

NOTES:

The ZVI methodology is a purely geometric assessment where the visibility of the proposed Liverpool Range wind farm is determined from carrying out calculations based on a digital terrain model of the site and the surrounding terrain.

This assessment methodology is assumed to be conservative as the screening affects of any structures and vegetation above ground level are not considered in any way. Therefore the wind farm may not be visible at many of the locations indicated on the ZVI maps due to the local presence of trees, vegetation or other screening potential. While the ZVI maps are a useful visualisation tool, they are very conservative in nature.

Additionally, the number of turbines visible at any one time is also affected by the weather condition at the time. Inclement or cloudy weather tends to mask the visibility of the proposed wind project.

LEGEND:

Number of wind turbine visible from hub height

- >260
- 101 - 200
- 81 - 100
- 61 - 80
- 41 - 60
- 21 - 40
- 0 - 20

- Proposed Liverpool Range wind turbine
- Distance from proposed Liverpool Range wind turbine
- Proposed 330 kV powerline
- Involved residential dwelling within 2 km of wind turbine
- Uninvolved residential dwelling within 2 km of wind turbine
- Uninvolved residential dwelling between 2 km and 5 km of wind turbine
- Uninvolved residential dwelling between 5 km and 10 km of wind turbine

Figure 13
ZVI Diagram 2 Hub height

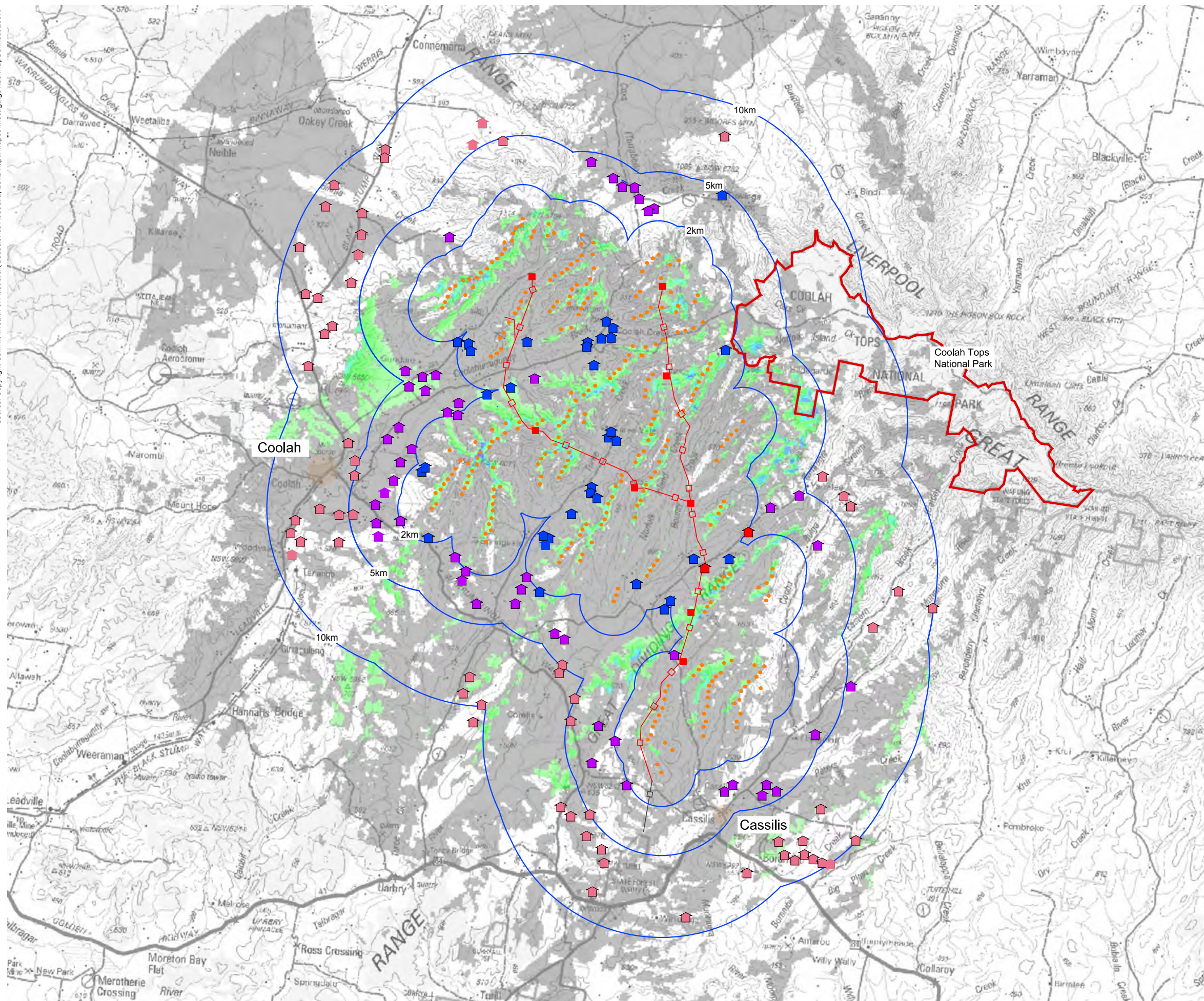
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This assessment methodology is assumed to be conservative as the screening affects of any structures and vegetation above ground level are not considered in any way. Therefore the wind farm may not be visible at many of the locations indicated on the ZVI maps due to the local presence of trees, vegetation or other screening potential. While the ZVI maps are a useful visualisation tool, they are very conservative in nature.

Additionally, the number of turbines visible at any one time is also affected by the weather condition at the time. Inclement or cloudy weather tends to mask the visibility of the proposed wind project.

LEGEND:

Number of whole wind turbine visible

- >260
- 101 - 200
- 81 - 100
- 61 - 80
- 41 - 60
- 21 - 40
- 0 - 20

- Proposed Liverpool Range wind turbine
- Distance from proposed Liverpool Range wind turbine
- Proposed 330 kV powerline
- Involved residential dwelling within 2 km of wind turbine
- Uninvolved residential dwelling within 2 km of wind turbine
- Uninvolved residential dwelling between 2 km and 5 km of wind turbine
- Uninvolved residential dwelling between 5 km and 10 km of wind turbine

Figure 14
ZVI Diagram 3 Whole turbine

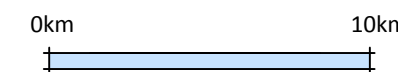
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It should be noted that the wind turbines, when viewed from distances of around, or greater than 10 km, will generally be less distinct from other distant elements within the same field of view, and that the majority of land within the viewshed comprises rural agricultural land and areas of dense timber growth.

7.6 Visibility

The level of wind turbine visibility within the Liverpool Range wind farm 10 km viewshed can result from a number of factors such as:

- distance effect;
- movement;
- relative position; and
- weather.

7.6.1 Distance effect

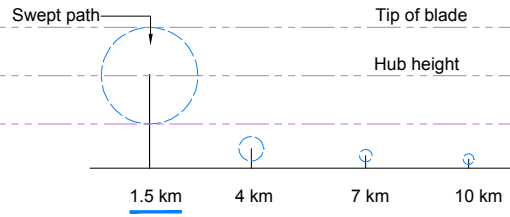
With an increase in distance the proportion of a person's horizontal and vertical view cone occupied by a visible turbine structure, or group of turbine structures, will decline. In order to demonstrate this a series of single frame photographs have been taken from pre-set distances (1.5 km, 4 km, 7 km and 10 km) toward wind turbines at the Capital wind farm in New South Wales. The photographs, illustrated in **Figure 15**, demonstrate the degree to which the apparent visible height of a wind turbine decreases with increasing distance (in a negative exponential relationship), and the increasing amount of horizontal skyline visible with an increasing distance.

As the view distance increases so do the atmospheric effects resulting from dust particles and moisture in the atmosphere, which makes the turbines appear to be grey thus potentially reducing the contrast between the wind turbines and the background against which they are viewed.

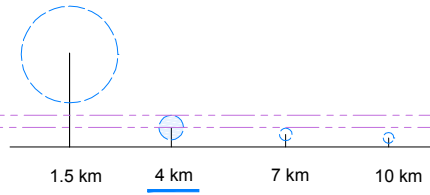
Whilst the distance between a view location and the wind turbines is a significant factor to consider when determining potential visibility, there are other issues which may also affect the degree of visibility. **Table 14** outlines the relative effect of distance on visibility and has been based on empirical research conducted by the University of Newcastle (2002) as well as direct observations made during wind farm site inspections.



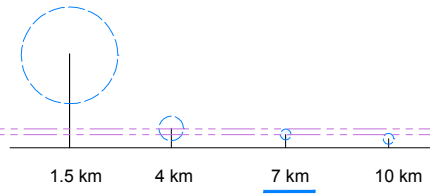
Capital Wind Farm - View distance 1.5 km



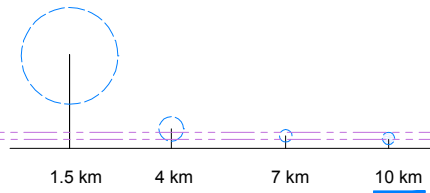
Capital Wind Farm - View distance 4 km



Capital Wind Farm - View distance 7 km



Capital Wind Farm - View distance 10 km



Capital Wind Farm turbines: Suzlon88, 80 m hub height, 88 m rotor diameter

Photographs: Pentax K10D, 50mm lens

Figure 15
Distance effect

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Table 14 – Distance effect

Distance from turbine	Distance effect
>20 km	<p>Wind turbines become indistinct with increasing distance. Rotor movement may be visible but rotor structures are usually not discernible.</p> <p>Turbines may be discernible but generally indistinct within viewshed resulting in Low level visibility and Nil where influenced or screened by surrounding topography and vegetation.</p>
10 km – 20 km	<p>Wind turbines noticeable but tending to become less distinct with increasing distance. Blade movement may be visible but becomes less discernible with increasing distance.</p> <p>Turbines discernible but generally less distinct within viewshed (potentially resulting in Low level visibility).</p>
5 km – 10 km	<p>Wind turbines visible but tending to become less distinct depending on the overall extent of view available from the potential view location. Movement of blades discernible where visible against the skyline.</p> <p>Turbines potentially noticeable within viewshed (potentially resulting in Low to Moderate level visibility).</p>
3 – 5 km	<p>Wind turbines clearly visible in the landscape but tending to become less dominant with increasing distance. Movement of blades discernible.</p> <p>Turbines noticeable but less dominant within viewshed (potentially resulting in Moderate level visibility).</p>
1 – 3 km	<p>Wind turbines will generally dominate the landscape in which the wind turbine is situated. Potential for high visibility depending on the category of view location, their location, sensitivity and subject to other visibility factors.</p> <p>Turbines potentially dominant within viewshed (potentially resulting in Moderate to High level visibility).</p>
<1 km	<p>Wind turbines will dominate the landscape in which they are situated due to large scale, movement and proximity.</p> <p>Turbines dominant and significant within viewshed (potentially resulting in High level visibility).</p>

7.6.2 Movement

The visibility of the wind turbines will vary between the categories of static and dynamic view locations. In the case of static views the relationship between a wind turbine and the landscape will not tend to vary greatly. The extent of vision will be relatively wide as a person tends to scan back and forth across the landscape.

In contrast views from a moving vehicle are dynamic as the visual relationship between wind turbines is constantly changing, as is the visual relationship between the wind turbines and the landscape in

which they are seen. The extent of vision can be partially constrained by the available view from within a vehicle at proximate distances.

7.6.3 Relative position

In situations where the view location is located at a lower elevation than the wind turbine, most of the turbine will be viewed against the sky. The degree of visual contrast between a white coloured turbine and the sky will depend on the presence of background clouds and their colour. For example, dark grey clouds will contrast more strongly with white turbines than a background of white clouds.

The level of visual contrast can also be influenced by the position of the sun relative to individual wind turbines and the view location. Where the sun is located in front of the viewer some visible portions of the wind turbine will be seen in shadow. If the background to the wind turbine is dark toned then visual contrast will tend to be reduced. Conversely where the sun is located behind the view location then the visible portion of the wind turbine will be in full sun.

Significance of visual impact

Section 8

8.1 Introduction

The significance of visual impact resulting from the construction and operation of the Liverpool Range wind farm will result primarily from a combination of:

- the overall sensitivity of visual receptors in the surrounding landscape; and
- the scale or magnitude of visual effects presented by the wind farm development.

The sensitivity of visual receptors has been determined and described in this LVIA by reference to:

- the location and context of the view point;
- the occupation or activity of the receptor; and
- the overall number of people affected.

This LVIA notes that although a large number of viewers in a category that will otherwise be of low or moderate sensitivity may increase the sensitivity of the receptor, it is also the case that a small number of people (such as residents) with a high sensitivity may increase the significance of visual impact. The following table illustrates examples of view categories and their relative sensitivity. The sensitivity of view location categories are also described in **Table 18**.

Table 15 – View Location Sensitivity

View Category	Sensitivity
Residential Properties	Highest Sensitivity
Pedestrians (recreational)	▽
Public Recreational Space	▽
Rural employment/farming	▽
Motorists	▽
Business (commercial)	▽
Industry	Lower Sensitivity

Table 16 – Numbers of viewers

Criteria	Definition
Number of viewers	
High	> 400 people per day
Medium to high	100 - 399 people per day
Medium	50 - 99 people per day
Low	10 - 25 people per day
Very low	< 10 people per day

The scale or magnitude of visual effects associated with the Project have been determined and described by reference to:

- the distance between the view location and the wind farm turbines;
- the duration of effect;
- the extent of the area over which the wind farm could be theoretically visible (ZVI hub height)
- the degree of visibility subject to existing landscape elements (such as forested areas or tree cover).

An overall determination of visual significance at each view location has also been assessed and determined against the criteria outlined in **Table 17** below:

Table 17 – Sensitivity and magnitude assessment criteria

Criteria	Definition
Distance	
Very short	<1 km
Short	1 – 3 km
Medium	3 km – 5 km
Long	5 km - 10 km +
Duration of effect	
High	> 2 hours
Medium	30 - 120 minutes
Low	10 – 30 minutes
Very low	< 10 minutes
Extent of visibility	
High	201 – 288 wind turbines visible from hub height

Table 17 – Sensitivity and magnitude assessment criteria

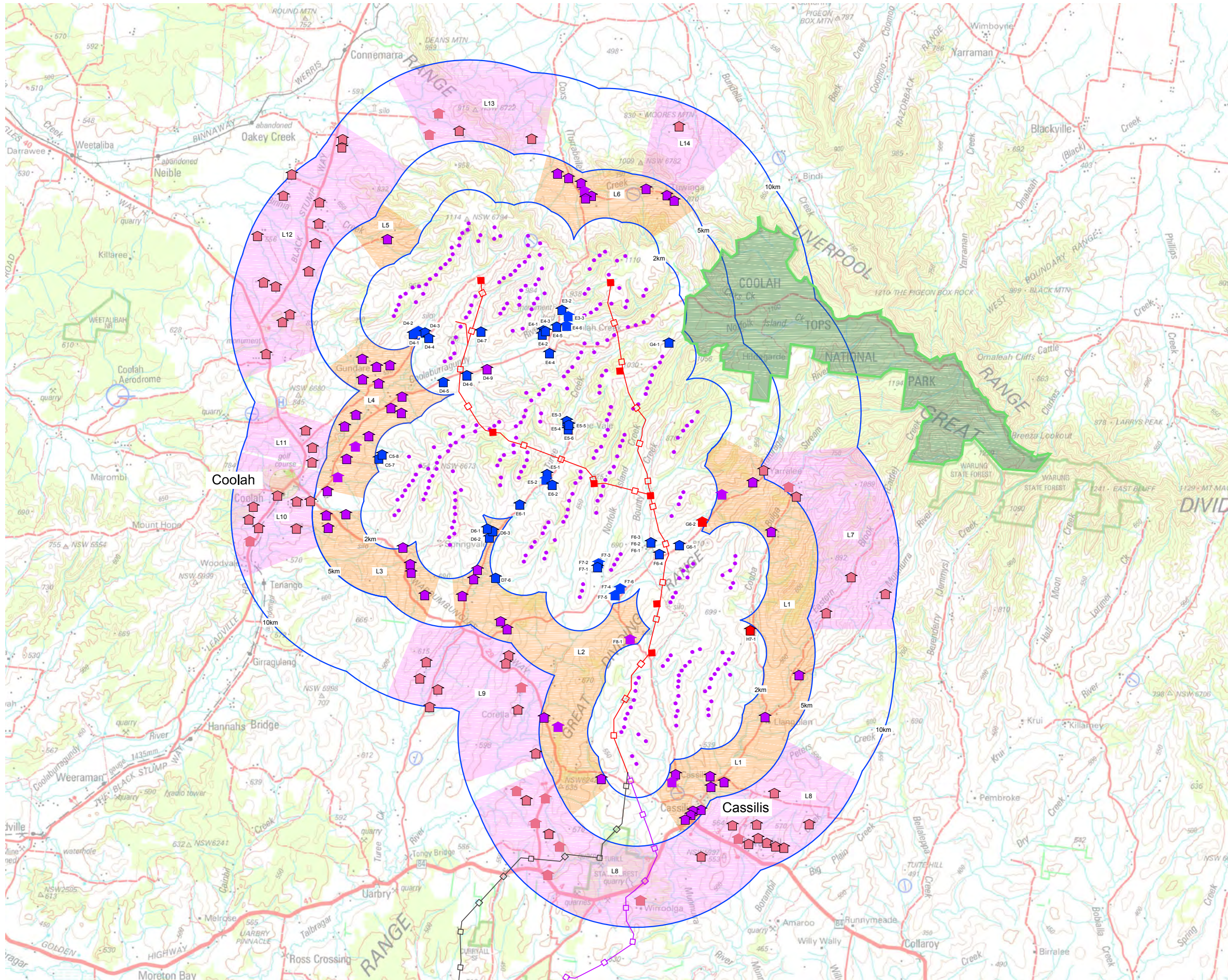
Criteria	Definition
Medium	81 – 200 wind turbines visible from hub height
Low	41 – 80 wind turbines visible from hub height
Very low	1 – 40 wind turbines visible from hub height

The levels of view sensitivity and scale or magnitude of change outlined in **Table 17** is used **as a guide** to determine levels of visual significance.

Table 18 Visual significance matrix

		Scale or magnitude of change in view caused by proposed development				
		High	Medium	Low	Very Low	
		Very short distance view over a long duration of time. A high extent of wind turbine visibility will tend to dominate the available skyline view and significantly disrupt existing views or vistas.	Short to medium distance views over a medium duration of time. A moderate extent of wind turbine visibility will have the potential to dominate available views with visibility recessing over increasing distance.	Medium to long distance views over a low to medium duration of time. Wind turbines in views, at long distances or visible for a short duration not expected to be significantly distinct in the existing view.	Visible change perceptible at a very long distance, or visible for a very short duration, and/or is expected to be less distinct within the existing view.	
Sensitivity of visual receptor	High	Indicator Large numbers of viewers or those with proprietary interest and prolonged viewing opportunities such as residents and users or visitors to attractive and/or well-used recreational facilities. Views from a regionally important location whose interest is specifically focussed on the landscape	High	Medium to High	Medium	Low to Medium
	Medium	Medium numbers of residents and moderate numbers of visitors with an interest in their environment e.g. visitors to State Forests, such as bush walkers and horse riders etc.... Larger numbers of travellers with an interest in their surroundings	Medium to High	Medium	Low to medium	Low
	Low	Low numbers of visitors with a passing interest in their surroundings e.g. those travelling along principal roads. Viewers whose interest is not specifically focussed on the landscape e.g. workers, commuters.	Medium	Low to Medium	Low	Very low to low
	Very Low	Very low numbers of viewers or those with a passing interest in their surroundings e.g. those travelling along minor roads.	Low to Medium	Low	Very low to low	Very low

This table is used as a guide only. The descriptions of magnitude and sensitivity are illustrative only. Each case is assessed on its own merits using professional judgement and experience, and there is no defined boundary between levels of impacts.



Legend

- Proposed Liverpool Range wind turbine (indicative location)
- Coolah Tops National Park
- Involved residential dwelling within 2 km of wind turbine
- Uninvolved residential dwelling within 2 km of wind turbine
- Uninvolved residential dwelling between 2 km and 5 km of wind turbine
- Uninvolved residential dwelling between 5 km and 10 km of wind turbine
- Area between 2 km and 5 km of wind turbines
- Area between 5 km and 10 km of wind turbines
- Distance from proposed Liverpool Range wind turbine
- Proposed 330 kV powerline route within wind farm project area
- Option 1 330 kV powerline route (project area to Ulan substation)
- Option 2 330 kV powerline route (project area to Ulan substation)

Figure 16
Residential dwellings

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0km 10km



8.2 Residential view location matrix

Table 19 – Residential view location matrix (Refer **Figure 16** for residential view locations)

View location (Refer to Figure 16)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
H7-1	Uninvolved landowner Residential dwelling High sensitivity	Very low	Short 1,778 m	High	Very Low	The property has been purchased as an environmental offset and the residential dwelling is unoccupied. Views toward the closest wind turbines are screened by topography and vegetation surrounding the residential dwelling. Views toward the closest visible turbines occur from the east side of the property at a distance of around 2,900 m.	Low
G6-2	Uninvolved landowner Residential dwelling High sensitivity	Very low	Short 1,858 m	High	Very Low	The property has been purchased as an environmental offset and the residential dwelling is unoccupied. Views toward the closest wind turbines are partially screened by vegetation surrounding the residential dwelling.	Low to Medium
G6-1	Involved landowner Residential dwelling High sensitivity	Very low	Short 1,402 m	High	Low	Views south will extend toward wind turbines elevated on hillside. Views north will be partially screened by tree planting surrounding residential dwelling.	Medium
F6-4	Involved landowner Residential dwelling	Very low	Short 1,769 m	High	Very Low	Views from the residential dwelling and surrounding garden will extend toward wind turbines on hills to the west, north and east of the property. Some partial screening will be provided by tree	High

Table 19 – Residential view location matrix (Refer Figure 16 for residential view locations)

View location (Refer to Figure 16)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
	High sensitivity					planting within and surrounding the garden.	
F6-1 to F6-3	Involved landowner Residential dwellings High sensitivity	Very low	Short 1,993 m	High	Low to Medium	Views from the residential dwelling toward wind turbines will be partially screened by tree planting around the dwelling.	Medium
F7-4 to F7-6	Involved landowner Residential dwellings High sensitivity	Very low	Short 1,305 m	High	Low to Medium	Views extend toward wind turbines on hilltops to the west and east of the dwellings with some partial screening provided by tree planting surrounding dwellings.	Medium
F7-1 to F7-3	Involved landowner Residential dwellings High sensitivity	Very low	Very short 810 m	High	Low to Medium	Short distance views will extend to wind turbines south of the residential dwelling with existing tree planting surrounding residential dwelling providing partial screening toward wind turbines north and north east of the dwelling.	Medium
F-81	Uninvolved landowner Residential dwelling High	Very low	Short 2,588 m	High	Medium	Elevated and distant views toward wind turbines along hills and ridgelines. Views toward closest wind turbines partially screened by tree planting around residential dwelling.	Medium

Table 19 – Residential view location matrix (Refer Figure 16 for residential view locations)

View location (Refer to Figure 16)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
	sensitivity						
D7-6	Involved landowner Residential dwelling High sensitivity	Very low	Short 2,081 m	High	Very Low	Views toward wind turbines will be partially screened by tree cover surrounding the residential dwelling.	Low to Medium
D6-1 to D6-3	Involved landowner Residential dwellings High sensitivity	Very low	Short 2,184 m	High	Low to Medium	Views toward wind turbines will be partially screened by tree cover surrounding the residential dwelling.	Medium
E6-1	Involved landowner Residential dwelling High sensitivity	Very low	Short 1,681 m	High	Medium	Views toward wind turbines will be partially screened by tree cover surrounding the residential dwelling.	Medium
E5-1, E5-2 and E6-2	Involved landowner Residential dwellings High sensitivity	Very low	Short 1,400 m	High	Low to Medium	Views toward wind turbines will be partially screened by tree cover surrounding the residential dwellings.	Medium

Table 19 – Residential view location matrix (Refer Figure 16 for residential view locations)

View location (Refer to Figure 16)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
E5-3 to E5-6	Involved landowner Residential dwellings High sensitivity	Very low	Very short 730 m	High	Low to Medium	Views toward wind turbines will be partially screened by tree cover surrounding the residential dwellings.	Medium to High
G4-1	Involved landowner Residential dwelling High sensitivity	Very low	Very short 920 m	High	Medium	Very short distance view extends toward wind turbines along surrounding ridgelines.	Medium to High
E4-1 to E4-6, E3-2 and E3-3	Involved landowners Residential dwellings High sensitivity	Very low	Very short 680 m to 2,100 m	High	Low to Medium	Very short distance view extends toward wind turbines along surrounding ridgelines. Some partial screening provided by tree planting around residential dwellings.	Medium to High
E4-4	Involved landowner Residential dwelling High sensitivity	Very low	Short 1,400 m	High	Low	Short distance view extends toward wind turbines along surrounding ridgelines.	Medium to High

Table 19 – Residential view location matrix (Refer Figure 16 for residential view locations)

View location (Refer to Figure 16)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
D4-9	Uninvolved landowner Residential dwelling High sensitivity	Very low	Short 2,243 m	High	Medium	Short distance view extends toward wind turbines along surrounding ridgelines.	Medium to High
D4-7	Involved landowner Residential dwelling High sensitivity	Very low	Short 1,324 m	High	Low to Medium	Short distance view extends toward wind turbines along surrounding ridgelines.	Medium to High
D4-6	Involved landowner Residential dwelling High sensitivity	Very low	Short 1,560 m	High	Medium	Short distance view extends toward wind turbines along surrounding ridgelines.	Medium to High
D4-5	Involved landowner Residential dwelling High sensitivity	Very low	Short 1,320 m	High	Medium	Short distance view extends toward wind turbines along surrounding ridgelines.	Medium to High

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View location (Refer to Figure 16)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
D4-1 to D4-4	Involved landowner Residential dwelling High sensitivity	Very low	Short 1,850 m	High	Low to Medium	Short distance views from residential dwellings toward wind turbines will extend north west to east along parallel ridgelines extending north east from the residential dwellings.	Medium to High
C5-7 and C5-8	Involved landowner Residential dwelling High sensitivity	Very low	Short 1,735 m	High	Very Low	Short distance views toward the closest wind turbines within the central portion of the Project area will be partially screened by landform rising to the east of the dwellings.	Low to Medium
Assessment of residential dwelling between 2 km and 5 km of the proposed Liverpool Range wind turbines (Refer Figure 16 for locations)							
L1	Uninvolved landowners Residential dwellings High sensitivity	Very low	Short to Medium 2,000 m to 5,000 m	High	Very low	Views toward turbines within the south portion of the Project area will be partially screened through a combination of landform and tree cover.	Low to Medium
L2	Uninvolved landowners Residential dwellings High	Very low	Short to Medium 2,000 m to 5,000 m	High	Very Low to Low	Views will extend along and across valleys toward wind turbines located on hilltop and ridgeline areas. Some residential dwellings will have partial screening through tree planting surrounding dwellings.	Medium

Table 19 – Residential view location matrix (Refer Figure 16 for residential view locations)

View location (Refer to Figure 16)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
	sensitivity						
L3	Uninvolved landowners Residential dwellings High sensitivity	Very low	Short to Medium 2,000 m to 5,000 m	High	Very Low to Low	Views will extend along and across valleys toward wind turbines located on hilltop and ridgeline areas. Some residential dwellings will have partial screening through tree planting surrounding dwellings.	Medium
L4	Uninvolved landowners Residential dwellings High sensitivity	Very low	Short to Medium 2,000 m to 5,000 m	High	Low to Medium	Views will extend along and across valleys toward wind turbines located on hilltop and ridgeline areas. Some residential dwellings will have partial screening through tree planting surrounding dwellings.	Medium
L5	Uninvolved landowners Residential dwellings High sensitivity	Very low	Short to Medium 2,000 m to 5,000 m	High	Very Low	Views from residential properties will be largely restricted to wind turbines elevated along the northern edge of the Project area.	Medium
L6	Uninvolved landowners Residential dwellings High sensitivity	Very low	Short to Medium 2,000 m to 5,000 m	High	Very Low	Views from residential properties will be largely restricted to wind turbines elevated along the northern edge of the Project area.	Low to Medium

Table 19 – Residential view location matrix (Refer Figure 16 for residential view locations)

View location (Refer to Figure 16)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
Assessment of residential dwelling between 5 km and 10 km of the proposed Liverpool Range wind turbines (Refer Figure 16 for locations)							
L7	Uninvolved landowners Residential dwellings High sensitivity	Very low	Long 5,000 m to 10,000 m	High	Very Low	Views toward wind turbines within the east portion of the Project area from a small number of rural residential properties to the south and west of Cassilis. A number of these dwellings will have some level of screening provided by surrounding landform and existing tree planting surrounding and beyond the dwellings.	Low
L8	Uninvolved landowners Residential dwellings High sensitivity	Very low	Long 5,000 m to 10,000 m	High	Low	Views will extend toward wind turbines within the south portion of the Project area from a small number of rural residential properties to the south and west of Cassilis. A number of these dwellings will have some level of screening provided by surrounding landform and existing tree planting surrounding and beyond the dwellings.	Low
L9	Uninvolved landowners Residential dwellings High sensitivity	Very low	Long 5,000 m to 10,000 m	High	Low to Medium	Views will extend toward wind turbines within the central and south portion of the Project area from a small number of rural residential properties to the south of Coolah. A number of these dwellings will have some level of screening provided by existing tree planting surrounding and beyond the dwellings.	Low to Medium
L10	Uninvolved landowners Residential dwellings High	Very low	Long 5,000 m to 10,000 m	High	Low	Views will extend toward wind turbines within the south west portion of the Project area from a small number of rural residential properties to the south of Coolah. A number of these dwellings will have some level of screening provided by existing tree planting	Low

Table 19 – Residential view location matrix (Refer Figure 16 for residential view locations)

View location (Refer to Figure 16)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
	sensitivity					surrounding and beyond the dwellings.	
L11	Uninvolved landowners Residential dwellings High sensitivity	Very low	Long	High	Medium	Views will extend toward wind turbines within the west and north west portion of the Project area from a small number of rural residential properties to the north of Coolah. Tree cover surrounding some dwellings will provide screening potential to residential dwellings.	Low
L12	Uninvolved landowners Residential dwellings High sensitivity	Very low	5,000 m to 10,000 m	High	Very Low	Views toward wind turbines within the north west and west portion of the Project area will be partially screened and/or restricted in extent by a combination of landform rising to the south east of the residential properties. A number of rural residential and homesteads will also have views toward the wind turbines restricted, or partially filtered, by tree planting within gardens surrounding residential dwellings.	Low
L13	Uninvolved landowners Residential dwellings High sensitivity	Very low	Long 5,000 m to 7,000m	High	Very Low	Views toward wind turbines within the north and north west portion of the Project area will be largely screened by a steep landform rising to the south of the residential properties.	Low
L14	Uninvolved landowners Residential	Very low	Long 5,000 m to 10,000 m	High	Very Low	Views toward wind turbines within the north portion of the Project area will be largely screened by landform rising to the south west of the residential properties, together with tree cover along	Low (and primarily Nil)

Table 19 – Residential view location matrix (Refer **Figure 16** for residential view locations)

View location (Refer to Figure 16)	Category of view location and sensitivity	Relative number of people	Approximate distance to closest turbine	Duration of effect	Extent of visibility (ZVI hub height)	Degree of visibility	Visual significance
	dwellings High sensitivity					ridgeline areas extending north to north west from the Coolah Tops National Park.	

8.3 Summary of residential visual significance (within 2 km of wind turbines)

This LVIA identified a total of 23 involved and uninvolved residential view locations within the Liverpool Range wind farm 2 km viewshed. Unoccupied residential dwellings have been included and assessed as part of this LVIA where structures and buildings were considered to be habitable at the time of the field work. An assessment of each potential residential view location indicated that for the Liverpool Range wind turbine design layout:

- 1 of the 23 residential view locations has been determined to have a low visual significance;
- 3 of the 23 residential view locations have been determined to have a low to medium visual significance;
- 9 of the 23 residential view locations have been determined to have a medium visual significance;
- 9 of the 23 residential view locations have been determined to have a medium to high visual significance; and
- 1 of the 23 residential view locations has been determined to have a high visual significance.

The field assessment for the majority of residential view locations was undertaken from the closest publicly accessible location, with a conservative approach adopted where there was no opportunity to confirm the actual extent of the available view from areas within or immediately surrounding the residence. It is anticipated that some visibility ratings will be less than those determined subject to a process of verification from private property.

8.4 Summary of residential visual significance (beyond 2 km of wind turbines)

The majority of residential dwellings located beyond a 2 km distance from the wind turbines are unlikely to be significantly impacted by the wind farm development and have been determined to have an overall low to medium and medium visual significance between 2 km and 5 km of the wind turbines. The localised influence of topography, as illustrated in the ZVI diagrams, has some direct and marked impact on the extent and nature of views within the 2 km and wider viewshed.

8.5 Towns and localities

There are a small number of towns and localities (which include a small number of dwellings), that surround the Liverpool Range wind farm Project area and occur partially or wholly within the 10 km viewshed. Those within the 10 km viewshed include:

- Cassilis (located to the southern boundary of the Project site and around 4 km from the closest wind turbine); and
- Coolah (approximately 4.6 km to the west of the Project site and 6.5 km from the closest wind turbine).



Plate 8 – Royal Hotel, Buccleugh Street - Cassilis

8.5.1 Cassilis

Cassilis is a small village (formerly known as Dalkeith) and is accessed via the Merriwa Road from the Golden Highway around 1.3 km to the south of the village. The village is located on gently to moderately sloping land to the west of the Munmurra River. The closest wind turbine will be located approximately 4.2 km to the north west of the Cassilis Public School and will not be visible from residential dwellings, the Public School or public spaces within Cassilis due to rising landform to the

north west of Cassilis. Views toward wind turbines north of Cassilis will also be screened by undulating landform and scattered tree cover within and beyond the village.

8.5.2 Coolah

Coolah is a small town to the west and approximately 6.5 km from the closest Liverpool Range wind turbine. The town is located to the west of the Coolaburragundy River valley and rises gently to the west toward a timbered undulating landform. There are various opportunities to gain long distance views toward a small number of wind turbines within the central west portion of the wind farm site; however, views from many of the streets within Coolah are screened and partially filtered by street tree planting and trees within residential properties.

The Liverpool Range wind farm is not expected to have a significant visual impact on residential dwellings and public view locations within the Cassilis and Coolah localities. This is primarily due to the screening influence of undulating landform, tree cover within the urban areas, as well as the distance between the wind farm and potential view locations within these rural localities.



Plate 9 – Typical view north toward Cassilis from Golden Highway (wind turbines will be visible at approximately 5 to 6 km above and beyond Cassilis, but largely screened from views within Cassilis by landform and tree cover).



Plate 10 – Typical view west toward Coolah from Coolah Creek Road.

8.6 Future residential dwellings

In general existing residential dwellings in the vicinity of the wind farm are located below surrounding ridgelines to maximise potential for shelter from prevailing wind, and/or where exposed tend to include a degree of shelter from windbreak planting or tree planting around dwellings. The tendency to locate residential dwellings in sheltered situations also acts to limit the extent of available views across the surrounding landscape for the majority of residential view locations, although there are a small number of dwellings that appear to have been located on properties to take advantage of distant and panorama views.

Potential future planning considerations for residential dwellings will be able to take advantage of any approved layout design for the Liverpool Range wind farm when determining the optimal location for residential dwellings on individual portions of land to minimise views toward wind turbines if desired. In some circumstances future residential dwellings could be located to take advantage of local topographic features in order to screen views toward wind turbines or implement in advance mitigation measures such as tree planting for windbreak and/or screening purposes.

Should residential dwellings be constructed on existing portions of land immediately adjacent to the wind farm site, there is likely to be an associated visual impact not only with additional residential structures within the landscape but also a range of domestic infrastructure associated with it.

8.7 Local roads

There are a small number of local roads that pass through the wind farm Project area including the:

- Rotherwood Road;
- Turee Creek Road;
- Coolah Creek Road; and
- Gundaree Road.

Views from vehicles travelling along local roads within the Project site will include a combination of very short to long distance direct and indirect views toward wind turbines. Whilst wind turbines may be visible whilst driving through the Project site, it is likely that the majority of journeys within the Project site will be those undertaken by residents involved with the Project.

Views from the Cassilis, Coolah and Vinegaroy Roads (between the Golden Highway, Cassilis and Coolah) will include direct and indirect views toward wind turbines in the south and central portions of the Project area up to a distance of 2km and 5 km from the wind turbines. The potential visibility of the Project will decrease slightly for vehicles travelling north west to south east.

Views from small portions of the road corridor between Coolah and Cassilis will be screened by landform and/or tree planting alongside or beyond the road corridor. The Liverpool Range wind farm will be unlikely to have a significant visual impact on motorists travelling along the Cassilis and Coolah roads.

The Golden Highway extends east to west below the Project area between a distance of 5 km and 10 km from the closest wind turbine and provides a sequence of contained and open views from the road corridor. Distant and very short duration views toward wind turbines in the south portion of the Project area will occur from a section of the highway between Borambil and Cassilis, but will not tend to result in a significant visual impact.

8.8 Coolah Tops National Park

The Coolah Tops National Park is located to the north east of the wind farm and around 2 km from the closest wind turbine. The Park contains a number of established and formalised camp sites and day use areas. These are located and identified on **Figure 49**. The camp site and day use areas are located within densely timbered areas and views toward the wind farm will be screened by tree cover and landform to the south west of the Park.

There are three scenic lookouts within the Park and include the Pinnacle Lookout, the Breeza Lookout and Shepherd Peak Lookout. The Lookouts are located within the north and east portion of the National Park and provide extensive views across the landscape to the north and north east of the Park. The lookouts will not provide any significant opportunity to view the Liverpool Range wind turbines.

Whilst this LVIA has determined that some recognisable characteristics of the landscape will be altered by the Project and result in the introduction of visually prominent elements that will alter some perceived landscape characteristics, the visual and landscape characteristics of the Coolah Tops National Park, as experienced within the Park, will not be altered by the wind farm.

Cumulative assessment

Section 9

9.1 What is cumulative assessment?

A cumulative impact could result from a proposed wind farm development being constructed in conjunction with other existing or proposed wind farm developments, and could be either associated or separate to it.

Separate wind farm developments could occur within the established viewshed of the proposed wind farm, or be located within a regional context where visibility is dependent on a journey between each site or an individual Project viewshed. Cumulative impacts presented by multiple wind farm developments may be presented as 'direct', 'indirect' or 'sequential' impacts.

- 'direct' cumulative visual impacts could occur where two or more wind farms have been constructed within the same locality, and could be viewed from the same view location simultaneously.
- 'indirect' cumulative visual impacts could occur where two or more wind farms have been constructed within the same locality, and could be viewed from the same view location but not within the same field of view.
- 'sequential' cumulative visual impacts could arise as a result of multiple wind farms being observed at different locations during the course of a journey (e.g. from a vehicle travelling along a highway or from a network of local roads), which could form an impression of greater magnitude and impact within the construct of short term memory.

9.2 State and regional wind farm developments

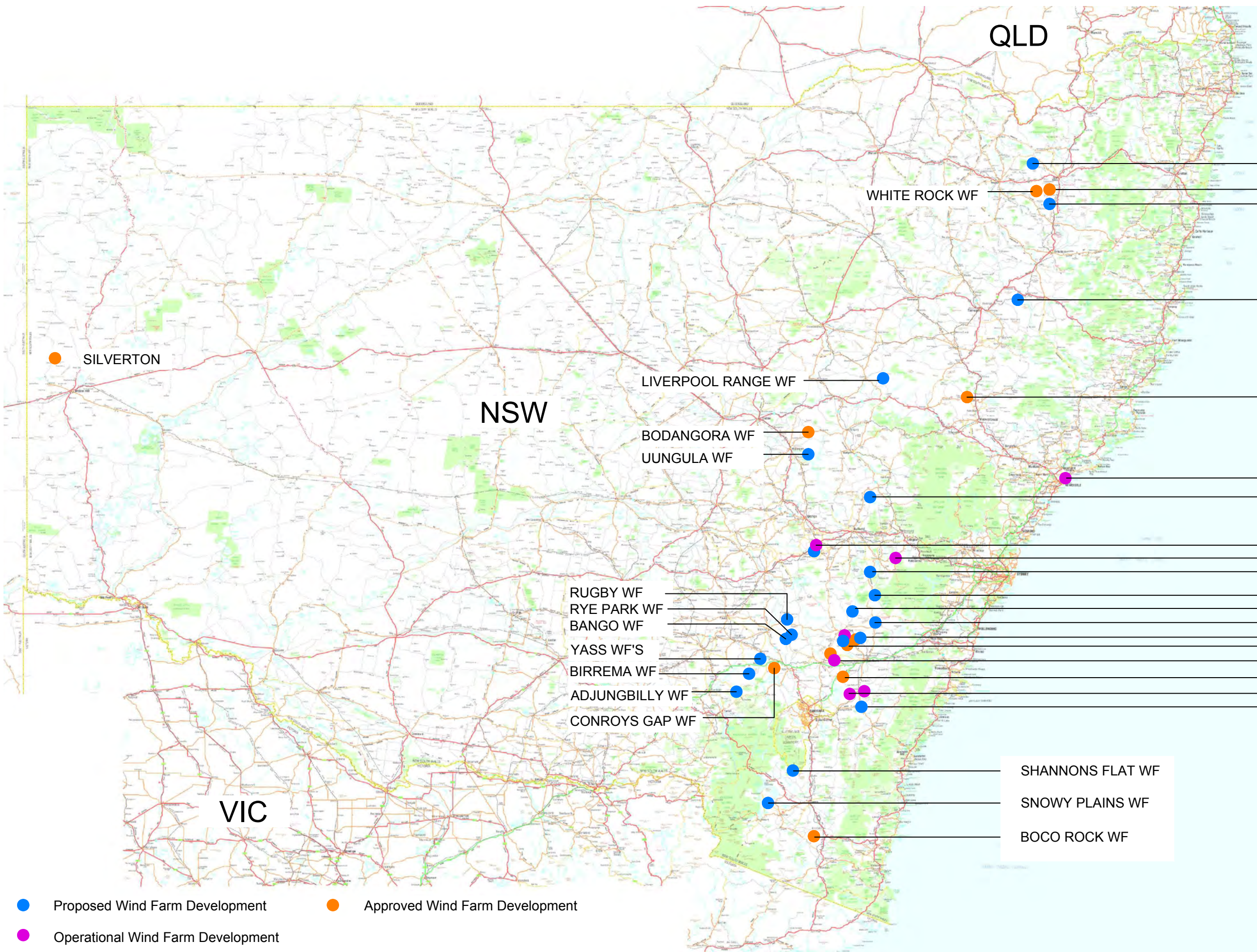
There are a number of proposed, approved and operating wind farm developments within New South Wales which are illustrated in **Figure 17**. The number and location of wind farms is likely to change as more wind farm projects are announced and enter the state or local planning system.

The Kyoto wind farm development is currently the only approved wind farm development in the Upper Hunter Renewable Energy Precinct. With an approval for up to 34 wind turbines, the Kyoto wind farm development has yet to commence construction. The Liverpool Range wind farm

development will be located approximately 70 km to the west of the Kyoto project site, therefore the opportunity for any significant 'direct' or 'indirect' visual impacts are likely to be negligible.

'Sequential' visual impacts will be limited by the absence of additional wind farm developments within the regional context and will not be expected to be significant between the approved Kyoto wind farm development and the Liverpool Range Project.

GBD is not aware of any smaller wind farm developments that are currently lodged, or being assessed by the relevant local government authorities.



- Proposed Wind Farm Development
- Approved Wind Farm Development
- Operational Wind Farm Development

- SAPPHIRE WF
- GLEN INNES WF
- BEN LOMOND WF
- WOOLBROOK WF
- KYOTO ENERGY PARK WF
- KOORAGANG WF
- CRUDINE RIDGE
- BLANEY/FLYERS CREEK WF
- HAMPTON PARK WF
- BLACK SPRINGS WF
- PALING YARDS WF
- GOLSPIE WF
- TARALGA WF
- CROOKWELL & BIALA WF'S
- GULLEN RANGE WF
- CULLERIN & GUNNING WF'S
- COLLECTOR WF
- CAPITAL & WOODLAWN WF'S
- JUPITER WF

Figure 17
NSW wind farms
(as of December 2013)

EPURON

Liverpool Range Wind Farm Pty Ltd

LIVERPOOL RANGE WIND FARM

Not to scale



GREEN BEAN DESIGN

landscape architects

Photomontages

Section 10

10.1 Photomontages

The DGR's state that the EA must *"include photomontages of the project taken from potentially affected residences (including approved but not yet developed dwellings or subdivisions with residential rights), settlements and significant public view points..."*

Whilst it is possible for any residential dwelling with a view toward the Project turbines to be potentially affected (with a resultant high, moderate or low impact), it is not feasible or practical to prepare a photomontage for each and every residential dwelling within the Project 10 km viewshed.

A total of 11 photomontage locations were selected to represent uninvolved residential dwellings and public view locations from surrounding road corridors. The photomontages locations are illustrated in **Figure 18** and are presented in **Figures 19 to 40**.

10.2 Photomontage preparation

The photomontages have been prepared with regard to the general guidelines set out in the Scottish Natural Heritage (2006) Visual representation of windfarms: good practice guidance and British Landscape Institute Advice Note 01/11 (March 2011) Photography and photomontage in landscape and visual impact assessment.

Photography for the photomontages was undertaken by GBD using tripod mounted Nikon D700 a digital single-lens reflex (SLR) camera. A 50 mm focal length prime lens was attached to the Nikon D700 and D90 SLR cameras.

The Nikon D700 has a full frame image sensor (36 x 23.9 mm Nikon FX format), and when mounted with a 50mm lens results in a single photographic image with a view angle equivalent to a 35 mm SLR camera with a 50 mm lens. The 50 mm lens is commonly utilised, and cited in landscape and visual assessment manuals and guidelines, for the preparation of landscape and visual assessment photomontages. Following site photography the photomontages were generated through the following steps:

- a digital terrain model (DTM) of the Project site was created from a terrain model of the surrounding area using digital contours;