	140	30	10	5
Wind farm traffic generation	LV	40 (80)	40 (80)	40 (80)	40 (80)	40 (80)
	HV	21 (113)	21 (113)	21 (113)	21 (113)	21 (113)
Combined future	LV	3,390 (3,430)	1,340 (1,380)	240 (280)	110 (150)	60 (100)

Traffic Scenario		Castlereagh Highway	Hill End Road	Windeyer Road	Pyramul Road	Aarons Pass Road
traffic	HV	421 (513)	161 (253)	51 (143)	31 (123)	26 (118)
Hourly (Peak) Traffic – vehicles per hour						
Existing traffic[1]	LV	400	180	45	15	5
	HV	50	20	5	2	1
Wind farm traffic generation	LV	20 (40)	20 (40)	20 (40)	20 (40)	20 (40)
	HV	5 (22)	5 (22)	5 (22)	5 (22)	5 (22)
Combined future traffic	LV	420 (440)	200 (220)	65 (85)	35 (55)	25 (45)
	HV	55 (72)	25 (42)	10 (27)	7 (24)	6 (23)

1. Existing traffic derived from *Table 3.1*. HV % assumed to be between 10% and 15% of total traffic volume.

Table 4.4: Future Traffic Volumes – Southern Access Route

Traffic Scenario		Great Western Highway	Mid Western Highway	Gilmour Street	Eleven Mile Drive	Duramana Road	Turondale Road	Hill End Road
Daily Traffic – vehicles per day								
Existing traffic[1]	LV	6,100	3,400	4,700	1,980	490	250	80
	HV	670	380	520	220	60	30	10
Wind farm traffic generation	LV	40 (80)	40 (80)	40 (80)	40 (80)	40 (80)	40 (80)	40 (80)
	HV	21 (113)	21 (113)	21 (113)	21 (113)	21 (113)	21 (113)	21 (113)
Combined future traffic	LV	6,140 (6,180)	3,440 (3,480)	4,740 (4,780)	2,020 (2,060)	530 (570)	290 (330)	120 (160)
	HV	691 (783)	401 (493)	541 (633)	241 (333)	81 (173)	51 (143)	31 (123)
Hourly (Peak) Traffic – vehicles per hour								
Existing traffic[1]	LV	670	400	540	270	90	45	15
	HV	80	50	60	30	10	5	2
Wind farm traffic generation	LV	20 (40)	20 (40)	20 (40)	20 (40)	20 (40)	20 (40)	20 (40)
	HV	5 (22)	5 (22)	5 (22)	5 (22)	5 (22)	5 (22)	5 (22)
Combined future traffic	LV	690 (710)	420 (440)	560 (580)	290 (310)	110 (130)	65 (85)	35 (55)
	HV	85 (102)	55 (72)	65 (82)	35 (52)	15 (32)	10 (27)	7 (24)

1. Existing traffic derived from *Table 3.1*. HV % assumed to be between 10% and 15% of total traffic volume.

Road capacity can be expressed and qualified along a section of the rural road network as its 'level of service' (LoS). Typically, the LoS is based on road capacity analysis as described in Austroads' "*Guide to Traffic Engineering Practice, Part 2 – Roadway Capacity*". Road capacity can be expressed in total vehicles per day and/or vehicles per hour.

The level of service descriptions are as follows:

LOS A: Free flow conditions, high degree of freedom for drivers to select desired speed and manoeuvre within traffic stream. Individual drivers are virtually unaffected by the presence of others in the traffic stream.

LOS B: Zone of stable flow, reasonable freedom for drivers to select desired speed and manoeuvre within traffic stream.

LOS C: Zone of stable flow, but restricted freedom for drivers to select desired speed and manoeuvre within traffic stream.

LOS D: Approaching unstable flow, severely restricted freedom for drivers to select desired speed and manoeuvre within traffic stream. Small increases in flow generally cause operational problems.

LOS E: Traffic volumes close to capacity, virtually no freedom to select desired speed or manoeuvre within traffic stream. Unstable flow and minor disturbances and/or small increases in flow would cause operational break-downs.

LOS F: Forced flow conditions where the amount of traffic approaching a point exceeds that which can pass it. Flow break-down occurs resulting in queuing and delays.

Road capacity for two-lane, two-way sections of a rural road network is largely based on a combination of design speed, travel lane and shoulder width, sight distance restrictions, traffic composition, directional traffic splits and terrain[12]. This provides a basic level of service and associated service flow rate under prevailing road and traffic conditions. Based on their road and traffic characteristics, the levels of service and flow rates for the affected sections of the rural road network along the northern and southern access routes are shown in *Table 4.5* following.

Table 4.5: Rural Road Network Service Flow Rates

	Level of Service (LoS)				
Road Section	**A**	**B**	**C**	**D**	**E**
Northern Access Route					
Castlereagh Highway	200 vph 2,000 vpd	390 vph 4,000 vpd	640 vph 6,600 vpd	1,050 vph 11,200 vpd	1,850 vph 19,000 vpd
Hill End Road	90 vph 900 vpd	210 vph 2,300 vpd	400 vph 4,400 vpd	620 vph 6,600 vpd	1,200 vph 12,300 vpd
Windeyer Road / Pyramul Road	70 vph 700 vpd	160 vph 1,800 vpd	320 vph 3,500 vpd	500 vph 5,300 vpd	960 vph 9,900 vpd
Aarons Pass Road	not applicable	not applicable	not applicable	not applicable	not applicable
Southern Access Route					
Great Western Highway	220 vph 2,200 vpd	430 vph 4,400 vpd	700 vph 7,200 vpd	1,150 vph 12,200 vpd	2,050 vph 20,800 vpd
Mid Western Highway	200 vph 2,000 vpd	390 vph 4,000 vpd	640 vph 6,600 vpd	1,050 vph 11,200 vpd	1,850 vph 19,000 vpd

12 Austroads "*Guide to Traffic Engineering Practice: Part 2 – Roadway Capacity*", Section 3

Road Section	Level of Service (LoS)				
	A	B	C	D	E
Duramana Road / Turondale Road	90 vph 900 vpd	210 vph 2,300 vpd	400 vph 4,400 vpd	620 vph 6,600 vpd	1,200 vph 12,300 vpd
Hill End Road	40 vph 400 vpd	100 vph 1,100vpd	180 vph 2,000 vpd	290 vph 3,100 vpd	650 vph 6,700 vpd

Based on the above service flow rates and the existing and additional wind farm generated construction traffic volumes (conservative scenario peak volumes used as a worst case scenario) of the rural roads along both access routes, 'before and after' levels of service can be expected as shown in *Table 4.6* following.

Table 4.6: Rural Road Network – Existing and Future Levels of Service

Road Section	Existing LoS	Future LoS
Northern Access Route		
Castlereagh Highway	B / C	B / C
Hill End Road	B	B / C
Windeyer Road / Pyramul Road	A	A / B
Southern Access Route		
Great Western Highway	C / D	C / D
Mid Western Highway	B / C	B / C
Duramana Road / Turondale Road	A / B	A / B
Hill End Road	A	A / B

From the above table, it is clearly evident that operating conditions (levels of service) along the rural road network would change insignificantly from existing conditions, even after the addition of the conservative scenario (maximum peak) wind farm generated construction traffic.

The majority of the rural road network under consideration has significant spare capacity and is operating at high levels of service (A or B). The Great Western Highway (with level of service C / D) is the exception, although its level of service is still acceptable as it approaches a major urban centre.

In the case of Great Western Highway, the addition of construction-related traffic to existing traffic volumes is a small percentage (approximately 2%), which would be well within any daily or seasonal variations of its average daily traffic flows. Similarly, additional construction-related traffic loaded onto existing traffic along Castlereagh Highway and Mid Western Highway constitutes a relatively minor increase well within any daily or seasonal variations along those roads.

For Aarons Pass Road, which is a minor unsealed road, service flow rates are not applicable as it does not have formed lanes and carriageways. However, it would be operating at a high level of service with significant spare capacity, due to its very low existing traffic volumes. The addition of construction-related traffic generation is able to be readily absorbed by Aarons Pass Road, particularly for the relatively short length along which it is proposed to be used.

With respect to the urban road network that is affected by the transport access routes proposed, Gilmour Street and Eleven Mile Drive (Wellington Street) as well as Great Western Highway within Bathurst along the southern access route are pertinent.

For urban roads, the level of service is largely defined in terms of average travel speed rather than actual road capacity (traffic volumes). This is because the urban road network generally has interrupted flow caused by intersection controls, side-street and parking manoeuvres, and turn movements. Intersection operations largely control traffic flow in the urban road network and delay at intersections affects the travel speed along a route.

Along the urban road network affected by the southern access route, the addition of traffic generated by the wind farm project would constitute the following increases in current traffic volumes along the roads affected and their intersections:

- Great Western Highway: less than 1% of daily traffic flows (additional 193 vpd generated by wind farm project against current 22,849 vpd) and approximately 2.7% of hourly traffic (additional 62 vph against current 2,300 vph)
- Gilmour Street: approximately 3.7% of daily traffic flows (additional 193 vpd against current 5,218 vpd) and approximately 10.3% of hourly traffic (additional 62 vph against current 600 vph)
- Eleven Mile Drive: approximately 13.0% of daily traffic flows (additional 193 vpd against current 1,480 vpd) and approximately 31.0% of hourly traffic (additional 62 vph against current 200 vph)
- Wellington Street (Eleven Mile Drive): approximately 8.8% of daily traffic flows (additional 193 vpd against current 2,197 vpd) and approximately 20.7% of hourly traffic (additional 62 vph against current 300 vph)

From the above, project generated traffic constitutes a negligible increase on current Great Western Highway traffic flows. This increase is well within the highway's daily or seasonal traffic variation and thus, the wind farm traffic generation would have an insignificant impact on the highway's traffic flow operations.

Similarly for Gilmour Street, the increases due to project generated traffic are relatively minor and likely to be within any daily or seasonal traffic variation. The wind farm traffic generation would have a minimal impact on traffic flow operations along Gilmour Street and its intersections.

For the other sections of urban road network, the increases in wind farm generated traffic against current traffic are significant. However, the pertinent sections of Eleven Mile Drive (Wellington Street) would typically have one-way mid-block capacities of between 600 vph and 900 vph. Current traffic volumes are well within these capacities and the addition of wind farm generated traffic would maintain available capacity. Therefore, this section of the urban road network is able to readily absorb the addition of wind farm generated traffic and traffic flow operations would not be adversely affected to any significant extent.

In summary, the addition of heavy vehicles and construction staff traffic during peak construction periods is able to be absorbed by the rural and urban road networks with appropriate road infrastructure upgrades and construction traffic management.

4.3.2 Site Access and Road Safety

Construction traffic is proposed to access the various wind turbine sites via an internal site road network off two site access points (described previously in *Section 3.2.6*). Both site access locations have sight distance issues onto the public road network and thus, suitable temporary traffic control (conforming to RMS' "*Traffic Control at Worksites Manual*" and relevant Australian Standards) will be required to warn road users of turning truck traffic and the like. Additional traffic management (eg. 'stop-go' traffic control) may also be required at the southern site access location (off the northern side of Hill End Road) due to sight restrictions to the west and at both site locations during peak activities such as concrete pours for example.

Suitable on-site manoeuvring areas would be available so that larger vehicles are able to safely manoeuvre into the site off the public road network, around the site and out of the site onto the public road network. The location and layout of the two site access junctions with Aarons Pass Road and Hill End Road would be confirmed with the relevant road authorities taking into account set back of property boundaries and swept path turn radii for over-size (length) loads.

It is envisaged that for the over-size and over-mass vehicles to be used for wind farm component delivery, escort vehicles, transport restrictions and appropriate traffic management would be adopted to ensure safe passage from the public road network onto the site. These issues would be resolved in detail by the by the selected transport contractor when seeking approvals from relevant road authorities.

All vehicles would enter and exit the site to/from the public road network in a forward direction only. All vehicles generated by construction staff would be accommodated within on-site parking areas.

To ensure adequate road safety is maintained, a comprehensive Construction Traffic Management Plan (CTMP) would be prepared in conjunction with the chosen transport contractor and relevant road authorities. The CTMP would detail appropriate construction traffic controls and management measures and all aspects would be implemented in co-ordination with the Councils and RMS. It is acknowledged that on occasions local traffic will be inconvenienced. However, the management measures within the CTMP would endeavour to mitigate any impacts. The CTMP would include, but not be limited to, provisions for:

- Scheduling of transport deliveries, particularly outside of school bus route hours, ie. 7:00 to 9:00 am and 3:00 to 4:30 pm;
- Undertaking community consultation before and during all transport and haulage activities, including contact details to ensure community concerns are logged and addressed;
- Clear communication of road closures (if required);
- Letterbox drop along affected routes;
- Minimising disruption to local vehicles by ensuring average and maximum wait times due to project traffic along local roads are stipulated by the chosen transport contractor (typically an average maximum of 3 minutes wait time);

- Upgrading road infrastructure including designing and implementing temporary modifications to intersections and roadside furniture as appropriate;
- Managing transport operations including provision of warning and guidance signage, traffic control devices, temporary construction speed zones and other temporary traffic control measures;
- Preparation of a 'Transport Code of Conduct' for all staff and contractors detailing designated transport routes, road behavioural requirements, speed limits and local climatic conditions that may affect road safety, eg. snow / ice, fog, etc.;
- Procedure to monitor traffic impacts and respond to impacts rapidly; and
- Reinstatement of pre-existing road conditions after construction phase is complete.

4.3.3 Internal Access Roads

The construction and maintenance of the wind farm will require the construction of an internal site road network to reach all the wind turbine locations and the substation. This internal site road network will allow access across entire wind farm site thus providing the flexibility of external transportation to either of the site access locations and then access to entire wind farm site.

In some cases the site road network works will involve upgrading existing access tracks and in others constructing new ones. Route selection for the access roads has been determined taking into consideration topography, drainage and potential erosion impacts – refer to *Appendix A: Proposed Wind Farm Layout*.

The internal site road network will consist of private roads and will not be accessible to the public. Access will be controlled by locked gates. The internal site access roads will generally be 6.0 m wide with regular passing bays and turning heads to accommodate construction vehicles and the crane required to assemble the wind turbines. Hardstand areas would be required around each turbine site for the safe operation of large cranes. These areas would also provide turning opportunities for delivery vehicles.

The roads will be an all-weather graded surface. Ongoing operational maintenance of on-site roads would be undertaken by the wind farm operator.

4.3.4 Road Condition Maintenance

There are a number of public road works that would be required to enable transport of components and materials to the wind farm sites. These have been identified in general previously in this assessment but would be confirmed and resolved in detail by the selected transport contractor when seeking approvals from relevant road authorities.

The permit system requires transport contractors to state the registration details of the trucks/ trailers used for each load, so the link between permissions and equipment is very tight.

Trucks being used for all escorted loads are given an inspection by the escort at the start of every trip, while other trucks are required to meet regulated maintenance requirements and these procedures are regularly audited to ensure compliance. Under these operating procedures, there would be no further actions required by local Councils to ensure that trucks are fit for purpose. Notwithstanding, the transport contractor would be expected to comply with any additional requirements from any party (ie. Councils, RMS, etc.), if requested to do so.

A thorough dilapidation survey would be undertaken on all public access roads prior to construction starting. This would provide the basis for identifying any road damage and subsequent restoration works after the construction period is complete. Regular inspection regimes undertaken in consultation between local Councils and the proponent would be developed. Any damage resulting from construction traffic, except that resulting from normal wear and tear, would be repaired to pre-existing conditions

4.4 Operational Phase Traffic Generation

Traffic generation during operations would be relatively minor. There is proposed to be 15 operational / maintenance staff, likely to be based in the local area, servicing the wind turbines. Aspects of the Project operation to be dealt with by on-site staff would include safety management, environmental condition monitoring, landowner management, routine servicing, malfunction rectification and site visits. Other remote monitoring functions would typically include turbine performance assessment, wind farm reporting, remote re-setting and maintenance co-ordination.

It is understood operational traffic would consist of 4WD-type service vehicles travelling between individual wind turbine sites along the internal road network after gaining access off the public road network from either of the two site access locations. It is envisaged that with journey-to-work and home trips, this would amount to a maximum of approximately 30 trips per day, which would readily be absorbed into the spare capacity of the existing road network.

There is the possibility that the operational wind farm may attract tourist traffic along the roads surrounding the sites. However, it is considered that this would not significantly increase traffic volumes or cause any unfavourable impacts.

4.5 Effect of Operation Phase Traffic Generation

Based on the relatively minor traffic generation during operations described above, traffic and road network impacts would be negligible. The current road network has significant spare capacity and is used by 4WD-type vehicles, which are proposed to be used for servicing the various sites.

All vehicles generated by operations staff would be accommodated within on-site parking areas.

4.6 Cumulative Impacts

At present there are no known nearby major developments or projects that would result in cumulative impacts to the subject wind farm project. If and when future major projects arise in the general surrounding area, the cumulative impact of multiple projects would need to be considered with respect to transport and traffic operations.

5. Mitigation Measures

5.1 General Management of Potential Impacts

The management of potential impacts caused by the proposed wind farm project would cover the construction, operation and decommissioning phases of the Project. With respect to the potential traffic impacts during the decommissioning phase, these essentially mirror the construction phase impacts, although would occur over a shorter time period.

For management of potential impacts during the construction phase, the following general measures would need to be undertaken:

- Engage a licensed and experienced transport contractor with experience in transporting similar wind farm component loads. The contractor would be responsible for obtaining all required approvals and permits from the RMS and local Councils and for complying with conditions specified in the approvals. Transport contractors would also conduct any dilapidation surveys and arrange for detailed pavement and infrastructure inspections (eg. bridge loading adequacy) to ensure all access routes are suitable prior to carrying out the transport tasks.
- Develop a Construction Traffic Management Plan (CTMP) in conjunction with the transport contractor and relevant road authorities and implement all aspects of the CTMP in co-ordination with the local Councils and RMS. Refer to previous *Section 4.3.2* for typical details to be included in the CTMP.
- Undertake road infrastructure upgrade works to allow over-size transport along the proposed transport routes to access the site. Details of specific upgrade works follow in *Section 5.3* below.
- There are numerous locations along the over-size transport route (northern access route) where relatively sharp curve alignments and/or narrow carriageway widths would require over-size vehicles to use the full carriageway width. This would require traffic management in the form of temporary, short-term full road closures (‘rolling’ road closures as vehicles pass critical locations) aided by escort vehicles.
- Prepare road dilapidation reports covering pavement, drainage and bridge structures in consultation with RMS and the local Councils for all of the proposed transport routes before and after construction. Regular inspection regimes undertaken in consultation between local Councils and the proponent would be developed. Any damage resulting from construction traffic, except that resulting from normal wear and tear, would be repaired to pre-existing conditions.
- Consider establishing a ‘car pool’ initiative for construction staff from nearby centres to minimise construction staff trips.
- For decommissioning, similar general measures would be necessary as those detailed for construction. However, the CTMP for decommissioning would need to be revised to address traffic operation and volume changes in the future years during the decommissioning phase.

For management of potential impacts during the operations phase, the following general measures would need to be undertaken:

- Establish a procedure to ensure the ongoing maintenance of the internal on-site access roads during the operation phase. This maintenance would include sedimentation and erosion control structures, where necessary.

5.2 Road Authority Approvals

The use of licensed and experienced contractors for transporting wind farm equipment is essential to ensure the minimisation of any impacts on the road network and traffic operations. There are a number of transport contractors who are experienced in the specialised transport of over-mass and over-size loads. These contractors operate closely with road authorities and are able to arrange all required permits for undertaking the transport tasks. They would also carry out detailed transport route assessments and confirm the requirement for any road infrastructure upgrades and/or bridge strengthening works.

In obtaining approval and permits for over-size transport, the following documents are pertinent:

- NSW RTA "*Operating Conditions: Specific permits for oversize and overmass vehicles and loads*" Version 2, August 2008
- NSW RTA "*Road Transport (General) Act 2005: General Class 1 Oversize (Load-Carrying Vehicle) Notice 2007 under Division 3 of Part 2 of the Road Transport (Mass, Loading and Access) Regulation 2005*" August 2007
- NSW RTA "*Road Transport (General) Act 2005: General Class 1 Oversize (Special Purpose Vehicle) Notice 2007 under Division 3 of Part 2 of the Road Transport (Mass, Loading and Access) Regulation 2005*" August 2007

Consultation with the NSW RMS regarding their requirements for transporting over-dimension and/or over-mass loads resulted in the following pertinent issues:

- Generally, the wider and longer over-size transport will require two pilot vehicles and contact with NSW Police for further guidance (pilot vehicles).
- Over-size permits are required to be 'specific' permits for each vehicle if they will be travelling along designated roads or locations. Additional and specific over-size permits may be required for loads with greater dimensions than covered by a General Class 1 Oversize Notice.
- A specific permit:
  - prescribes the travel conditions that apply to a particular vehicle;
  - identifies the vehicle to which the permit applies; and
  - identifies the registered operator of the vehicle.
- The permit may also specify conditions to secure payment for:
  - damage caused to roads, bridges or other property by the over-size vehicle;
  - road work that must be conducted before the vehicle can travel on a particular route; or
  - costs incurred by the RMS to evaluate the proposed route or provide any special escort services.
- An over-mass permit will be required for each nacelle component.

- An over-size (length) permit will be required for each blade component. The requirement for over-mass permits for blade components will depend on the type of vehicle used to transport them. However, preliminary assessment indicates that over-mass permits may not be required for blade components.
- Transport of blade components will most likely utilise a rear-end steering system on a trailer or low loader.
- An over-mass permit will be required for each tower component.
- An over-mass permit will be required for the sub-station transformer unit.
- An over-mass permit will be required for each crane.
- Night transport is generally available along the major road network (between 1 am and sunrise or 6 am, whichever is earlier).
- Transport through the any urban areas must generally occur during daylight periods. It is recommended that if the transport routes pass through any school zones or adjacent to any schools, transport also be restricted to outside school drop-off and pick-up times (8:00 am to 9:30 am and 2:30 pm to 4:00 pm) to prevent conflicts with these activities.
- As part of the transport permit process, the RMS and local Councils require a detailed sufficiency assessment of all bridges and other structures along the transport route to identify and specify strengthening requirements, if any. This may apply to several bridge crossings along Castlereagh Highway, Hill End Road and Windeyer / Pyramul Road.

5.3 Potential Road Infrastructure Upgrades

As well as the construction of an internal on-site road network that link up the various wind turbine sites and associated wind farm infrastructure, road upgrade works are likely to be required at a number of locations to accommodate the increased heavy vehicle volumes and over-size transport vehicles. The latter issue would be confirmed by a licensed transport contractor as part of their transport route assessment based on specific vehicles to be used.

The potential road infrastructure upgrades that may be required and/or would need to be considered by the chosen transport contractor include the following (refer to *Section 5.4* below for typical examples of upgrade works and other risk mitigation measures along over-size transport routes).

Hill End Road (northern access route)

- The Castlereagh Highway / Hill End Road intersection would require some widening works and adjustments to the central median and signposting on the Hill End Road leg to provide adequate swept path for longer vehicles.
- Approximately 2.5 km north of the Windeyer Road turn-off, a narrow bridge carriageway width would need to be assessed and confirmed as adequate as would the bridge's loading capacity.
- Bridge loading capacities would need to be assessed and confirmed as adequate at the following locations:
  - Approximately 5.3 km west of Castlereagh Highway
  - Approximately 350 m north of Windeyer Road

Windeyer Road / Pyramul Road

- The Hill End Road / Windeyer Road intersection would require some widening works to provide adequate swept path for longer vehicles.
- Approximately 8.1 km south of Hill End Road, a narrow bridge carriageway width would need to be assessed and confirmed as adequate as would the bridge's loading capacity.
- Approximately 9.6 km south of Hill End Road, a narrow bridge carriageway width would need to be assessed and confirmed as adequate as would the bridge's loading capacity.
- Approximately 19.8 km south of Hill End Road, a sharp left curve would require widening and some clearance of trees / vegetation on the inside of the curve.
- From approximately 20.3 km to 20.7 km south of Hill End Road, a series of sharp curves on grade are likely to require widening.
- Approximately 24.1 km south of Hill End Road, a sharp left curve within a causeway sag would require widening.
- Approximately 24.3 km south of Hill End Road, a sharp right curve is likely to require widening.
- Approximately 28.0 km south of Hill End Road, a narrowed causeway with a left curve is likely to require upgrade.
- Approximately 28.7 km south of Hill End Road, a sharp right curve within a crest may require widening.
- Through the Pyramul village area, overhanging roadside tree foliage is likely to need clearing / pruning.
- Approximately 400 m north of Aarons Pass Road, a narrow bridge carriageway width would need to be assessed and confirmed as adequate as would the bridge's loading capacity.
- The Pyramul Road / Aarons Pass Road intersection would require some widening works to provide adequate swept path for longer vehicles.
- Bridge loading capacities would need to be assessed and confirmed as adequate at the following locations:
  - Approximately 1.3 km south of Hill End Road
  - Approximately 3.6 km south of Hill End Road
  - Approximately 15.3 km south of Hill End Road (Meroo Creek Bridge)
  - Approximately 19.2 km south of Hill End Road
  - Approximately 23.1 km south of Hill End Road (narrowed concrete causeway)
  - Approximately 26.2 km south of Hill End Road
  - Approximately 30.3 km south of Hill End Road (narrowed concrete causeway)
- Apart from the curve upgrade works detailed above, there are several locations along the route where relatively sharp curve alignments would require over-size vehicles to use the full carriageway width, necessitating traffic management in the form of temporary, short-term full road closures ('rolling' road closures as vehicles pass critical locations) aided by escort vehicles. Pertinent locations are as follows:
  - Approximately 2.9 km south of Hill End Road for a sharp right curve

- Approximately 5.7 km south of Hill End Road for a sharp right curve within a slight crest alignment
- Approximately 9.3 km south of Hill End Road for a sharp left curve
- From approximately 13.4 km south of Hill End Road for a series of sharp right and left curves

Aarons Pass Road

- At approximately 0.5 km, 1.1 km and 1.9 km east of Pyramul Road, causeways are likely to require upgrade – loading capacities need to be assessed and confirmed.

Bombandi Road

- Provide an all-weather surface for the currently unsealed section of Bombandi Road required for minor access to the switching station.

Duramana Road / Turondale Road

- The Duramana Road / Turondale Road route is part of the southern access route and is an alternative vehicle transport route subject to a number of road upgrades. It is suitable for use by standard heavy vehicles in its current condition although, the following bridges would still require further detailed assessment of loading capacities:
  - Approximately 7.2 km north of Eleven Mile Drive
  - Approximately 15.6 km north of Eleven Mile Drive (Harold Cranston Bridge across Winburndale Rivulet)
  - Approximately 16.5 km north of Eleven Mile Drive (across Cheshire Creek)
  - Approximately 22.6 km north of Eleven Mile Drive (across Millah Murrah Creek)
  - Approximately 25.7 km north of Eleven Mile Drive
  - Approximately 26.8 km north of Eleven Mile Drive
- At approximately 37.8 km to 38.3 km north of Eleven Mile Drive, there is a steep downgrade into a series of very tight, hairpin curves on the approach and departure from the Coles Bridge over Turon River. The adequacy of the curved alignment and bridge loading capacity would need to be assessed in detail and confirmed for all heavy vehicle transport.

Southern site access

- Restricted sight distance to the west off the northern side of Hill End Road would require either 'stop-go' traffic control during entry / exit movements, a temporary restriction (lowering) of the speed limit (based on available sight distance) or relocating the site access location so that sight distance in both directions is suitable.

5.4 Typical Transport Route Upgrade & Risk Mitigation Measures

Full structural road upgrades are not normally required for the routes intended to provide wind farm access. Exceptions include where access is via an under-rated bridge or where there are obstructions that overhang the road or limit the width of the vehicle / load that can pass. Mitigation strategies typically comprise the following:

Road Surface

As a general rule, ground clearances as low as 300 mm should be considered for over-mass trailers. Depending on the details of the transport equipment to be used, road camber, rise, fall and undulations may require review. Placing limits on vehicle speed ensures that even with heavy loads, the stresses on the road surface can be minimised. Whilst a sealed road surface is ideal, the vehicles are designed to and capable of travelling on unsealed surfaces such as those found on wind farm sites during construction – see *Figure 5.1* below. Therefore, temporary surfaces of crushed rock or similar material are normally adequate, on the basis that any such surface is properly drained to prevent loaded vehicles becoming bogged. There is not anticipated to be any significant impacts to road safety and/or traffic operations as a result of this type of road surfacing measure.

Figure 5.1: Typical unsealed access road within wind farm site

Road width

Larger WTG loads require a road width of up to 5 m, which is sometimes more than the width of minor roads that service remote wind farm sites. Consideration needs to be given to ensure adequate road width for over-size transport, although it is not normal to increase the width of a sealed surface if it already exists at less than 5 m. Where the road width is restricted (be it sealed or unsealed), the common approach is to clear sufficient vegetation from the sides of the road to allow shoulders of crushed rock to be laid. The level of the surface of any such preparation needs to match the edge of the existing road, to prevent tyre damage (and in the case of sealed roads, the break-up of the edge of the sealed section) when the vehicle is required to run wide for corners or to move over for on-coming traffic – see *Figure 5.2* below for increased unsealed road width.

Swept path analysis is generally undertaken once the WTG has been determined for the project, to ensure that any obstacles such as ditches or traffic furniture can be identified and remedied ahead of time. Where further road modifications are required to allow for 'cutting in' of vehicle rear wheels, crushed rock in-fill is normally sufficient on the basis that the vehicles are travelling slowly enough on the curves / turns to ensure minimum road stresses. Where temporary or crushed rock road surfaces are used, a regime of regular maintenance should be employed when over-size / over-mass vehicles are travelling to / from the wind farm site.

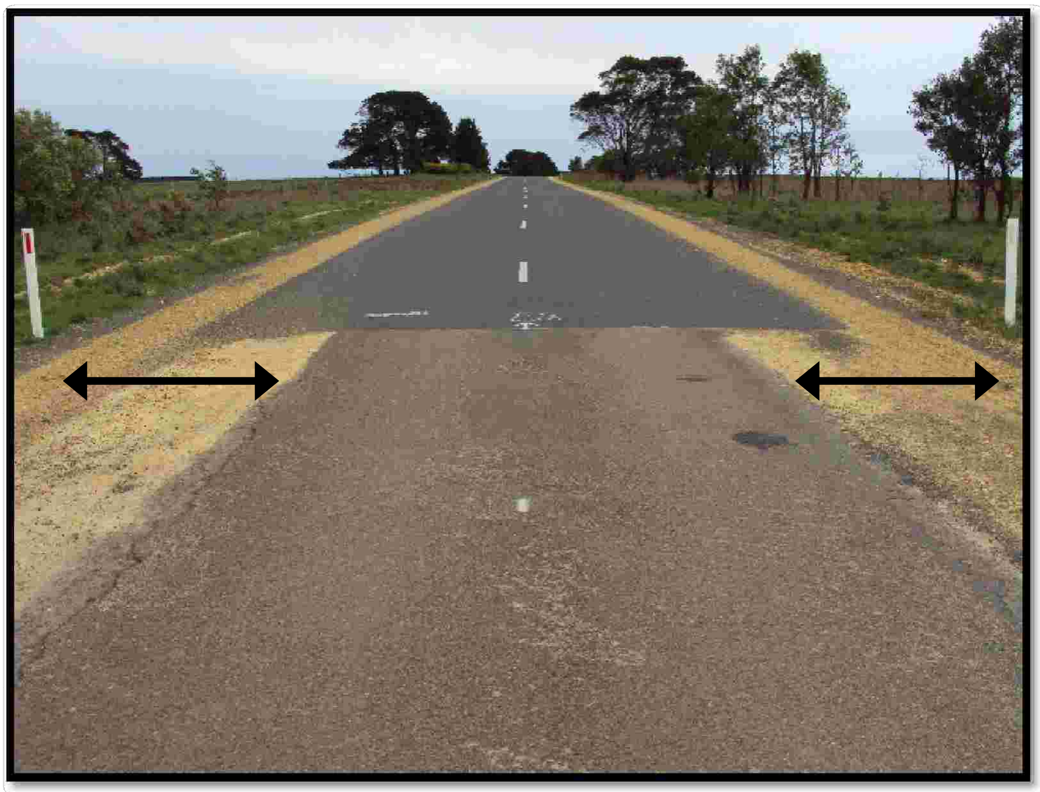


Figure 5.2: Typical unsealed increase in width of (public) road

Overhead obstacles

Over-size vehicles can travel with a combined total height of 5.2 m without the need for an overhead pilot. Any obstructions or height risks such as low bridges (see *Figure 5.3* below), overhead power lines, hanging wires or tree branches would be identified. Where there is a bridge risk, detailed calculations would be done to ensure the loads as specified by the selected WTG manufacturer do not present any risk of a bridge strike. If this is possible, alternative route(s) should be sought. Overhanging wires can be provided with additional temporary support if required, whereas any overhanging tree branches would be cut back or restrained away from the path of the vehicle.

Bridges and culverts

In the event that there are bridges and/ or culverts which are deemed not strong or wide enough (typically less than 5 m travel path width) to support WTG transport equipment, the options are as follows:

- Build a temporary diversion with a structure to provide the necessary support, whilst leaving the original structure in place.
- Reinforce the existing structure by means of steel plates / girders as required to provide the necessary support. Reinforcement can be provided either below the structure, or as additional support on top of the existing road surface.

– As a last resort, if other options are not feasible or practicable, consideration may be given to the replacement of the bridge / culvert with a structurally suitable permanent upgrade to support the projected wind farm component loads.

The selection of any of the above options is dependent on a full technical assessment from a qualified structural engineer which typically occurs during the detailed design phase of the project, once the dimensions and loads are known.

Figure 5.3: Identification of bridge underpass height risk

6. Summary & Conclusions

The following pertinent issues summarise the transport impact assessment for the proposed Crudine Ridge Wind Farm project:

- The wind farm would consist of up to 106 wind turbines to be located on rural land near Pyramul, New South Wales, midway between Mudgee and Bathurst.
- Road transport is the preferred method of transport. Rail is not feasible due to larger wind farm components not being able to be accommodated by the rail system, lack of vertical and horizontal clearance in some sections, double handling, problems of scheduling rail services and potential restriction on track capacity.
- The preferred transport route for over-size vehicles from the north is via Castlereagh Highway, Hill End Road, Windeyer Road, Pyramul Road and Aarons Pass Road to the northern site access location. The preferred southern access route for over-size vehicle transport is via Duramana Road / Turondale Road / Hill End Road subject to a number of road upgrades.
- The major road network provides transport routes to Mudgee (connecting to the northern access route via Castlereagh Highway) and Bathurst (connecting to the southern access route via Great Western Highway and/or Mid Western Highway).
- The minor road network of Hill End Road, Windeyer Road / Pyramul Road and Aarons Pass Road (northern access route) and Duramana Road / Turondale Road and Hill End Road (southern access route) all have significant spare capacity along the road network.
- Site access is proposed via two major access points. These would be located off Aarons Pass Road (northern access) and Hill End Road (southern access).
- The whole wind farm site would be able to be accessed from either access point via the internal road network.
- In addition to the two major site access locations, there would be minor and limited construction access required to the switching station site (via Bombandi Road) and the external transmission line route (via Crudine Road).
- During the construction phase, several tasks would generate traffic including wind farm component delivery, construction material delivery, concrete pours and construction staff transport. For the majority of the construction period, maximum daily traffic generation would be 80 light vehicle trips and 42 heavy vehicle trips per day.
- Traffic generation would typically be split equally between the northern and southern access routes. Some minor traffic generation would also use the Bombandi Road / Crudine Road access routes.
- During peak construction activities, all affected roads on the road network would maintain their levels of service and adequately absorb construction-generated traffic.
- It is proposed that during peak traffic generation activities such as concrete pours and for over-size vehicles to be used for wind farm component delivery, escort vehicles and appropriate traffic management would be adopted to ensure safe passage from the public road network onto the site.

- Traffic generation during operations would be minimal resulting in a maximum of approximately 30 trips per day. Consequently, traffic and road network impacts would be negligible during the operational phase.
- For the potential over-size transport routes, road infrastructure upgrades would be required at a number of locations along Hill End Road, Windeyer Road / Pyramul Road, Aarons Pass Road and Bombandi Road (northern transport route) or along Duramana Road / Turondale Road and Hill End Road (southern transport route) to accommodate the increased heavy vehicle volumes and/or over-size transport vehicles.
- Along the over-size transport routes, where vehicles would require the use of the full carriageway width, traffic management would be required in the form of temporary, short-term full road closures ('rolling' road closures as vehicles pass critical locations) aided by escort vehicles.
- A Construction Traffic Management Plan (CTMP) would be prepared in conjunction with the transport contractor and relevant road authorities and all aspects would be implemented in co-ordination with the local Councils and RMS. The CTMP would typically address:
  - Scheduling of transport deliveries, particularly outside of school bus route hours;
  - Community consultation and issue logging;
  - Clear communication of road closures (if required);
  - Letterbox drop along affected routes;
  - Minimising disruption to local vehicles by ensuring average and maximum wait times due to project traffic along local roads;
  - Road infrastructure upgrade requirements;
  - Traffic management of transport operations;
  - Preparation of a 'Transport Code of Conduct' for all staff and contractors;
  - Procedure to monitor traffic impacts and respond to impacts rapidly; and
  - Reinstatement of pre-existing road conditions after construction is complete.
- The use of licensed and experienced contractors for transporting wind farm components would ensure a minimisation of transport impacts. They would arrange required over-size vehicle permits, carry out a detailed transport route assessment and confirm the requirement for any road / bridge infrastructure upgrades.

This Transport Assessment has addressed Planning NSW's Director General's Requirements (DGRs), as well as some additional issues raised by NSW RMS, for the construction and operational impacts of the project as follows:

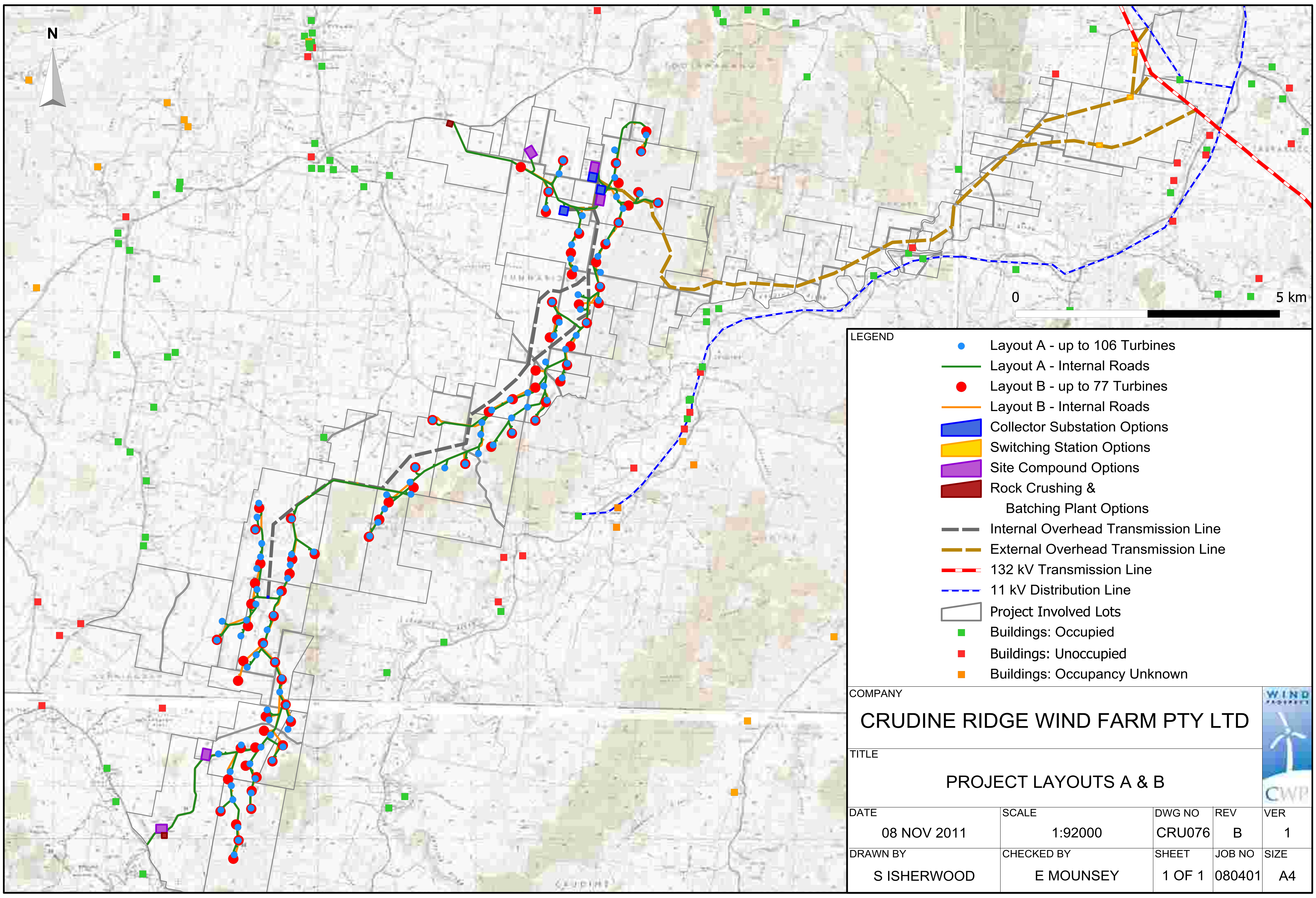
- Details of light and heavy vehicle traffic volumes during construction and operation – refer to *Section 4.2* (specifically *Tables 4.2* and *4.3*) and *Section 4.4*.
- Details of transport routes during construction and operation – refer to *Section 3.2*.
- Assess potential impacts on road network operations and road safety – refer to *Section 4.3.1* and *Section 4.3.2*.
- Assess the capacity of the existing road network to accommodate the type and volume of traffic generated by the project (including over-size vehicles) during construction (refer to *Section 4.3.1*) and operation (refer to *Section 4.5*), including full details of any required upgrades to roads, bridges, site access provisions (for safe access to the public road network) or other road features (refer to *Section 5.3*).

- Details of measures to mitigate and/or manage potential impacts – refer to *Section 5*, particularly *Section 5.3*.
- Details of internal site access roads and connections to the existing public road network, including ongoing operational maintenance for on-site roads – refer to *Section 3.3*, *Section 4.3.2* and *Section 4.3.3*.
- On-site internal road network layout, parking facilities and infrastructure – refer to *Section 4.3.3* and *Appendix A: Proposed Wind Farm Layout*.
- Preparation of a Traffic Management Plan (TMP) to address management of additional traffic during construction (and decommissioning) and site access issues – refer to *Section 4.3.2*.
- Unloading and loading of transport and service vehicles, particularly over-size vehicles – refer to *Section 4.3.2* and *Section 4.3.3*.
- Hours and days for construction and operation – refer to *Section 4*.
- Details of local climatic conditions that may affect road safety – refer to *Section 4.3.2*.
- Any cumulative impacts from other proposed and approved developments in the surrounding area – refer to *Section 4.6*.

In conclusion, it is considered the proposed Crudine Ridge Wind Farm Project would not create any significant adverse impacts with respect to transport issues such as traffic operations, road capacity on the surrounding road network, site access and road safety. The management of heavy vehicle movements during construction would be appropriately covered by a CTMP to be prepared prior to construction starts, while the use of a specialised and licensed transport contractor would ensure that the transport of over-size wind turbine components would be carried out in an appropriate manner.

Appendix A

Proposed Wind Farm Layout


N
0
5 km
LEGEND
Layout A - up to 106 Turbines
Layout A - Internal Roads
Layout B - up to 77 Turbines
Layout B - Internal Roads
Collector Substation Options
Switching Station Options
Site Compound Options
Rock Crushing &
Batching Plant Options
Internal Overhead Transmission Line
External Overhead Transmission Line
132 kV Transmission Line
11 kV Distribution Line
Project Involved Lots
Buildings: Occupied
Buildings: Unoccupied
Buildings: Occupancy Unknown
COMPANY
CRUDINE RIDGE WIND FARM PTY LTD
TITLE
PROJECT LAYOUTS A & B
DATE
08 NOV 2011
SCALE
1:92000
DWG NO
CRU076
REV
B
VER
1
DRAWN BY
S ISHERWOOD
CHECKED BY
E MOUNSEY
SHEET
1 OF 1
JOB NO
080401
SIZE
A4
CWP