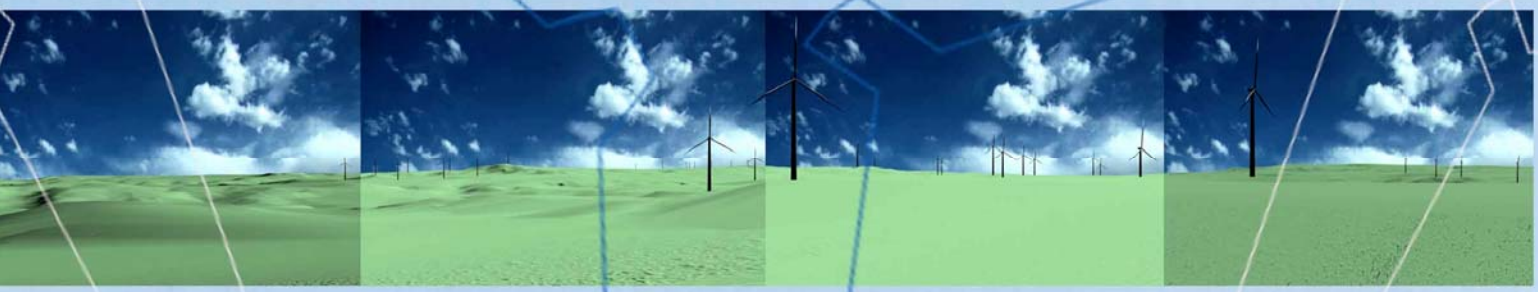
APPENDIX C - REVIEW OF THE CROOKWELL II WIND FARM EIS VISUAL ASSESSMENT (JANUARY, 2005)

Review of the Crookwell II Wind Farm EIS Visual Assessment

Summary Working Document

For

The New South Wales Department of Infrastructure, Planning and Natural Resources



Prepared by

Scenic Spectrums Pty Ltd
Scenic, Recreation and Tourism Planning & Design

January 2005

REVIEW OF THE CROOKWELL II WIND FARM EIS VISUAL ASSESSMENT

SUMMARY WORKING DOCUMENT

Prepared January 2005 for:

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By:

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19 January 2005

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1.0 INTRODUCTION

1.1 Background

This report is an independent review of the Proposed Crookwell II Wind Farm Environmental Impact Statement (EIS) Visual Assessment prepared by Scenic Spectrums for the New South Wales Department of Infrastructure, Planning and Natural Resources (DIPNR).

The Wind Farm Joint Venture Group (WFJV) have submitted an Development Application for 55 wind turbines, access roads, a substation and underground cables in the upper Wollondilly Valley area in the Southern Tableland Region of New South Wales (refer to Figure 1 for vicinity plan).

The project aims have been to:

1. Identify the visual effect of the wind farm on the broad landscape of the area

2. Identify the specific visual effects of the wind farm on surrounding properties, and identify potential methods to ameliorate these impacts

1.2 Methods

The methods used include field reviews, a DIPNR workshop with EIS submission stakeholders in Crookwell, consultations with selected owners of properties potentially visually affected, desktop reviews and computer analyses.

The Scenic Spectrums Visual Evaluation Model (SS-VEM^{TM} – Scenic Spectrums and Williamson, 2003) has been used to:

1. assess and map a series of **visual significance zones** based on the combination of viewpoints and viewshed (visibility) distance zones (mapped and classified by viewer sensitivity levels)

2. assess **landscape character and scenic quality** utilising available information and research on relevant stakeholder perceptions and attitudes

3. develop **visual performance standards** for each visual significance zone

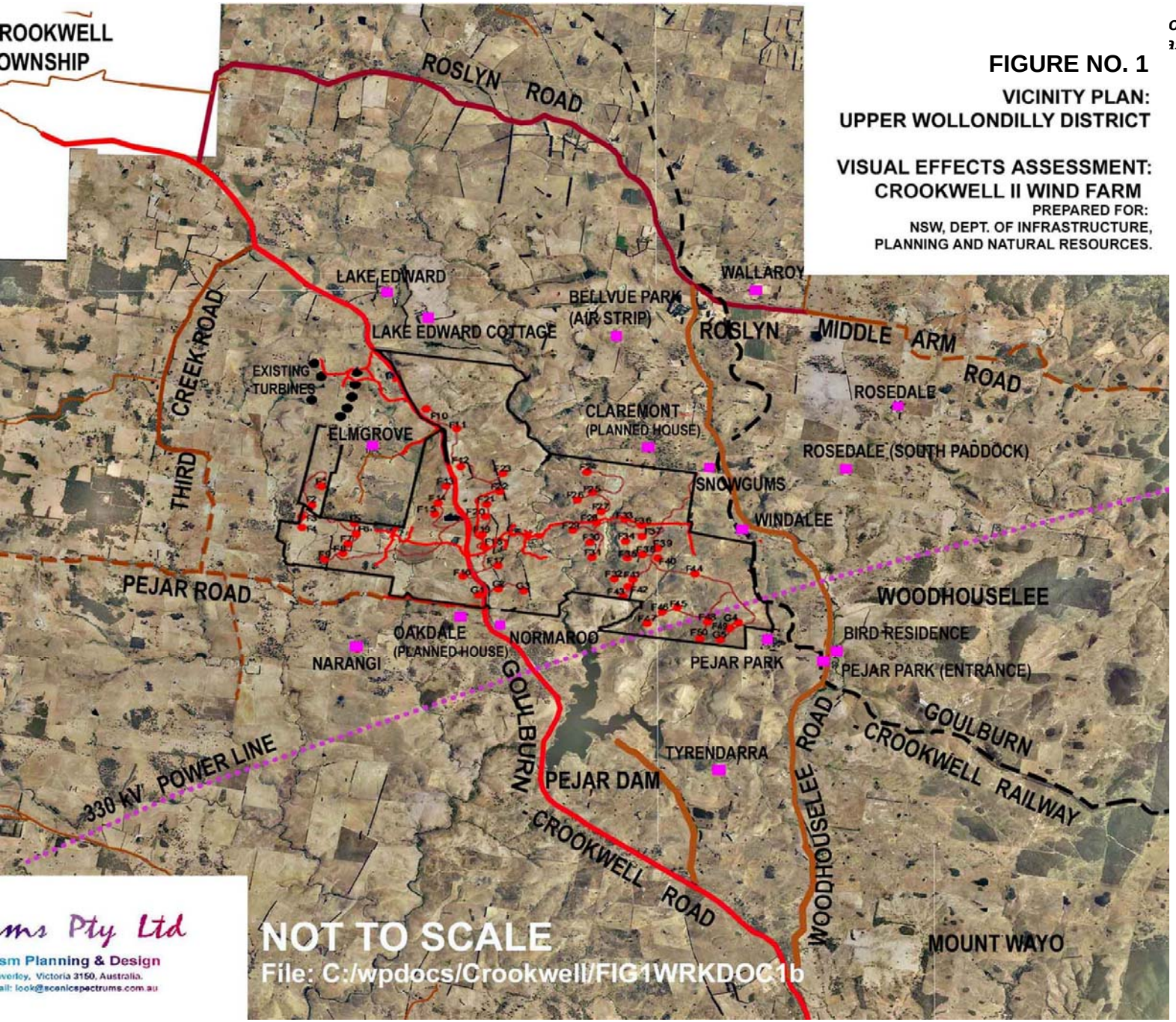
4. provide a **benchmark for the assessment of the visual effects** of the proposed wind farm **on existing landscape character, scenic integrity and scenic quality**

5. assess **potential visual impacts** and develop of a range of **visual impact minimisation options** using various visual analyses, illustration and computer simulation techniques

FIGURE NO. 1

VICINITY PLAN:
UPPER WOLLONDILLY DISTRICT

VISUAL EFFECTS ASSESSMENT:
CROOKWELL II WIND FARM
PREPARED FOR:
NSW, DEPT. OF INFRASTRUCTURE,
PLANNING AND NATURAL RESOURCES.



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1.3 Consultations

Scenic Spectrums consultations with the community were undertaken selectively based on DIPNR lists of property owners. The lists were limited to those who had made EIS submissions and whose properties may be visually affected by the proposed development.

Contacts were made during the last week of November and during the first week of December, 2004, through three mechanisms:

1. telephone interviews;

2. on-site interviews;

3. a DIPNR workshop in Crookwell on 30 November.

Altogether, 14 property owners were contacted by telephone and site visits were made to 16 properties.

Forty-seven individuals attended the Crookwell workshop. A more detailed summary and analysis of the Crookwell workshop is provided by Quatro Communication Group (2004).

Lists of those contacted by telephone and on site visits are provided in Appendix 1.

1.4 End Result

This review has provided a complete review of the EIS visual assessment (refer to Section 2).

This review has also assessed the existing visual situation covering issues of community perceptions and attitudes, scenic quality, landscape character, viewsheds, etc. to derive maps of visual significance zones and to develop specific visual performance standards (refer to Sections 3 and 4).

The end result of this review has been the development of 3 basic alternative courses of actions:

1. approve the wind farm development application as proposed
2. reject the application on the basis of unacceptable visual effects, or
3. approve under specified conditions.

The third course of action is recommended and 15 wind farm options have been developed and assessed (refer to Section 5 and Table 11). Through a process of elimination, the 15 options have been narrowed to three for further consideration. One of these is preferred by Scenic Spectrums.

Wind Farm Options Recommended for Consideration

The options remaining for consideration include:

- Option 6 (refer to Table 11 and Figure 5)
- Option 8 (refer to Table 11and Figure 6)
- Option 9 (refer to Talble 11and Figure 6).

Option 6

Option 6 would allow the proposed wind farm under the following conditions:

- exclude or relocate turbines from within 1 km of high sensitivity residences
- exclude or relocate of turbines from local landmarks and focal points
- special individual colouring of wind turbines to reduce their visual contrast and impact , allowing them to better blend into the landscape
- provision of tree plantings along the Goulburn-Crookwell Road and on intervening spur ridges to effectively screen the turbines and direct motorists and residents visual attention away from the turbines as much as possible.

The greatest visual drawback of Option 6 would be the continuation of many turbines within a relatively short distance of the Goulburn-Crookwell Road given local concerns for the views from this section of road.

Option 8

Option 8 would allow the proposed wind farm under the following conditions:

- exclude or relocate turbines to areas outside a 500 m setback from Goulburn-Crookwell Road
- exclude or relocate turbines from within 1 km of high sensitivity residences
- exclude or relocate turbines from local landmarks and focal points
- provision of the planting of intervening ridges, gullies and the Wollondilly River Valley to achieve effective vegetative screening and scenic enhancement.

The major visual drawback of Option 8 is the lack of colouring of turbine towers and blades to better blend in with the landscape.

Option 9

Option 9 is Scenic Spectrums' most preferred option. It would allow the proposed wind farm under the following conditions:

- exclude or relocate turbines to areas outside a 500 m setback from Goulburn-Crookwell Road
- special individual colouring of wind turbines to reduce their visual contrast and impact , allowing them to better blend into the landscape
- exclude or relocate turbines from within 1 km of high sensitivity residences
- exclude or relocate turbines from local landmarks and focal points
- planting of intervening ridges, gullies and the Wollondilly River Valley to achieve effective vegetative screening and scenic enhancement.

Option 9 is preferred from a visual standpoint because it would most effectively minimise the potentially significant adverse visual effects of the wind farm while allowing the development to become established in a more harmonious with the scenic values and concerns of the local community.

2.0 FINDINGS REGARDING THE EIS VISUAL ASSESSMENT

Findings regarding the EIS visual assessment are presented under key issues in Table 1.

The EIS visual assessment is well done regarding some of the issues. Many other issues could have been addressed more fully and rigorously.

3.0 SCENIC PERCEPTIONS, LANDSCAPE CHARACTER, FEATURES, SCENIC QUALITY, VIEWPOINTS AND VIEWSHEDS

3.1 Community Perceptions of Scenic Quality and Wind Farms

Few individual landscape features of scenic significance emerged, aside from views of Pejar Dam and the sweeping views possible from the Goulburn-Crookwell Road.

Most people consulted believe the upper Wollondilly area is of very high scenic quality.

Those consulted especially value the pastoral character, peacefulness and tranquillity of the area, the very wide horizon lines and panoramic views afforded by the tablelands location on the Great Dividing Range (the "big sky" quality), and local landmark features (e.g. Monument Hill, Pigmans Hill, Table Mount, Pejar Dam and it's backdrop). These factors, combined with their perceived sense of pastoral heritage/history, strongly form their sense of place in the landscape.

Table 1 Review of EIS Response to Fifteen Key Assessment Issues

Key Visual Issue	Comments
1. Location and visual description of all proposed landscape changes and modifications.	▪ A topographic contour plan with elevations and proposed turbines and roads would have improved description. ▪ More particulars are desirable on underground cabling.
2. Description of study area landscape (including existing natural/cultural landscape features, landscape character, landscape units or landscape setting units).	▪ Landscape unit description highly generalised and not tied in well with assessment. ▪ Landscape setting units based on localised areas of visual containment may improve description and analysis (refer to Fig. 2 of this report).
3. Maximum affected viewshed (viewing catchment or zone of visual influence).	▪ Primary viewing catchment mapped does not fully account for height of proposed turbines and underestimates visibility ranges, particularly to the east. Maximum zone of visual influence not assessed.
4. Potential viewpoints and viewing route locations.	▪ Viewpoints from surrounding rural residential and farm properties not fully addressed. ▪ Viewpoints in far middleground and background distances (4 – 20 km) not fully identified.
5. Visual sensitivity level of viewers and viewpoints.	▪ Viewer/viewpoint sensitivity rating confused with "visibility rating". ▪ Viewers categorised as/by "dynamic or static", viewing context, distance to nearest turbine, number (volume), period of view, and view elevation. ▪ Criteria and assumptions used not well substantiated.
6. Visibility from all key viewpoints/viewing routes based on terrain and vegetation.	▪ Handled in a general manner. ▪ Visibility of all proposed alterations viewed from all key viewpoints not detailed. ▪ Potential removal of existing vegetation not fully assessed.
7. Distance zones of visible areas from the viewpoints and potential visual magnitude of proposed modifications.	▪ Distance to nearest turbine from selected viewpoints provided. ▪ Total number of turbines viewed from selected viewpoints and their relative distances not provided. ▪ Distance zones from public roads and affected residences relative to the visual significance of different land areas not mapped or analysed.
8. Photographs of key views with written description and annotations of likely position of proposed modifications.	▪ Views photographed and described in Table 5 (Section 6 of Appendix F) not adequate. ▪ Full panoramic views of areas affected not shown. ▪ written description of each scene and the position/description of proposed modifications is not comprehensive.
9.Relevant scenic quality perception surveys, attitudinal surveys or other community consultations (including visual acceptability of proposed modifications).	▪ Results of any consultations or surveys of the local community not included. ▪ Only one scenic perception study from the UK is quoted, leaving impression that little research is available in this area and that most people find wind turbines visually acceptable once installed and not detrimental to perceived scenic quality levels. In fact, many different studies have been conducted with mixed results.

Table 1 continued…..

Key Visual Issue	Comments
10. Relative scenic quality of the existing landscape (using explicitly stated and credible criteria).	▪ EIS indicates high scenic quality in area of Pejar Dam and moderate scenic quality elsewhere, but provides no assessment criteria or mapping. ▪ Explicit criteria and mapping usually required, but Scenic Spectrums found similar, albeit marginally higher scenic qualities based on set criteria.
11. Areas or zones of relative visual/scenic significance based on the combination of viewshed distance zones from identified viewpoints, viewer sensitivity levels and scenic quality assessments.	▪ No assessment or mapping of the relative visual significance of different landscape areas within the study area and surrounding district. ▪ This is considered important in the assessment of relative visual effects and in determination of siting & design options.
12. Recommended desirable visual performance standards or visual quality objectives based on above information.	▪ Standards/objectives for assessment of capability of proposed alterations to meet a suitable standard for the landscape not provided for benchmark comparisons. ▪ Local planning scheme objectives and regulations not considered.
13. Sketches, photomontages or computer simulations depicting the proposed alterations from selected key viewpoints;	▪ Simulations appear accurate, but limited cone of view presented does not show all turbines visible from the selected viewpoints. ▪ Proposed roads and substation are not shown in simulations.
14. Potential relative visual effects of proposed alterations on the existing landscape character and scenic quality of the landscape based on all the above factors and the cumulative effect of the proposed alteration in conjunction with any other existing or planned alterations;	▪ Visual effects of individual and collective landscape modifications are not fully described and assessed. ▪ Assumptions re effects on landscape character and scenic quality are questionable; ▪ Existing Crookwell wind farm and 330 kv powerline not considered in assessment of cumulative effects
15. Recommended impact minimisation options or measures (including do nothing, alternative siting, reductions in mass, form, height or number of alterations, changes to colour/materials, screen plantings or vegetative blending; addition of complementary positive landscape features).	▪ Alternative siting of turbines and substation not adequately explored from visual standpoint. ▪ Limited exploration of colour options for turbines.

Consultations with individuals supporting and opposing the proposed wind farm indicate that different people do have different perceptions and attitudes toward wind farms and wind turbines, as indicated elsewhere in the EIS, but that the community appears to be fairly evenly divided in their attitudes.

Some think the wind turbines are elegant, graceful and beautiful cultural features, while others think that they are a monstrously imposing blight on the landscape that connote an industrial or distractingly busy landscape.

3.2 Landscape Character

A key finding is that the area is essentially typical of the many pastoral districts that occur throughout the New South Wales tablelands and uplands. The landscape represents and is typical of what may be referred to as a *Pastoral Tablelands and Valleys Landscape Character Type*.

Aside from the pastoral nature of the area, panoramic, long distance views and wide horizon lines are a special attribute of the study area. This is due to its location near the top of the Great Dividing Range and the extensively open grassland cover, which may be similar to the natural grassland cover that existed on the basalt tablelands prior to European settlement (Robertson, pers. com., 2004 and Eddy et. al., c. 2003). In relation to this, a number of local hills are important to the horizon line profile and scenic character of this area, forming landmarks and/or visual focal points that draw viewers attention or visually important backdrops or complementary elements to high scenic quality features such Mount Wayo and Pejar Dam. Local hills within the proposed development area that meet this description are indicated on Figure 2 and include:

- Monument Hill
- Park Hill
- Pejar Hill
- Pigmans Hill
- Table Mount

Other notable local features or focal points that contribute to the landscape character and quality of the area are indicated on Figure 2. The Wollondilly River Valley as a whole (Landscape Setting Unit 1, Figure 2) is also perceived as a scenically important feature of the area.

3.3 Scenic Quality

Employing the criteria set out in Table 2, features within the general study area of High Scenic Quality include:

- Mt Wayo
- Pejar Dam

The Upper Wollondilly District landscape is rated as of moderate or moderate to high scenic quality, except for the Pejar Dam area, which is of high scenic quality, based on:

- what we know of the study area's landscape features and characteristics
- what we can assess according to scenic quality frames of reference (Figure 2)
- available scenic quality research (e.g., Williamson & Chalmers, 1982 and Lothian, 2004, etc.).

The scenic quality findings are similar to, but perhaps slightly higher than, the EIS scenic quality assessment.

Justification is not found for areas within the proposed development site being rated as high or very high, despite many local residents opinion to the contrary.
On the other hand, the area has been found to be of moderate/moderate-high scenic quality and should not be dismissed as having no scenic value to the local and wider community.

It is important to note that scenic quality classification is based on the presence or absence of particular landscape features or attributes and is not dependent on the viewpoints from which the landscape is viewed or upon the sensitivity of the viewers who view it. However, the combinations of those factors are later accounted for in the designation of overall Visual Significance Zones.

3.4 Landscape Setting Units

Scenic Spectrums has delineated 12 Landscape Setting Units (LSUs – refer Figure 2) in which the landscape is experienced. Views may be contained within the LSUs, but often extend between units. A number of major district features and notable local features or focal points are shown on Figure 2, which are described in Section 3.2 as important to the landscape character and scenic quality of the area.

3.5 Public Viewpoints and Viewer Sensitivity Levels

Public viewpoints and the sensitivity level (relative concern for scenic values) of viewers are assessed independently from the scenic quality of the landscape. In other words, the scenic quality of the landscape is not dependent on the sensitivity level of the viewers (or viewpoints they use) and viewer sensitivity levels are not dependent on the scenic quality classification of the landscape viewed. These two elements are assessed independently and later considered in combination when developing Visual Significance Zones.

Table 2 Suggested Scenic Quality Classification – Frame of Reference for the Pastoral Tablelands and Valleys Landscape Character Type (Upper Wollondilly District)

Description	High Scenic Quality	Moderate Scenic Quality	Low Scenic Quality
Landforms	▪ Isolated peaks, tabletop hills, cones or escarpments with distinctive form and/or colour contrast that become focal points ▪ Larger areas of distinctive rock outcrops or boulders ▪ Well defined, steep sided valley gorges	▪ Rounded hills, ridges and peaks which are not overtly visually dominant, but which do form locally important features or focal points ▪ Broad shallow valleys ▪ Moderately deep gorges or moderately steep valley walls ▪ Minor rock outcrops	▪ Large expanses of indistinctly dissected or unbroken landforms that provide little illusion of spatial definition or landmarks with which to orient
Vegetation	▪ Strongly defined patterns with combinations of eucalypt forest, naturally appearing openings, streamside vegetation and/or scattered exotics ▪ Distinctive stands of vegetation that may create unusual forms, colours or textures in comparison to surrounding vegetation	▪ Predominantly open forest or woodland combined with some natural openings in patterns that offer some visual relief; ▪ Vegetative stands that exhibit a range of size, form, colour, texture and spacing	▪ Extensive areas of similar vegetation, such as grasslands with very limited variation in colour and texture
Waterforms	▪ Visually prominent lakes, reservoirs, rivers, streams and swamps	▪ Intermittent streams, lakes, rivers, swamps and reservoirs	▪ Waterforms absent

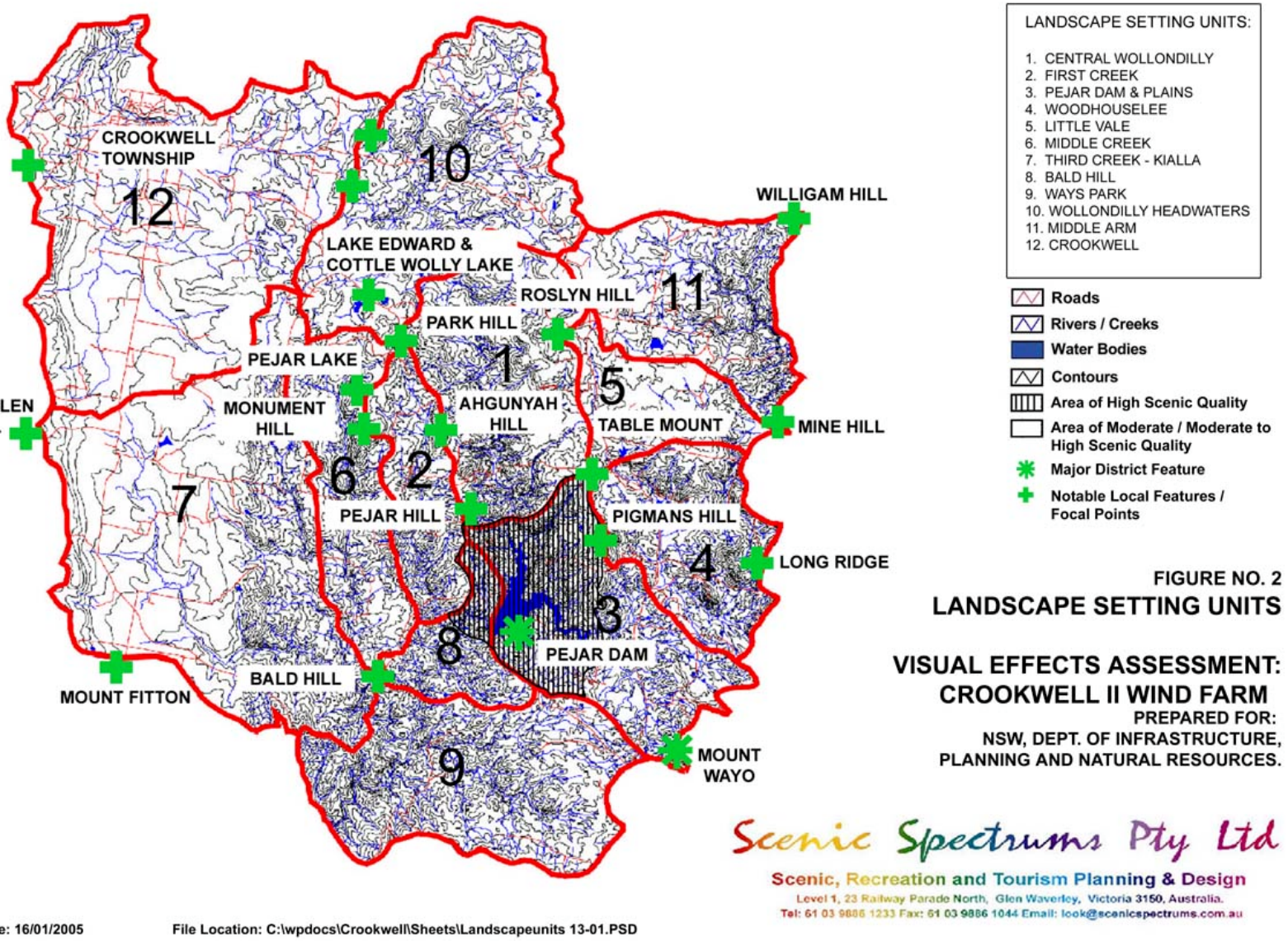

FIGURE NO. 2
LANDSCAPE SETTING UNITS

VISUAL EFFECTS ASSESSMENT:
CROOKWELL II WIND FARM
PREPARED FOR:
NSW, DEPT. OF INFRASTRUCTURE, PLANNING AND NATURAL RESOURCES.

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The **SS-VEM™** model also utilises the criteria shown in Table 3 as a guide to the classification of viewpoints (including travel routes) according to relative viewer sensitivity levels (i.e. levels of relative concern for scenic viewing or scenic quality). The viewer sensitivity levels assigned to public roads and use areas in the study area include:

- Goulburn-Crookwell Road — Level 1: High Sensitivity
- Pejar Dam Picnic Area — Level 1: High Sensitivity
- Crookwell I Wind Farm Viewing Area — Level 1: High Sensitivity
- Woodhouselee Road — Level 2: Moderate Sensitivity
- Roslyn Road — Level 2: Moderate Sensitivity
- Middle Arm Road (to Grants Flat) — Level 2: Moderate Sensitivity
- Third Creek Road — Level 2: Moderate Sensitivity
- Pejar Road — Level 2: Moderate Sensitivity
- Kialla Road — Level 2: Moderate Sensitivity
- St. Stephens Road — Level 2: Moderate Sensitivity
- Bannister Road — Level 2: Moderate Sensitivity

The Goulburn-Crookwell Heritage Railway was considered for inclusion as a Level 1: High Sensitivity travel route, but this has been discounted due to the uncertain nature and timing of planned redevelopment of the railway (Graham, pers. Com, 2004). The viewshed from the railway has been indicated for future reference, however.

3.6 Private Viewpoints and Viewer Sensitivity Levels

Viewpoints on the following private properties are classified as Level 1: High Sensitivity due to the owners' high level of scenic concern:

- Bellvue Park and Roslyn Station (Roslyn)
- Bird Residence (Woodhouselee, Woodhouselee Road)
- Elmgrove – (southeast of Crookwell)
- Glan Aber (Kialla)
- Lake Edward and Lake Edward Cottage (southeast of Crookwell)
- Normaroo (north of Pejar Dam)
- Pejar Park (Woodhouselee)
- Rosedale (Roslyn)
- Snowgums (Woodhouselee)
- Windalee (Woodhouselee)

Once again, the Viewer Sensitivity Level 1 or High Sensitivity rating is not dependent on the scenic quality of the landscape viewed, but on the relative level of concern for scenic values of the viewers at these viewpoints.

Table 3 Viewer Sensitivity Level Classification of Travel Routes and Use Areas

Level 1 – High Sensitivity	**Level 2 – Moderate Sensitivity**
1. Freeways and State Highways with more than 500 vehicles/day. 2. Classified Tourist Roads. 3. Main Sealed Roads with more than 75 vehicles/day. 4. Recreation, Cultural or Scenic Sites and Viewpoints of National or Interstate Significance. 5. Walking Tracks of National Significance 6. Residential Areas with High Degrees of Scenic Concern. 7. Interstate Passenger Rail Lines with Daily Daylight Service. 8. Rail Lines of Cultural, Historic or Scenic Significance. 9. Navigable Waterways of National Recreation Significance.	1. Main Sealed Roads with more than 50 vehicles/day. 2. Recreation/Tourist Access and Other Roads with more than 35 vehicles/day. 3. Roads with less than 35 vehicles/day, but Planned for Recreation Promotion within 5 years. 4. Recreation, Cultural or Scenic Sites of State Significance. 5. Walking Tracks of State or High Local Significance. 6. Residential Areas with Moderate Degrees of Scenic Concern. 7. State Passenger Rail Lines with Daily Rural Town Service. 8. Navigable Waterways of State Recreation Significance.
Level 3 – Low Sensitivity	**Level 4 – Very Low Sensitivity***
1. Land Management or Tourist/Recreation Access Roads with Occasional Recreation Traffic up to 10 vehicles/day. 2. Walking Tracks of Low Local Significance 3. State Passenger Rail Lines with Less than Daily Rural Town Service.	1. Land Management Roads with Infrequent Recreation Traffic less than 3 vehicles/day 1. Walking Tracks with Infrequent Recreation Usage. * Note: Viewpoints of Level 4 are usually not assessed in viewshed analysis or included in designation of Visual Significance Zones.

(Source: Scenic Spectrums Pty Ltd, adapted from Williamson and Calder, 1979.)

3.7 Private Viewpoints Excluded from Consideration

Viewpoints on seven properties were considered but subsequently excluded due to two factors:

1. No existing residence or building permit for a residence currently exists (DIPNR policy not to consider non-permitted uses)

2. The owners were not objecting to the development proposal or highly concerned about its effects on the scenic quality or landscape character of the area.

These excluded properties included:

- Oaklands (south of Pejar Road)
- Narangi (south of Pejar Road)
- Claremont (west of Snowgums and Woodhouselee Road)
- Wallaroy (Roslyn, north of Middle Arm Road)
- Hillview Park (Woodhouselee)
- Tyrendarra (Pejar Dam area, off St. Stephens Road)
- Wollondilly (Pejar Dam area, west of Goulburn-Crookwell Road)

3.8 Viewshed Distance Zone Analyses

Based on recent research on the perceptual recognition and visual impact ratings of wind turbines by Bishop (2001) and observations made by Scenic Spectrums, the **SS-VEM™** model identifies seven distance zones as indicated in Table 4.

Table 4 SS-VEM™ Viewshed Distance Zones

Distance from Viewer	Distance Zone Name	Relative Visual Magnitude of Object/Feature Viewed
0 – 500 m	Near Foreground (NF)	***Greatest Visual Magnitude***
500 m – 1 km	Mid Foreground (MF)	
1 – 2 km	Far Foreground (FF)	
2- 4 km	Near Middleground (NM)	
4- 8 km	Far Middleground (FM)	
8 – 13 km	Near Background (NB)	
13 – 20+ km	Far Background (FB)	***Least Visual Magnitude***

Computerised topographic viewshed mapping of the areas potentially visible from the selected viewpoints and travel routes has been conducted.

Viewpoints selected were located where foreground vegetation screening does not exist.

Viewshed mapping has also been conducted from the hub height (67 m above ground level) and top of blade height (107 m above ground level) for each of the proposed wind turbines. This has been done to identify the potential maximum viewshed or zone of visual influence surrounding the proposed development.

Viewsheds have been mapped from the viewpoints indicated in Sections 3.5 and 3.6 and segmented into the seven distance zones. Essentially all of the proposed turbines will be visible from multiple viewpoints from various distances and in different contexts. (Detailed viewshed mapping has been provided separately to DIPNR).

The results of composite mapping of Viewshed Distance Zones classified by Viewer Sensitivity Levels are combined in the designation of Visual Significance Zones in Figure 3. Refer to further discussion in Section 4.

4.0 RECOMMENDED VISUAL SIGNIFICANCE ZONES AND VISUAL PERFORMANCE STANDARDS

4.1 Visual Significance Zones

Visual significance zones are a result of combining the following factors:

- Scenic Quality Class
- Viewsheds classified by Viewer Sensitivity Levels and Distance Zones

Higher visual significance is usually associated with areas of higher scenic quality, higher viewer sensitivity levels and closer distance zones.

Lower visual significance is associated with areas of lower scenic quality, lower viewer sensitivity levels and further distance zones.

For the development of Visual Significance Zones, three classifications of Scenic Quality (high, moderate and low) are considered, regardless of borderline distinctions that may be otherwise taken into consideration. In this case, the proposed wind farm development, lies within the Moderate Scenic Quality Class.

The three Viewer Sensitivity Levels (Very High, High, and Moderate* - refer to Table 3) and the seven Viewshed Distance Zones (NF, MF, FF, NM, FM, NB, and FB – refer to Table 5) can be combined into 21 potential Viewer Sensitivity Level – Distance Zones or Viewpoint Classifications. Table 5 indicates the designation of three Visual Significance Zones (VSZ1, VSZ2 and VSZ3) based on different combinations of these visual factors using the **SS-VEM**^{TM}model.

In the case of the proposed development area, seven Viewpoint Classifications apply (1NF, 1MF, 1FF, 1NM, 2NF, and 2MF – for example, 1NF means a viewshed area seen in the Near Foreground – 0 to 500m from/by a Level 1 or High Sensitivity Viewpoint/Viewer, while 2MF means a viewshed area seen in the Mid Foreground – 500m to 1 km – from/by a Level 2 or Moderate Sensitivity Viewpoint/Viewer).

Only two of the three possible Visual Significance Zones apply to the proposed study area as derived from Table 5 and mapped in Figure 3 – VSZ1 and VSZ2 (or Zone 1 and Zone 2). The proposed wind turbine sites are grouped into four clusters as shown on Figure 3 for further reference.

Within the proposed development site, **Visual Significance Zone 1 (VSZ1)** applies to:

- the Goulburn-Crookwell Road corridor within 1 km of the road
- a small area north of Monument Hill within 1 km of Elmgrove Homestead

- the upper elevations of Pigmans Hill and Table Mount within 1 km of selected viewpoints on private properties at Pejar Park, Snowgums and Windalee.

Visual Significance Zone 2 (VSZ2) applies to the remainder of the development site. These areas are visible from viewpoints of moderate viewer sensitivity levels and/or viewsheds that fall within distance zones beyond 1 km from the relevant viewpoints.

It is important to note that the same viewshed area, feature or proposed modification (e.g. wind turbine) may be visible from multiple viewpoints. However, the viewpoint with the highest Viewer Sensitivity Level and the closest Viewshed Distance Zone is used when designating the Visual Significance Zone.

As an example, land areas or wind turbines on Monument Hill may be visible in the Far Middleground (FM, 4-8 km) from Glan Aber Station (Level 1 Viewer Sensitivity or High Sensitivity), in the Near Middleground (NM, 2-4 km) from Goulburn-Crookwell Road Station (Level 1 Viewer Sensitivity or High Sensitivity), in the Far Foreground (FF,1-2 km) from Third Road (Level 2 Viewer Sensitivity or Moderate Sensitivity) and in the Far Foreground (FF,1-2km from the house at Elmgrove (Level 1 Viewer Sensitivity or High Sensitivity). From among the possible viewpoint classifications, those with a Level 1- Far Foreground (1FF) are given the priority for the designation of Visual Significance Zones.

In general, it is also assumed that if a proposed landscape modification is designed to meet desired visual performance standards set for this viewpoint classification, it is highly likely to also satisfy any visual performance standards that may be desired when viewed from less sensitive or more distant viewpoints.

4.2 Recommended Visual Performance Standards

Visual performance standards presented in Table 6have been recommended for the two Visual Significance Zones. The standards for the two zones address the issues of:

- landscape character
- scenic integrity
- scenic quality
- wind turbine distance/visual magnitude
- horizon line and panoramic views
- cumulative visual effect
- key landscape features
- high sensitivity residential viewpoints.

The performance standards serve as guides rather than hard and fast rules.

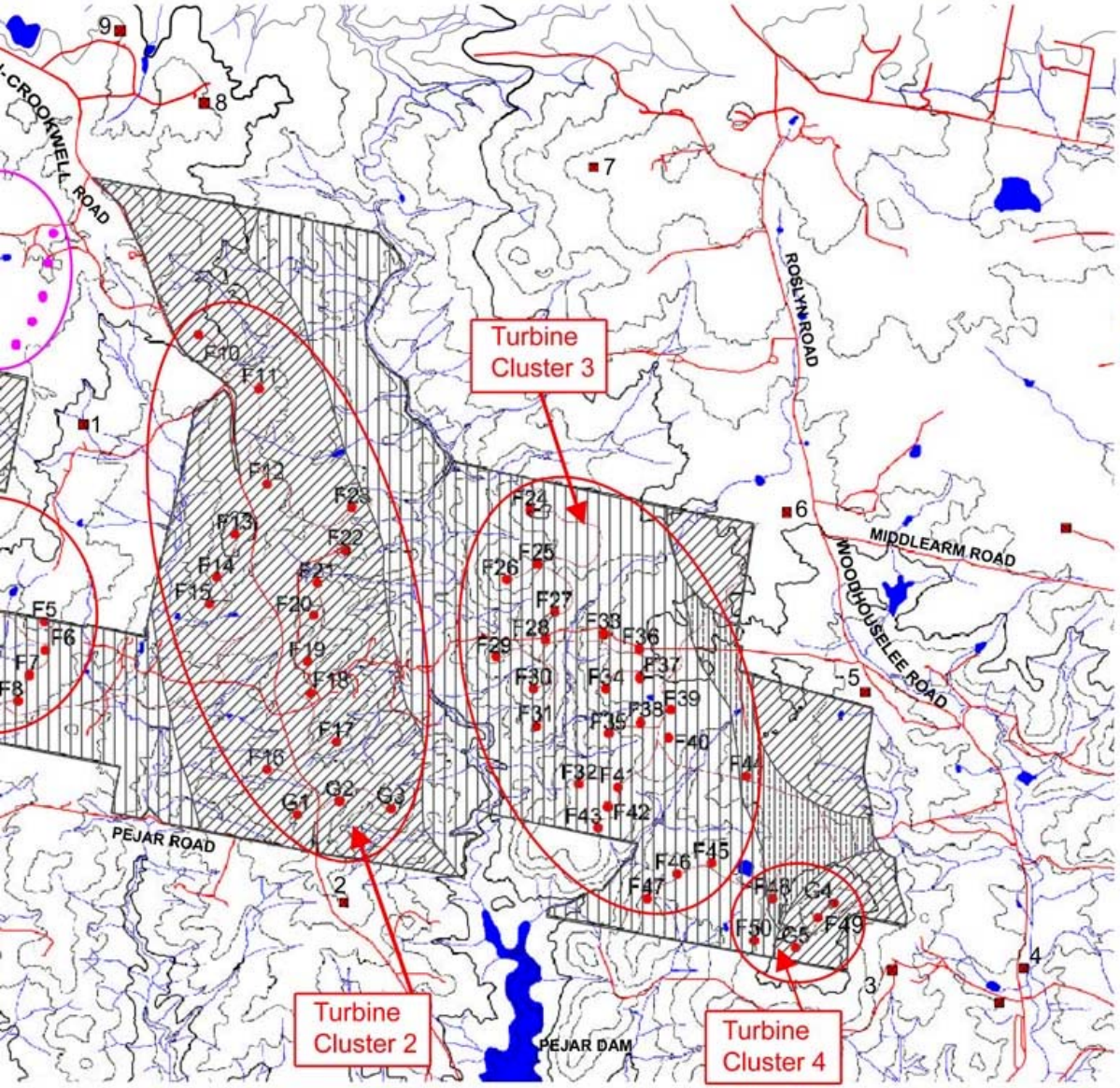
The Crookwell and Mulwarre Local Environmental Plan objectives to maintain the rural character of the area are considered in the development of the performance standards. By rural character, it is assumed that the LEPs refer to the traditional pastoral character of the area.

Table 5 SS-VEM™ Visual Significance Zone (VSZ) Matrix

Viewpoint Classification Priority for VSZ Designation	Viewpoint Classifications	Scenic Quality Class		
	Viewer Sensitivity Level - Distance Zone	High	Moderate *	Low
Highest Priority	1NF	VSZ1	VSZ1	VSZ2
	1MF	VSZ1	VSZ1	VSZ2
	1FF	VSZ1	VSZ2	VSZ2
	1NM	VSZ1	VSZ2	VSZ2
	1FM	VSZ1	VSZ2	VSZ2
	2NF	VSZ1	VSZ2	VSZ2
	2MF	VSZ1	VSZ2	VSZ2
	2FF	VSZ1	VSZ2	VSZ2
	3NF	VSZ2	VSZ2	VSZ2
	1NB	VSZ2	VSZ2	VSZ3

	1FB	VSZ2	VSZ2	VSZ3
	2NM	VSZ2	VSZ2	VSZ3
	2FM	VSZ2	VSZ3	VSZ3
	3MF	VSZ2	VSZ3	VSZ3
	2NB	VSZ2	VSZ3	VSZ3
	2FB	VSZ2	VSZ3	VSZ3
	3FF	VSZ2	VSZ3	VSZ3
	3NM	VSZ2	VSZ3	VSZ3
	3FM	VSZ2	VSZ3	VSZ3
	3NB	VSZ2	VSZ3	VSZ3
Lowest Priority	3FB	VSZ2	VSZ3	VSZ3
Scenic Quality Class Priority		**Highest Priority**		**Lowest Priority**

* Scenic Quality and Viewpoint Classification combinations of proposed development site.



LEGEND

- Existing Wind Turbine Location
- Proposed Wind Turbine Location
- Selected Houses & Private Viewpoints
- Roads
- Contours
- Visual Significance Zone 1
- Visual Significance Zone 2
- VSZ2 Area Within 1km of Crookwell Railway
- Rivers / Creeks
- Water Bodies
- Proposed Turbine Clusters

VISUALLY CRITICAL PRIVATE VIEWPOINTS:

1. Elmgrove (House)
2. Normaroo (House)
3. Pejar Park (House)
4. Bird Residence (House)
5. Windalee (Driveway)
6. Snowgums (House)
7. Ballvue Park - Roslyn Station (Air Strip)
8. Lake Edward Cottage (House)
9. Lake Edward (House)

NOTES:

1. Visual Significance Zones delineated based on Scenic Quality, Viewshed Distance Zones and Viewer Sensitivity Levels as per the SS-VEM™ procedure

FIGURE NO. 3

VISUAL SIGNIFICANCE ZONES

VISUAL EFFECTS ASSESSMENT:
CROOKWELL II WIND FARM
PREPARED FOR:
NSW, DEPT. OF INFRASTRUCTURE, PLANNING AND NATURAL RESOURCES.

0 1 2 3 4 5 KILOMETERS

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Scenic Spectrums Pty Ltd
Scenic, Recreation and Tourism Planning & Design

Table 6 Recommended Visual Performance Standards

Performance Issue	Visual Significance Zone 1	Visual Significance Zone 2
Desired Landscape Character	Predominantly Open Pastoral Tablelands and Valleys, particularly for areas viewed from the Goulburn-Crookwell Road, from the Goulburn-Crookwell Heritage Railway and from rural residences and properties with High Viewer Sensitivity Levels	Open Pastoral Tablelands with smaller areas of Wind Farm Pastoral Tablelands and Valleys
Scenic Integrity	Moderate – Partial Retention. Landscapes where the valued landscape character "appears slightly altered." Noticeable landscape alterations must remain visually subordinate to the landscape character being viewed.	Low – Modification. Landscapes where the existing landscape character "appears moderately altered". Alterations begin to dominate the existing landscape character being viewed, but they borrow valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes or architectural styles outside the landscape being viewed but compatible or complimentary to the character within.
Scenic Quality	Maintain as a perceived moderate scenic quality by most viewers	Alterations resulting in a potential low to moderate scenic quality permitted, but should utilise impact mitigation techniques as identified under **scenic integrity** above.
Distance/ Visual Magnitude	No turbines within 1 km from Level 1 travel routes, public viewpoints and private residences/driveways with high viewer sensitivity levels	No turbines within 500m of other residences with moderate viewer High Sensitivity Levels*
Horizon Line & Panoramic Views	Maintain significant portion (say 80%) of horizon line views or panoramas free from wind turbines as viewed from Level 1 travel routes, public viewpoints and private residences/driveways with high viewer sensitivity levels	Maintain significant portion (say 60%) of horizon line views or panoramas free from wind turbines as viewed from Level 1 travel routes, public viewpoints and private residences/driveways with high viewer sensitivity levels
Cumulative Visual Effect	Avoid significant extension of the visual effect and Wind Farm Pastoral Character created by the existing wind turbines beyond their centre point. Tight clusters with smaller numbers of turbines are preferable. Provide a significant visual gap between turbine clusters on a local basis and between wind farm projects on a regional basis.	Avoid excessive extension of the visual effect and Wind Farm Pastoral Character beyond 3-4 km of their centre point. Provide a significant visual gap between these larger turbine clusters on a local basis and between wind farm projects on a regional basis. Maintain relatively tight clustering of wind turbines where possible, however, more widely spaced turbines are acceptable.
Key Landscape Features	Avoid locating wind turbines on or near major and notable local landform, waterform, vegetation or cultural features that have visual prominence or are focal points (refer Fig. 2). Also avoid interruption of views to such features or focal points by wind turbines.	Avoid locating wind turbines on or near notable local landform, waterform, vegetation or cultural features that have visual prominence or are focal points (refer Fig. 2).
High Sensitivity Residential Viewpoints*	Avoid visual dominance of rural residential houses and driveways by wind turbines located within 1 km distance or within 2 km where ridge top turbine positions may visually exaggerate the visual dominance.	Avoid visual dominance of rural residential houses and driveways by wind turbines located within 1 km distance or within 2 km where ridge top turbine positions may visually exaggerate the visual dominance.

*The Distance/Visual Magnitude standard recommended for VSZ2 appears to apply only to residences within the proposed development site. As such, this standard is advised, but would be at the discretion of the land owners within the proposed development site. Consideration for houses provided for property managers and others within the site should be made, however. **It High Sensitivity Residential Viewpoint standard is recommended in the same manner for VSZ1 and VSZ2 areas, providing full consideration for residents with high sensitivity to scenic values. However, given the position of those identified High Sensitivity Residential Viewpoints, it appears that proposed Turbines F1 and F2 on Monument Hill in relation to Elmgrove are where this is likely to occur, although proposed Turbines F48 and F50 should be examined further in relation to views from Pejar Park.

Table 7 Landscape Character Options*

Landscape Character Goal Options	Description
Naturally Evolving	Landscape character expressing the natural evolution of biophysical features and processes, with very limited human intervention.
Natural Appearing	Landscape character that expresses predominantly natural evolution, but also human intervention including cultural features and processes.
Cultural	Landscape character expressing built structures and landscape features that display the dominant attitudes and beliefs of specific human cultures.
Pastoral	Landscape character expressing dominant human created paddocks (pastures) or grasslands and associated structures, reflecting valued historic land uses and lifestyles.
Agricultural	Landscape character expressing dominant agricultural land uses producing food crops and domestic products – cultivated croplands.
Historic	Landscape character expressing valued historic features that represent events and period of human activity in the landscape.
Pastoral Wind Farm	Landscape character expressing dominant wind farm uses that exert a strong visual influence over the character of the landscape primarily in the form of tall wind turbines with moving blades, access roads, substations and supporting infrastructure.
Urban	Landscape character expressing concentrations of human activity, primarily in the form of residential, commercial, industrial, cultural, educational, transportation structures and supporting infrastructure.

* Adapted from USDA Forest Service, 1998, p 5-5,6

Recommended Landscape Character

Here the performance standards are drawn from a number of possible landscape character options as indicated in Table 7.

In this case, the Pastoral Tablelands and Valleys landscape character has been selected as the predominant existing and desired character to be maintained and enhanced where possible.

Recommended Scenic Integrity Levels

Scenic integrity is a measure of the degree of intactness and wholeness of the desired landscape character.

Scenic integrity levels vary from very high to extremely low.

Table 8 provides a frame of reference for of six possible scenic integrity levels.

The original landscape character currently displays a moderate scenic integrity level where the Pastoral Tablelands and Valleys characteristics have been partial retained,

Table 8 Scenic Integrity Level Frame of Reference

Scenic Integrity Level	Visual Quality Objective	Visual Dominance of Modifications	Frame of Reference
Very High	Preservation	Unmodified	The valued landscape character is "intact" with only minute if any alterations. The existing landscape character and sense of place is expressed at the highest possible level with a visually unaltered landscape.
High	Retention	Inevident Modification (Appears Unaltered)	Landscapes where the valued landscape character "appears" intact. Alterations may be present, but must repeat the form, line, colour, texture and pattern common to the landscape character so completely and at such scale that they are not evident to the casual observer.
Moderate	Partial Retention	Slightly Modified (Slightly Apparent Modification)	Landscapes where the valued landscape character "appears slightly altered." Noticeable landscape alterations must remain visually subordinate to the landscape character being viewed.
Low	Modification	Moderately Modified (Apparent Modification)	Landscapes where the valued landscape character "appears moderately modified". Modifications begin to dominate the valued landscape character being viewed, but they borrow valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes or architectural styles outside the landscape being viewed but compatible or complimentary to the character within.
Very Low	Maximum Modification	Heavily Modified (Dominant Modification)	Landscapes where the valued landscape character "appears heavily modified". Alterations may strongly dominate the valued landscape character. They may not borrow from valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes or architectural styles within or outside the landscape being viewed. However, alterations must be shaped and blended with the natural terrain (landforms) so that elements such as unnatural edges, roads, landings and structures do not dominate the composition.
Extremely Low	Extreme Modification (Excessively Dominant Modification)	Excessive Modification (note: this only describes existing situations, it is not a Visual Quality Objective)	Landscapes where the valued landscape character appears extremely altered. Deviations are extremely dominant and borrow little if any form, line, colour, texture, pattern or scale from the landscape character. Landscapes at this level of integrity need rehabilitation. This level should only be used to inventory existing integrity. It must not be used as a management objective.

but modified by the Crookwell I Wind Farm, the 330 kV powerline, roads and other built structures.

Due to the limited number of turbines in the existing wind farm, the desired landscape character of the Upper Wollondilly District appears slightly altered. Overall, the noticeable landscape alterations remain visually subordinate to the landscape character being viewed from the majority of viewpoints within the district.

Scenic integrity levels recommended for each visual significance zone are:

- Visual Significance Zone 1 (VSZ1): Moderate Scenic Integrity
- Visual Significance Zone 2 (VSZ2): Low Scenic Integrity

Recommended Scenic Quality

Professional judgement and knowledge of relevant scenic perception research results (e.g. Williamson & Chalmers, 1982 and Lothian, 2004) have been used to estimate the potential scenic quality effects of proposed landscape modifications.

In research conducted during 2002 by Dr Andrew Lothian (Unpublished manuscript, 2004), South Australian coastal and inland agricultural landscapes were rated for their relative scenic quality with and without wind turbines by 311 observers. The scenes were rated on a 1 to 10 scale.

Many of the inland scenes consisted of pastoral landscapes with a combination of flat plains and hill landscapes. The scenes were predominantly taken during the summer period with dry brown grass in the paddocks. Treed vegetation was generally sparse to partially wooded. Although not exactly the same type of landscape character as the upper Wollondilly Valley, there were similarities in many of the scenes. By way of comparison, it is Scenic Spectrums' considered opinion that the upper Wollondilly landscapes are at least as scenic as the South Australian scenes that were rated 5.5 or greater out of 10 for their scenic quality.

Lothian computed trend line graphs for the mean scenic quality ratings of the inland scenes assessed with and without wind turbines. He states that *"the trend lines cross at a rating of 5.1: above this the wind farm will generally detract from scenic quality while below it the wind farm will generally enhance scenic quality,"* (Lothian, 2004).

The recommended scenic quality performance standards are:

- Visual Significance Zone 1 (VSZ1):Moderate Scenic Quality
- Visual Significance Zone 2 (VSZ2): Low to Moderate Scenic Quality

Recommended Turbine Distances and Visual Magnitude

Performance standards regarding the minimum distance between the proposed wind turbines and specified viewpoints have been suggested based on the research of Bishop (2001) and field observations of established wind farms by Geoffrey Sinclair of Environment Information Services in the United Kingdom and Dennis Williamson of Scenic Spectrums.

It has long been established that the visible size of an object diminishes with distance, as established through the principles of perspective and visual vanishing points. Iverson (in Zube, Brush and Fabos, 1975) pointed out the usefulness of such principles and research for visual impact assessment. He states that from a static view, the average human eyes have a binocular coverage of 120 degrees (7,200 minutes) horizontally and 130 degrees (7,800 minutes) vertically in a modified oval or elliptical cone of vision. The closer any object is to a viewer, the greater the proportion of the field of vision filled and, presumably, the greater the visual influence of the object on the viewers visual perception of the view.

Dr Ian Bishop (2001) has provided perception research results regarding wind turbine visibility and visual impact thresholds for detection, recognition and impact. He used animated computer simulations in paired comparisons that provided for comparisons of variable distances and variable colour contrast against adjusted sky backdrops. A 50 m tower (to hub or nacelle) with 26 m long blades was used. Sixty-one Melbourne University students and staff members viewed the scenes and responded to questions regarding detection, recognition and impact.

Quantitative methods for assessing impact thresholds that reflected the distance at which at least 50% of respondents rated the visual impact level at least half-way to the high impact extreme of a bi-polar scale (low to high visual impact). In other words, at least half of the respondents had to indicate that the visual impact exceeded the mid position between low and high visual impact levels before the Impact Threshold was set.

Atmospheric conditions were varied between clear conditions with maximum colour/hue contrast and light haze conditions. Atmospheric scattering effects created with treed and agricultural field backgrounds were tested as well.

Key findings of Bishop's (2001) investigation are summarised below.

Visual Recognition Thresholds (Furthest Distance Recognised) of White Wind Turbines:

- recognition by only 5% of people @ 30 km distance
- recognition by only 10% of people @ 20 km distance
- most significant drop in recognition rates occur at 8 - 12 km in clear air
- most significant drop in recognition rates occur at 7- 9 km in light haze.

Visual Impact Threshold (Distance at Which 50% of Viewers Assessments of Visual Impact Exceed the Midpoint Position between Low and High Visual Impact Level Ratings) of White Wind Turbines:

- visual impact drops rapidly at approx. 4km and is <10% of its highest level @ 6 km in clear atmospheric conditions
- visual impact drops rapidly 4km and is <10% of its highest level @ 5 km in light haze.

Responses to the Visual Contrast of White Wind Turbines Against Light and Dark Backgrounds:

- low contrast in light haze reduces the distance of visual impact thresholds by 20%
- high contrast can dramatically increase the potential visual impact of white wind turbines.

Bishop concludes that visual recognition levels and perceived visual impact thresholds are highly sensitive to changing atmospheric conditions. For visual effects assessment, Scenic Spectrums recommends the use clear conditions rather than average atmospheric conditions. It should also be noted that the proposed Crookwell II wind turbines are considerably larger than those used by Bishop in his research study, hence, one would assume that the recognition and visual impact distances would be greater for Crookwell II.

Geoffrey Sinclair has observed the visual impact of wind turbines over various distances. In his statement to the Portland Wind Energy Project Panel (Victoria, Australia), Sinclair indicated that turbine numbers and size both have a bearing on potential visual impact as set out in what he refers to as the 'Sinclair-Thomas Matrix' (refer to Table 9)

Sinclair's observations are as follows:

- Wind turbines up to 100m tall will have a high visual magnitude and create significant visual impacts up to 4 km distance;
- 100 m tall turbines have medium- high visual magnitude and significant visual impact from 4-8 km;
- 100 m turbines have medium visual magnitude and potential contributing significant impact from 13 - 18 km distance;
- 100m turbines have low-medium visual magnitude and non-significant impact from 18-23 km distance;
- 100 m turbines have negligible visual magnitude and impacts at 30 km.

Sinclair's results are reasonably similar to those of Bishop. However, variations in atmospheric lighting contrast conditions are not indicated and the towers he refers to have greater height than those used by Bishop.

Table 9. Sinclair's Observations of the Visual Magnitude and Impact Significance of Wind Turbines (Sinclair, 2001)

Potential visual impact matrix for wind turbines of 72-74m overall height (field observation) and 90-100 m (extrapolated) Distances in km.

Band		72-74m	90-100m	Magnitude (subject to other factors)	Significance (subject to other factors)
A	Dominant impact due to large scale, movement, proximity and number	0-3	0-4	High	Potential for independent significant impact
B	Major impact due to proximity: Capable of dominating landscape	3-6	4-8	Medium/High	
C	Clearly visible with moderate impact: potentially intrusive	6-10	8-13	Medium	Potential for contributory significant impact
D	Clearly visible with moderate impact: becoming less distinct	10-14	13-18	Medium	
E	Less distinct: size much reduced but movement still discernible	14-18	18-23	Low/Medium	Potential for ancillary non-significant impact: only becoming significant if numerous or cumulative with other installations.
F	Low impact, movement noticeable in good light: becoming components in overall landscape	18-23	23-30	Low	
Approximate recommended threshold for ZVI (Zone of Visual Influence) analysis					
G	Becoming indistinct with negligible impact on the wider landscape	23-30	30-38	Negligible	
H	Noticeable in good light but negligible impact	30-35	38-45		

Scenic Spectrums Pty Ltd (1998) examined high voltage towers with an average height of 65 m and their diminishing visual magnitude over a distance of 2 km as viewed in a photograph taken with a 50 m lens to approximate the angle of view of a single human eye. This information was graphed and scaled against the 67.5 m high wind turbines proposed at that time for Cape Bridgewater, Victoria.

Further comparison was made of the graphed powerline tower data with the height of the Vestas V66 model wind turbine (80 m to hub 112 m to top of rotor blade) recently proposed for the Portland Wind Energy Project. It was found that:

- the relative height of these wind turbines viewed at 500 m was less than half (44%) that at 0 m
- the relative height of these wind turbines viewed at 1000 m was less than half (46%) that at 500 m
- the relative height of these wind turbines viewed at 2000 m was less than half (38%) that at 1000m.

As Bishop's (2001) research shows, physical size reductions are not necessarily the same as perceived size or visual impact reductions. However, they do provide and indication of how quickly the relative visual size of an object ,as photographed, reduces with increasing distance from the observer. This reduction in visual magnitude with increasing distance also improves the opportunity for intervening objects, such as trees, to fully or partially screen views of wind turbines or other objects/features. The effectiveness of the screening would depend on the position of the intervening object relative to the viewer and the wind turbine.

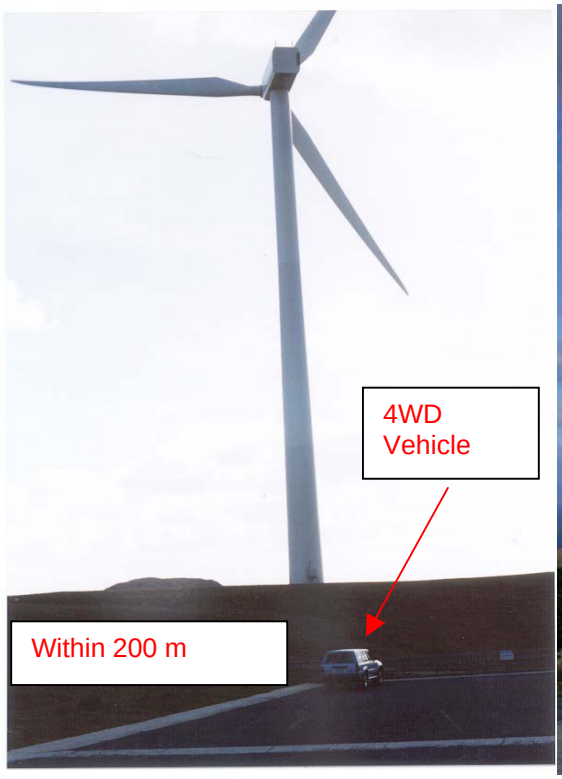
The combination of these research results and field observations lead Scenic Spectrums to conclude that the visual magnitude of the proposed wind turbines and their visual dominance is notably reduced when viewed beyond 500 m and even more significantly at distances of 1 km or more. They are also more easily screening from view with increasing distances from the viewer.

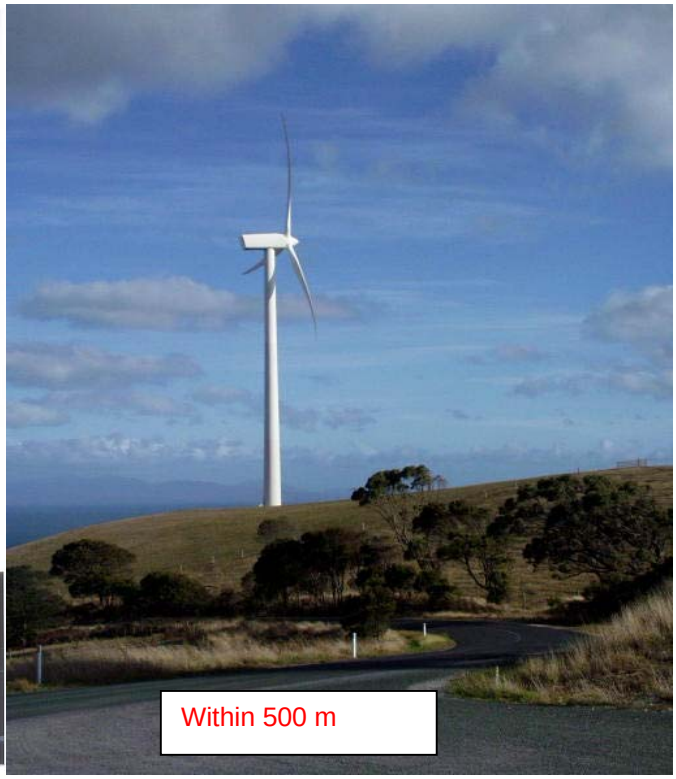
Bishop's (2001) research shows that perceived visual impact thresholds do not drop rapidly until the turbines are viewed at approx. 4km in clear atmospheric conditions. Sinclair also finds the turbines create a highly dominant visual impact in distances from 0 to 4 km. Although Scenic Spectrums does not disagree with these observations, we also believe that the perceived visual magnitude and dominance of large wind turbines also decreases appreciably at distances of 500 m through 1 km from viewers.

Photos 1-3 illustrate the visual effects of wind turbines of a similar size to those proposed viewed at distances within 200 m (Photo 1), within 500 m (Photo 2) and from 500 m to 1 km (Photo 3). It is not difficult to see how the visual magnitude and dominance become exaggerated between 500 m and 200 m and how they become significantly reduced when viewed at 1 km compared to at 500 m.

Based on these findings, performance standards that call for setbacks of 1 km from high sensitivity travel routes and residential viewpoints within VSZ1 and 500 m from residences within VSZ2 would appear to be reasonable.

Photos 1-3 105 m High Wind Turbines Viewed within 200 m, 500 m and from 500 m to 1 km





Consideration of Turbine Distances and Potential Driver Distraction

Aside from the effect of the proposed wind turbines on the scenic quality and integrity of the landscape, the issue of potential distraction of motor vehicle drivers on main roads should also be given consideration. Although there appears to be no specific research on the potential distractive effect of moving wind turbines on motor vehicle drivers, driver distraction has been identified as a major traffic safety research topic in recent years.

Driver distraction has been defined as *"any shift of attention away from safe driving,"* (Streff, 2001). Streff (2001)states that *"Essentially everything that distracts a driver is a potential hazard. Of course, some tasks have benefits that are acceptable. The question is, and no one really agrees, where to draw the line".* The University of Michigan Transport Research Institute (2001) indicates that from 25% to 50% of all vehicle crashes in the United States
occur because drivers are paying attention to something other than the road.

A Pennsylvania State Senate report (Commonwealth of Pennsylvania, 2000) found that in that state and in the United States nationally, an outside object, person or event is most often the distraction that at least partially contributed to causing a crash and represents 20% to 30% of those distractions. Sixty-six percent of crashes with 2 or more vehicles in the USA involved distractions by outside objects, persons or events.

A recent US Department of Transportation (2001) literature review on the potential safety effects of electronic billboards identified various research investigations dating back to the 1950s showing significant or notable relationships between increased motor vehicle accident levels and the presence of either ordinary billboards or (more recently) electronic billboards.Research tests have found that driver distractions tend to decrease the driver's attention to the rear view mirror and the speedometer. The report states that *" this could be interpreted as a predictor of decreased probability for detecting traffic events."*

It is known that it takes up to 3/10ths of a second for the human eye to fixate, requiring drivers to concentrate their vision on less and less, further and further away as they increase their speed. At 40 kph a driver's cone of vision is at approximately 100 degrees of view and the minimum fixation distance is approximately 15.25 metres (USDA Forest Service, 1973, p. 63). At 100 kph a drivers cone of vision is reduced to approximately 38.5 degrees and the minimum fixation distance is approximately 35 m.

As drivers accelerate from 40 kph to 100 kph, the point on which they focus their attention extends from approximately 180 m to approximately 610 m. Where moderate curvature in road alignments occur, setbacks of 500 m would remove wind turbines from within the immediate attention distance of 100 kph drivers, while 1000m setbacks would remove turbines from this zone where more pronounced curvatures in road alignments occur.

As the Goulburn-Crookwell Road has some reasonably pronounced curves in the section running through the proposed wind farm, 1 km setbacks of turbines would seem appropriate. However, 500 m setbacks would considerably reduce the number of moving turbines within the driver attention zone through this section of roadway.

Consideration of Turbine Distances and Potential Shadow and Flicker Effects

Potential adverse effects on drivers resulting from the shadow and flicker effects of turbine blades rotating in sunlight is also a possible concern. Scottish Planning (2002) suggest that wind turbines should be setback from residences a distance of at least 10 times the diameter of the turbine blades to prevent adverse shadow and flicker effects. In the case of the proposed Crookwell II turbines, this would be a minimum distance of 390 metres. This potential impact in relation to Goulburn-Crookwell Road should be considered.

Effects on Scenic Values Principle Reason for Turbine Setbacks – But Precautionary Principle for Motor Vehicle Safety MayAlso Apply

Although Scenic Spectrums primary justification for such setbacks is based on the reduction of visual impacts on scenic quality and integrity in order to retain the landscape character of the Upper Wollondilly District, it is also believed that precautionary measures regarding motor vehicle safety are certainly worth providing. This is analogous to the precautionary principal of ecological management.

Recommended Standards for Horizon Lines and Panoramic Views

The following proportions of the horizon and panoramic views should be free from wind turbines as viewed from Level 1 travel routes, public viewpoints and private residences/driveways with high viewer sensitivity levels:

- Visual Significance Zone 1 (VSZ1): 80% of Horizon Line Views
- Visual Significance Zone 2 (VSZ2): 60% of Horizon Line Views

Recommended Standards for Cumulative Visual Effects

The cumulative visual effect of the existing and proposed wind farms is another important issue, indicated to a certain extent by the horizon line percentage or angle of view taken up by skylined wind turbines. Again, options that reduce cumulative visual effects should be sought out where possible.

Recommended Standards for Key Landscape Features

The performance standards also address the positive benefits of maintaining the existing topographic profile and scenic integrity of key landscape features. Features such as Mount Wayo, Pigmans Hill, Pejar Dam and its backdrop, and other locally notable features such as Monument Hill could potentially be visually degraded by wind turbines. Minimisation of these effects should be encouraged where possible by finding alternative locations for wind turbines.

Recommended High Sensitivity Residential Viewpoints

Viewpoints from houses, homestead complexes, driveways and airstrips on properties where owners have expressed a high sensitivity to the potential visual effects of wind turbines are considered as High Sensitivity (Level 1) Residential Viewpoints. Where possible, the performance standards encourage a 1 km setback from these viewpoints within VSZ1 areas and a minimum setback of 500 m within VSZ2 areas.

Residential properties with these viewpoints selected for performance standard application include:

- Elmgrove
- Normaroo
- Pejar Park
- Windalee
- Snowgums
- Bellvue Park and Roslyn Station
- Lake Edward and Lake Edward Cottage.

Properties for which there are no existing residences (e.g. Oakdale, Claremont) have not been assessed for such viewpoints in keeping with DIPNR town planning protocols that do not assess impacts on properties or uses that do not currently exist, despite any unofficial plans that may have been made by landowners.

4.3 General Wind Farm Siting and Design Guidelines

The development of visual performance standards and a set of optional wind farm layout and visual impact mitigation measures considers general wind farm siting and design guidelines drawn from Gipe (1995 and 1997'), Nielsen (1996), Stanton (1996), Vissering (2001), and Scenic Spectrums Pty Ltd (2002). These guidelines are presented in Table 10.

Considerable consensus exists on a number of these issues. However, differences in opinion remain regarding such issues as the vertical position of wind turbines relative to ridgelines (i.e. on or near the ridgetop verses partially or fully below the horizon line) and the colour of turbines (darker or lighter in relation to landscape or sky backdrops). Scenic Spectrums believes that the guidelines indicated by previous reports can only provide items for consideration and every case must be evaluated on its own circumstances and merits.

Table 10 Optional Wind Farm Siting and Design Guidelines for Consideration in Visual Assessment

Key Issue	Optional Guidelines for Consideration
Siting	• Wind energy facilities should be sited and designed to minimise impacts on significant views and scenic landscape values as seen from sensitive residential and public use areas • Where practical, site wind turbines and ancillary structures out of or at the periphery of significant views • If within an important viewing corridor, maximise the distance from viewers where practicable • Avoid locating turbines near visually attractive features and focal points • Avoid locating numerous turbines in an open landscape • Avoid the siting of turbines where the movement of blades may potentially distract the attention of motor vehicle drivers • Avoid the siting of turbines where major bird migration routes or raptor concentrations are likely to exist in order to minimise the loss of scenically attractive bird life • Where practical, position turbines and associated facilities where they will be screened by existing vegetation
Cumulative Effects	• Minimise adverse cumulative visual effects where more than one wind farm development is considered within the same region
Turbine Arrays and Clustering	• Carefully consider the array and spacing of wind turbines to complement and enhance existing landscape topography, vegetation, stream patterns, natural features, cultural features and other characteristics • Use open arrays (spacing) of turbines, but cluster turbines in groupings of 4 to 8 turbines rather than placing them in excessively spaced or rigid linear rows. • Avoid overly dense spacing, which causes visual clutter- use simplicity in the arrangement of turbine arrays • Space turbines at regular intervals where possible • Closer clustering of turbines may reduce the loss of scenically attractive eagles, hawks, falcons and other raptor
Design	• Design wind turbines and other structures dimensions to minimise their visibility or visual magnitude as viewed from key observation points • Minimise contrast in the design form, line, colour, textures or reflectivity of the wind turbines and associated structures • Consider the visual backdrop of the landscape behind proposed turbines and structures in selecting appropriate exterior colours. Generally, lighter off-whites or grey tones will minimise colour contrast where sky or cleared paddocks form the backdrop, while darker earth tones or olive-greens may minimise colour contrast where trees, shrubs or other masses of vegetation form the backdrop (note - assess each case separately - there are no set solutions) • Design ancillary buildings and structures using local materials and mimic traditional architectural features and styles of traditional buildings in the surrounding landscape where practicable • Maintain visual uniformity and harmony in the design details, height, exterior visual appearance and blade rotation direction and orientation of the wind turbines • Ensure that a streamlined nacelle cover is always installed to minimise contrast and soften the form and lines between the turbine rotor, nacelle and tower. Ensure that the nacelle is architecturally well connected and in proportion to the tower.

Blade Glint, Shadow Flicker and Movement	• Finish turbine blades with a low reflectivity surface treatment to ensure that blade glint is minimised • Minimise shadow flicker created by certain sun angles in relation to the rotation of wind turbine blades to not more than 30 hours per year • Keep the blades spinning for as much of the time as possible in order to maintain viewer perceptions that the turbines are serving a useful purpose
Ancillary Facilities and Services	• Place electricity and other service lines undergrounded wherever practicable • Avoid unnecessary transformer boxes and other visually noticeable services at the base of turbine towers
Earthworks	• Minimise site disturbance, earthworks and roads • Provide erosion control measures to protect drainage lines and waterways
Vegetation	• Minimise removal of vegetation; • Establish visual screening through the planting of vegetation or the installation of other visual screening devices where appropriate (note - such screening may not always be desirable);
Lighting	• Minimise security and other lighting on and near wind farm facilities during day and night time hours. Use motion-activated lighting where required • Ensure that all necessary lighting meets the guidelines and requirements of AS for all direct and indirect lighting.
Advertising and Signage	• Minimise non-essential signage and billboards on or near the wind farm facilities that do not serve an environmental interpretation or safety function • Ensure that any signage or identification markings on turbine towers or ancillary structures are applied neatly and in a visually non-obtrusive manner. Avoid bright or luminescent graphics;
Maintenance	• Ensure that all areas of the wind energy facility are well maintained, that oil or other pollutants are controlled and that unsightly stored materials, litter and rubbish are not allowed to collect within the wind farm site
Public Access and Interpretation	• Provide interpretive facilities and/or programs that assist viewers to see the wind turbines and understand how they work and their contribution to sustainable energy production;

5.0 WIND FARM LAYOUT AND VISUAL MITIGATION OPTIONS

5.1 Summary

Scenic Spectrums has considered a number of options for the layout and visual mitigation of the proposed wind farm. The options range from the wind farm as presented in the EIS and proposed in the Development Application to a "do nothing" situation in which the existing landscape remains completely unmodified.
The options are described in tabular form in Table 11 and are distinguished from each other in terms of variations in five key visual impact mitigation factors, as follows:

1. reduced visual impacts associated with access roads:

    a. exclude access roads from summit area of Monument Hill

    b. grass and revegetate excess access road verges after turbine construction period (as per EIS suggestion).

2. reduction of the visual magnitude of turbines:

    a. exclude turbines within 500 m of Goulburn-Crookwell Road

    b. exclude turbines within 1 km of Goulburn-Crookwell Road

    c. exclude turbines within 1 km of high sensitivity private viewpoints

    d. exclude turbines from the tops of Monument, Ahgunyah, Pejar and Pigmans Hills (Turbine Nos. F1, F2, F13-15, G1, G2, F48-F50, G4 and G5.

2. reduction in the colour contrast of turbines:

    a. customise colours of each turbine to blend into the backdrop by using appropriate shades of intermixed olive green, brown, and black on tower sections, graduated to shades of intermixed blue, grey and white on upper towers and blades

3. relocation of turbines to less visually sensitive areas:

    a. relocate turbines excluded from original locations to a number of less sensitive locations within the proposed development site based on terrain, elevation and spacing considerations.

4. increased vegetative screening of turbines:

    a. plantings of tall trees on top of ridgelines in sections of 1 km or less along Goulburn-Crookwell Road corridor between Park Hill and Pejar Hill

Table 11 Wind Farm Layout and Visual Impact Mitigation Options

	REDUCE VISUAL MAGNITUDE OF TURBINES				**REDUCE COLOUR CON-TRAST OF TUR-BINES**	**RE-LOCATE TURBINES TO LESS SENSITIVE AREAS**	**TREE AND SHRUB PLANTINGS TO SCREEN TURBINES AND ENHANCE SCENIC QUALITY**			**REDUCE IMPACTS OF ACCESS ROADS**	
OPTIONS	Exclude Turbines within 500 m of Goulburn – Crookwell Road (Turbines F10 –F20 inclusive,G1 & G2)	Exclude Turbines within 1km of Goulburn – Crook-well Road (Turbines F10 –F23 inclusive,G1 -G3 inclusive)	Exclude Turbines within 1km of Visually Critical Private View-points. (G1- G5 inclusive and F49)	Exclude Turbines from Tops of Monument, Ahgunyah, Pejar and Pigmans Hills (Turbines F1, F2, F13, F14, F15, G1, G2, F48, F49, F50, G4 & G5)	Customise colours of each turbine tower and blade to blend into the landscape and sky	Relocate turbines excluded from original locations to less sensitive areas (refer to Figure 4 for map of visually less sensitive areas)	Plant tall trees on top of ridgelines in sections of 1 km or less along Goulburn – Crookwell Road Corridor between Park Hill and Pejar Hill	Plant tall trees on intervening spur ridges (refer to Option plan for suggested areas)	Plant locally indigenous riparian and gully trees and shrubs in gullies and lower slopes of Grays Creek, Stoney Creek and the Wollondilly River	Exclude access road from summit area of Mon-ument Hill	Grass and revegetate excess access road verges post turbine construction (as per EIS suggestion)
1	Option 1 as per the Development Application and EIS										✓
2							✓	✓			
3					✓						✓
4			✓		✓	✓					✓
5			✓	✓	✓	✓				✓	✓
6			✓	✓	✓	✓	✓	✓		✓	✓
7	✓		✓		✓	✓					✓
8	✓		✓	✓		✓		✓	✓	✓	✓
9	✓		✓	✓	✓	✓		✓	✓	✓	✓
10		✓	✓			✓	✓	✓			✓
11		✓	✓	✓		✓		✓		✓	✓
12		✓	✓	✓	✓	✓				✓	✓
13		✓	✓	✓	✓	✓	✓			✓	✓
14		✓	✓	✓	✓	✓		✓	✓	✓	✓
15	Existing Conditions – No Change										

b. plantings of tall trees on intervening spur ridges to screen turbines and guide views away from turbines in certain areas

c. plantings of locally indigenous riparian and gully trees and shrubs in gullies and lower slopes of Grays Creek, Stoney Creek and the Wollondilly River.

These visual impact mitigation measures have been applied in different combinations to 14 optional wind farm siting and design schemes. Option 15 would be the maintenance of existing conditions (no change or do nothing).

Options 1, 3, 6, 8 and 9 are presented in the main report as Figures 4, 5 and 6. The remaining options are provided in Appendix 2.

Potential Additional Turbine Sites

The proposed development site is among the better wind resource areas of New South Wales according to the State Wind Resource Map. Without access to the detailed wind resource and behaviour information available to WFJV, the precise location of potential additional wind turbine sites within the proposed development site cannot be identified. However, clues can be taken from the proposed turbine layout, the elevations on which turbines are located and the spacing of turbines laterally to each other and from one row to the next.

As is shown in Figure 4, the proposed turbines are primarily located on main or spur ridge sites above 845 m in elevation. Lateral spacing appears to vary greatly from approximately 180 m apart (G4 and F49) to approximately 630 m apart (F10 and F11). Distances between rows may be as much as 870 m (F4 to F6) to as little as 300 m (F32 and F41). Although some very specific wind behaviour dynamics may explain the layout and siting differences that occur, it is difficult to understand how such detailed wind modelling could be possible for an area of over 2000 hectares based on the data from only two or three wind turbines (as indicated in the EIS and through information provided by WFJV).

At this point, it is assumed that there is considerable scope for potential additional wind turbines within the proposed development site. Potential areas are mapped in Figure 4 for the purposes of illustration and for the development of the layout and siting options. We have identified areas on spur ridges at elevations above 845 m, away from stream gullies and beyond 1 km from existing houses where it appears that there would be room for additional turbines within the spacing tolerances displayed by the proposed turbine layout. In some areas, a minor reconfiguration of the proposed sites may be necessary to achieve a slightly higher density of turbines.

WFJV should examine these potential areas further in order to identify the viable additional sites. However, it certainly appears as if there is physically scope for many more wind turbines within the site. This would provide scope for the relocation of some proposed turbines from visually sensitive and vulnerable sites to those that are less sensitive.

5.2 Potential Turbine Colour Options

One of the key impact minimisation options suggest the special colouring of wind turbines individually to assist the reduction in colour contrast and to assist the blending in of towers with the backdrop landscape and sky as viewed from the most critical private or public viewpoints.
The EIS makes a minor mention of possibly using grey colours instead of off-white colours for the turbine towers and blades.

Although it is claimed that off-white has been selected as the best all-round colour for different weather conditions, the following factors may need further consideration:

- white and black are the two highest contrast colours that could be used in an outdoor environment
- except where snow, white water or sea surf occur, white is not a readily occurring colour in the natural landscape
- white has been selected for best average match with the sky, however, the occurrence of pure white clouds in the sky is not that frequent and the sky would probably be either shades of blue or grey much more often – white appears in the highest possible contrast with these colours
- the lower section of the tower or the entire tower and a portion of the rotor blades are often viewed with a landscape backdrop instead of a sky backdrop
- Even the turning movement of the blades is accentuated by the colour contrast of the blades against the landscape or earth backdrop

Bishop (2001) observes the high contrast of white colours in his wind turbine research. Several others have indicated that colours that blend in better with the landscape and sky may lead to reduced visual impacts. Lothian (2004) found blue and grey coloured turbines associated with scenes that were perceived to have a higher scenic quality than the same scene with white turbines.

TJP Envision (1999) found that both camouflaged coloured turbines, turbines with colours blended vertically from darker earth tones to lighter greys and blues in the upper tower and blade areas and turbines in which changes in colour shades around the tower cylinder and vertically showed promise for reducing visual contrast and impacts over those created with white turbines.

Stanwell Corporation have attempted something similar by banding the lower section of turbines with a monochrome range of green hues at the Windy Hill Wind Farm in the Atherton Tablelands, Queensland (refer to Photo 4). It would appear that this experiment was not as successful as it may have been due to the use of exactly the same technique with every turbine, regardless of its position in the landscape. However, it does indicate that such colour schemes have great potential if properly executed.

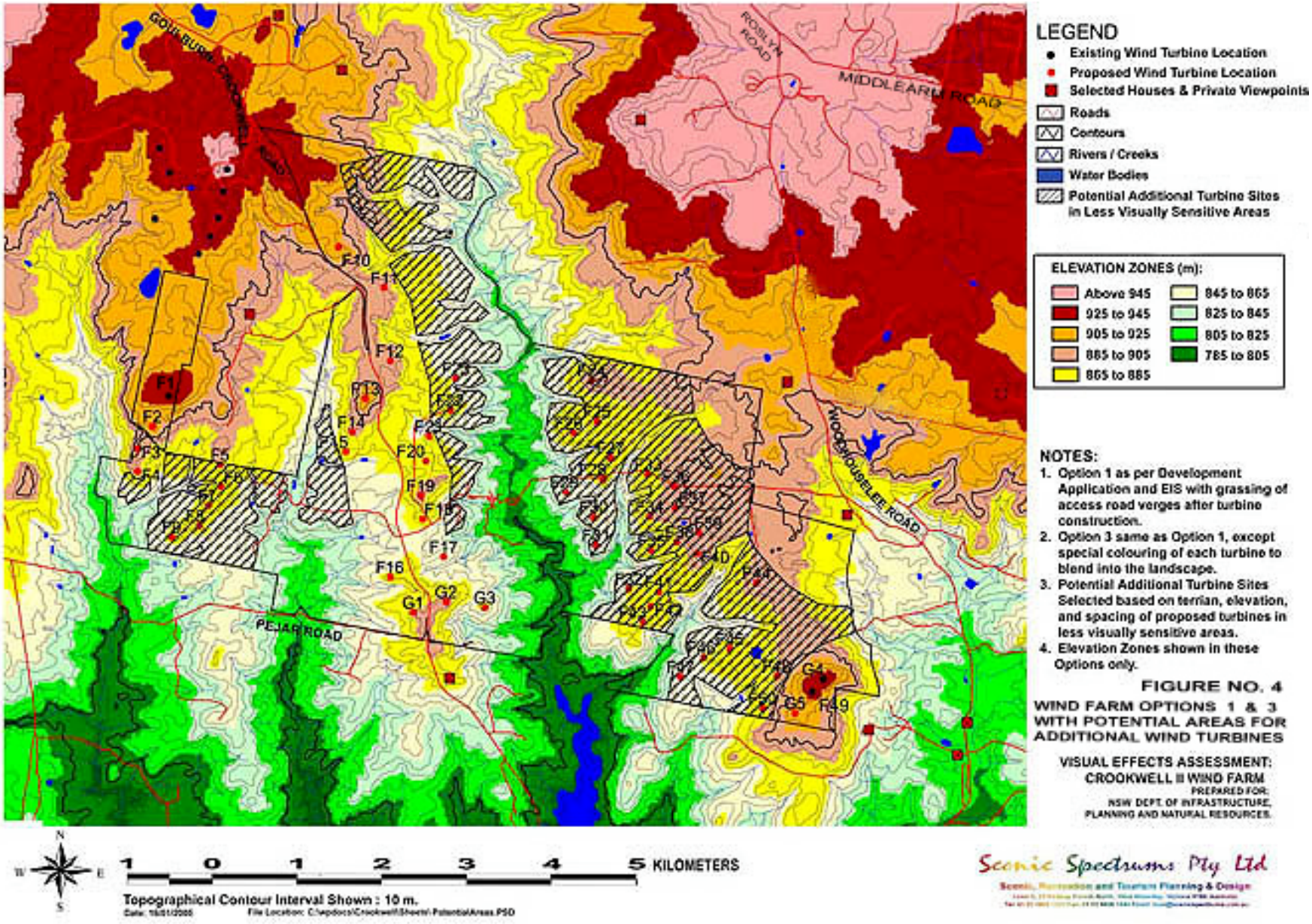
It is clear that if the degree of turbine colour contrast can be significantly reduced, the perceived scenic quality ratings and scenic integrity levels would probably be much closer to existing landscapes than they are otherwise. It is also clear that colour contrast, the visual magnitude and viewing distance of turbines combine to influence the degree to which they are visually recognised and perceived to visually dominate or blend with the landscape.

Photo 4 Colour Banding of Lower Turbine Towers by Stanwell Corporation at Windy Hill Wind Farm in Queensland

Because the distances change and the landscape backdrops change with each turbine placement, a single colour solution will never produce the least visual impact results in every situation. To achieve the least visual contrast results, individual colour schemes would be needed for each turbine, reflecting the variables of the most significant views to each turbine.

The following alternatives might be considered as effective ways of reducing visual impacts and protecting community horizon lines:

- use of a medium blue, grey or camouflaged blue, white and grey pattern would possibly blend the upper sections of the towers and blades seen from the most critical viewpoints against a sky backdrop
- use of camouflaged greens, browns and blacks (adjusted to match local conditions) of lower and/or upper sections of towers and blades seen from the most critical viewpoints against a landscape backdrop.
- Use of matte finishes on all paints and sealers to prevent reflection, glint and glare.


GOULBURN CROOKWELL ROAD
ROSLYN ROAD
MIDDLEARM ROAD
WOOMARGELEE ROAD
PEJAR ROAD
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
F11
F12
F13
F14
F15
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F44
F45
F46
F47
F48
F49
G1
G2
G3
G4
G5
LEGEND
Existing Wind Turbine Location
Proposed Wind Turbine Location
Selected Houses & Private Viewpoints
Roads
Contours
Rivers / Creeks
Water Bodies
Potential Additional Turbine Sites in Less Visually Sensitive Areas
ELEVATION ZONES (m):
Above 945
925 to 945
905 to 925
885 to 905
865 to 885
845 to 865
825 to 845
805 to 825
785 to 805
NOTES:
1. Option 1 as per Development Application and EIS with grassing of access road verges after turbine construction.
2. Option 3 same as Option 1, except special colouring of each turbine to blend into the landscape.
3. Potential Additional Turbine Sites Selected based on terrian, elevation, and spacing of proposed turbines in less visually sensitive areas.
4. Elevation Zones shown in these Options only.
FIGURE NO. 4
WIND FARM OPTIONS 1 & 3 WITH POTENTIAL AREAS FOR ADDITIONAL WIND TURBINES
VISUAL EFFECTS ASSESSMENT:
CROOKWELL II WIND FARM
PREPARED FOR:
NSW DEPT. OF INFRASTRUCTURE, PLANNING AND NATURAL RESOURCES.
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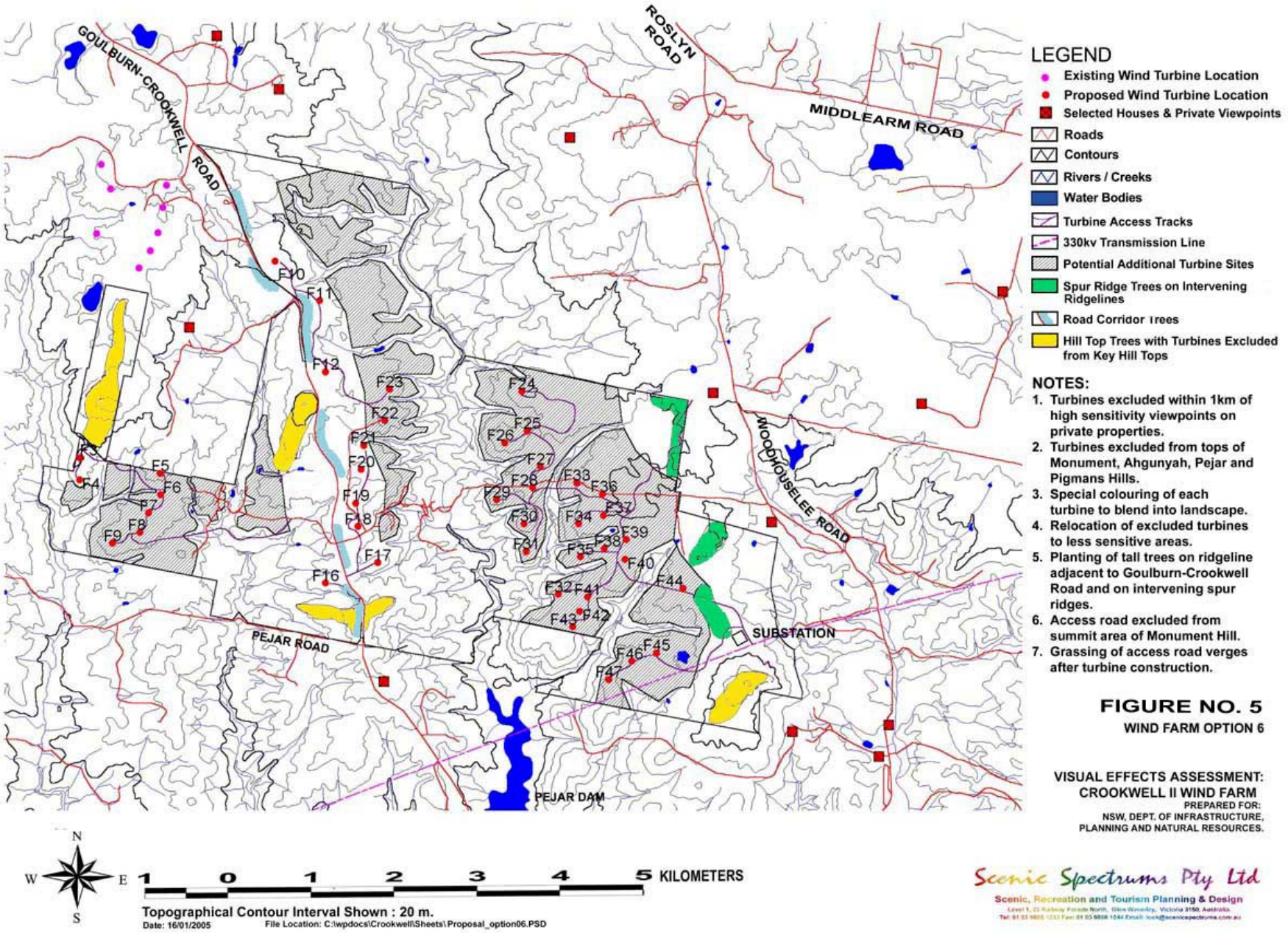
Scenic Spectrums Pty Ltd
Scenic, Recreation and Tourism Planning & Design


GOULBURN-CROOKWELL ROAD
ROSLYN ROAD
MIDDLEARM ROAD
WOODHOUSELEE ROAD
PEJAR ROAD
SUBSTATION
PEJAR DAM
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
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LEGEND
Existing Wind Turbine Location
Proposed Wind Turbine Location
Selected Houses & Private Viewpoints
Roads
Contours
Rivers / Creeks
Water Bodies
Turbine Access Tracks
330kv Transmission Line
Potential Additional Turbine Sites
Spur Ridge Trees on Intervening Ridgelines
Road Corridor Trees
Hill Top Trees with Turbines Excluded from Key Hill Tops
NOTES:
1. Turbines excluded within 1km of high sensitivity viewpoints on private properties.
2. Turbines excluded from tops of Monument, Ahgunyah, Pejar and Pigmans Hills.
3. Special colouring of each turbine to blend into landscape.
4. Relocation of excluded turbines to less sensitive areas.
5. Planting of tall trees on ridgeline adjacent to Goulburn-Crookwell Road and on intervening spur ridges.
6. Access road excluded from summit area of Monument Hill.
7. Grassing of access road verges after turbine construction.
FIGURE NO. 5
WIND FARM OPTION 6
VISUAL EFFECTS ASSESSMENT:
CROOKWELL II WIND FARM
PREPARED FOR:
NSW, DEPT. OF INFRASTRUCTURE, PLANNING AND NATURAL RESOURCES.
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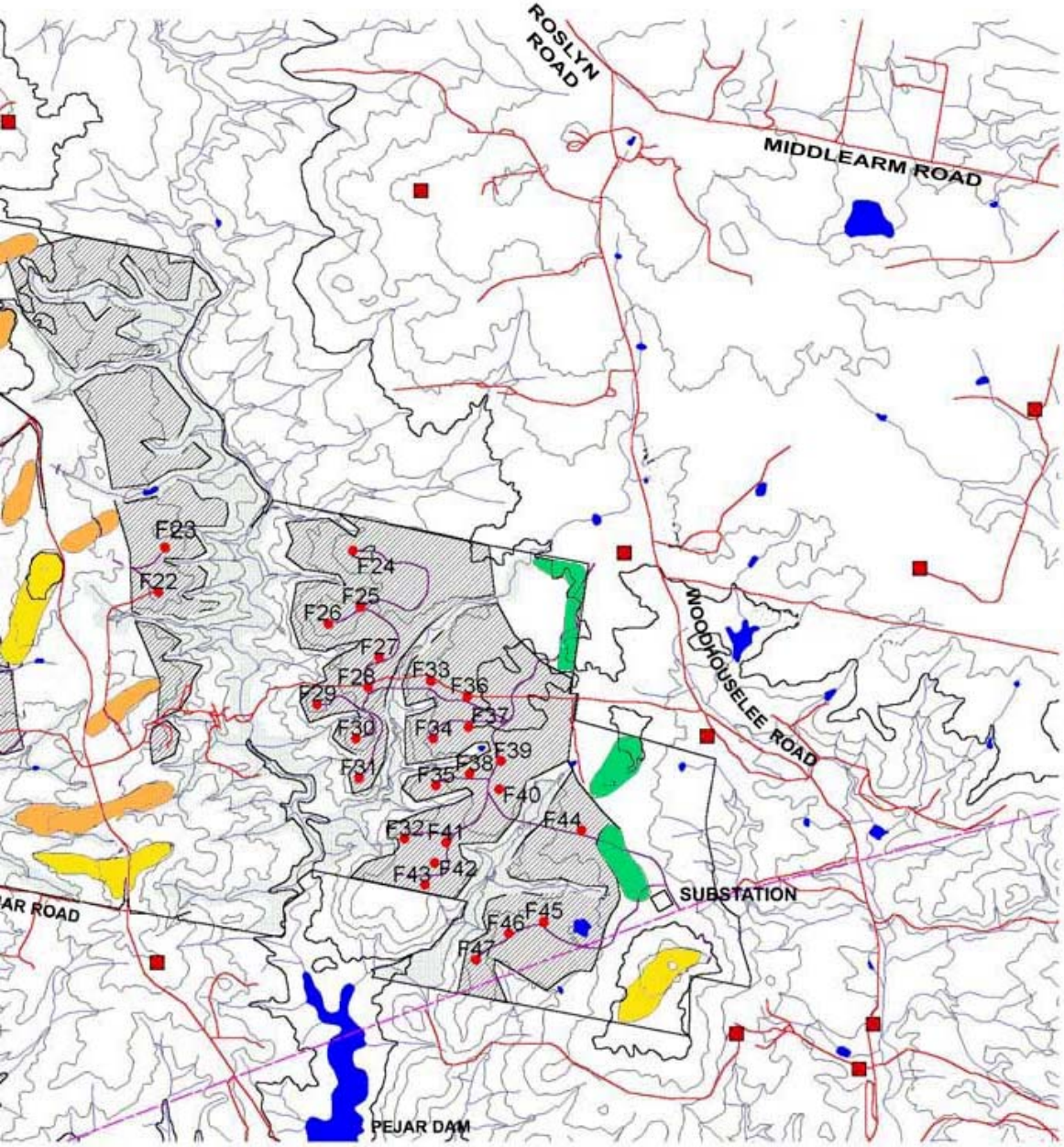
Scenic Spectrums Pty Ltd
Scenic, Recreation and Tourism Planning & Design



LEGEND

- Existing Wind Turbine Location
- Proposed Wind Turbine Location
- Selected Houses & Private Viewpoints
- Roads
- Contours
- Rivers / Creeks
- Water Bodies
- Turbine Access Tracks
- 330kv Transmission Line
- Potential Additional Turbine Sites
- Spur Ridge Trees with as is Turbine Proposal
- Spur Ridge Trees with Turbines Excluded from Goulburn-Crookwell Road Corridor
- Hill Top Trees with Turbines Excluded from Key Hill Tops
- Riparian and Gully Trees

NOTES:

1. Turbines excluded within 500m of Goulburn-Crookwell Road.
2. Turbines excluded within 1km of high sensitivity viewpoints on private properties.
3. Turbines excluded from tops of Monument, Ahgunyah, Pejar and Pigmans Hills.
4. Special colouring of each turbine to blend into landscape in Option 9 only.
5. Relocation of excluded turbines to less sensitive areas.
6. Planting of tall trees on intervening spur ridges.
7. Planting indigenous riparian trees and shrubs in gullies and lower slopes.
6. Access road excluded from summit area of Monument Hill.
7. Grassing of access road verges after turbine construction.

FIGURE NO. 6
WIND FARM OPTION 8 & 9

VISUAL EFFECTS ASSESSMENT:
CROOKWELL II WIND FARM
PREPARED FOR:
NSW, DEPT. OF INFRASTRUCTURE, PLANNING AND NATURAL RESOURCES.

1 2 3 4 5 KILOMETERS

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Scenic Spectrums Pty Ltd
Scenic, Recreation and Tourism Planning & Design

5.3 Assessment of Potential Visual Effects of the Suggested Options

Analysis of Effects Viewed from Public and Private Viewpoints

The suggested options obviously present a progression of visual impact mitigation measures ranging from no more than the grassing of access road verges following turbine construction to combinations of most of the possible measures. Generally, potential visual impacts of the proposed development should be progressively reduced as we move from Option 1 through Option 15. However, the visual effects will not be the same when viewed from different viewpoints.

Table 12 (Appendix 3) presents Scenic Spectrums' assessment of visual effects of the various options as viewed from public viewpoints in general when compared against key visual performance criteria. Table 13 (Appendix 4) presents Scenic Spectrums' assessment of the visual effects of the various options as viewed from selected high sensitivity viewpoints on private properties.

Analysis of Existing and Potential Vegetation Screening on Significantly Affected Properties

Table 14 (Appendix 5) presents the analysis of existing and potential vegetation screening on significantly affected properties. As indicated in the table, vegetation screening could be very effective on properties such as Snowgums, Pejar Park and Normaroo in blocking views to proposed turbines. However, most of the property owners interviewed do not want to lose the views they currently enjoy.

One side benefit of vegetative screening on some properties would be the provision of soil erosion controls and fauna habitat in areas that currently suffer from soil erosion, gully erosion and lack of habitat. This is also true for the proposed development site in relation to options that provide for a combination of screen planting, riparian and gully revegetation. Another benefit of screening around the houses of high sensitivity residents is the shade that could be provided and associated energy savings.

Achievement of Visual Performance Standards

Turbine Clusters 2 and 4 of the proposed development would not meet the recommended VSZ1 performance standards. With the exception of proposed Turbines F1, F2, F48 and F50, Turbine Clusters 1 and 3 would probably meet the recommended VSZ2 performance standards. As viewed from many public and private viewpoints, the proposed development would significantly change the existing landscape to a Wind Farm Pastoral character, reducing the existing scenic quality and resulting in a lower scenic integrity level than might be desired. With the exception of proposed Turbines F1, F2, F48 and F50, Turbine Clusters 1 and 3 would probably meet the recommended VSZ2 performance standards.

Areas that would be particularly adversely affected by the proposed wind farm include:

- **The Near and Mid Foreground Areas of Goulburn-Crookwell Road Corridor:** These areas are within 1 km of the road and straddle a visually significant ridgeline. The visual magnitude and interference with panoramic views (and potentially the distraction of motor vehicle drivers) would be especially pronounced. The proposed array of turbines (Cluster 2, F10-F23 and G1-G3) located along this ridgeline would also create visual disruption, loss of scenic integrity and quality, complete change of landscape character and extensive cumulative visual effects to roadway travellers, as well as to highly sensitive property owners located in the northern and eastern portions of the upper Wollondilly Valley.

- **The Pigmans Hill and Table Mount Summit Ridgetop Areas:** These are local landmarks and notable visual features and focal points visible within approximately 1 km of high sensitivity residential viewpoints. Proposed turbines (G4-G5, F49 and potentially F44, F48 and F50) on these areas would overlook and dominate highly sensitive property owners at Pejar Park, the Bird Residence, Windalee and Snowgums.

- **Monument Hill, Ahgunyah Hill and Pejar Hill:** These are locally notable and prominent hills that are landmarks and visual features viewed from three or four of the identified landscape setting units of the district. Proposed wind turbines located on these hills would cause a loss of scenic integrity, landscape character and scenic quality to these landforms and would overlook and dominate highly sensitive property owners at Elmgrove and Normaroo.

- **Park Hill:** This is also a notable local feature and focal point potentially visually affected by proposed Turbine F10 and F11. These turbines lie within consideration of the Goulburn-Crookwell Road corridor as indicated above. However, when viewed from most other vantage points (the exception being from the Lake Edward area), these turbines would be seen in close proximity to the existing Crookwell I Wind Farm turbines. From these other viewpoints, Turbines F10 and F11 pose lesser adverse visual effects.

As indicated, there are a few viewing situations where the proposed development would come closer to achieving the recommended performance standards. For the most part, the turbines proposed for the area south of Monument Hill (Cluster 1, F3 – F9) and on the eastern side of the Wollondilly Valley below the Pigmans Hill-Table Mount Ridgeline (Cluster 3) are more appropriately sited within the VSZ2 area from a visual standpoint. This gives evidence that achieving the standards is possible, within reason, given the nature of the proposed development.

6.0 RECOMMENDED WIND FARM OPTIONS

6.1 Alternative Courses of Action

Perspective and Context

Prior to selecting alternative courses of action, it is useful to consider the study area and the proposed development in broader perspective and context, stepping back from the detail of the assessment. The following key points should be considered:

1. The upper Wollondilly area is really a typical tablelands/highlands pastoral area of Moderate/Moderate-High Scenic Quality. In that context, if wind farms were disallowed based soley on scenic quality, they would probably not be constructed in many areas of the New South Wales tablelands or highlands, regardless of the wind potential of the region.

2. The area does have scenic qualities that are highly regarded and valued by many community residents and visitors alike. As opposed to statements in the EIS, some scenic perception research studies have shown that rural landscapes of moderate scenic quality can be adversely affected visually by wind turbines.

3. The potential visual impact of the proposed wind farm would be highly significant in this area, regardless of its scenic quality rating. The proposed wind turbines – the key elements of the proposed development – would be 107 metres to the top of the rotor blades. This is equivalent in height to a 35 to 40-storey building or tower. In addition, each turbine would have a 39 meter diameter rotor blade that will be moving under the right wind conditions somewhere up to 30 rotations per minute (estimated, but to be confirmed by WFJV), further drawing the attention of viewers.

   Fifty-five of these tall structures would be placed into a predominantly open landscape with tabletop and gently rolling landforms where the top of the surrounding ridges and hills would be lower than the top of the wind turbines. The visual effect of this development on the scenic integrity of the existing landscape character of the upper Wollondilly district could be extremely negative as perceived by many local residents. The proposed development could have a significant effect on these residents' sense of place and regard for the place they live.

Three Basic Alternative Courses of Action

Three basic alternative courses of action could be considered:

1. **Basic Alternative 1 – Approve Development Application as Proposed, Regardless of Visual Effects:** On balance, the overall significance of the area for wind energy production is considered as more valuable to the New South Wales and Australian community than the visual values of the study area. Although recognising the scenic perceptions and attitudes of many

persons of the local community, the visual values are not considered to be of such high significance that they form the basis for not approving the development application of the proposed wind farm.

2. **Basic Alternative 2 – Do Not Approve Development Application on Visual Impact Grounds:** On balance, the potential adverse visual effects of the proposed wind farm on district landscapes of local visual significance cannot be allowed, despite the potential positive benefits that wind energy production would bring to the State and Australia as a whole. Although recognising the importance of wind energy production and its support by many in the community, the retention and maintenance of the existing landscape character, quality and scenic integrity of the Upper Wollondilly River Valley area is considered to be of greater value;

3. **Basic Alternative 3 – Approve Development Application Subject to Specified Conditions for Amelioration of Visual Impacts:** The study area offers significant scenic landscape and wind resource values. As neither of these values should be completely lost in lieu of the other, options that lean too far in one direction or the other should probably be dismissed. However, those options that allow for the mutual provision and co-existence should be considered, giving priority for one value or the other where necessary in different situations.

Scenic Spectrums has provided a great deal of information for the New South Wales Government to assist in it's decision regarding the first or second basic alternative courses of action. Either of those choices would have to be a government decision on behalf of the wider community.

Scenic Spectrums does not favour the first or second basic alternatives, but recommends the third basic alternative course of action.

Recommended Alternative Course of Action

The third basic alternative would essentially offer approval of the development proposal based on the applicants agreement to meet certain conditions that would further protect the landscape character of the area and minimise potential adverse visual effects of the wind farm on the scenic quality and scenic integrity of the area.

6.2 Recommended Elimination and Retention of Options

Wind Farm Options Recommended for Elimination

In keeping with the direction set above, the following wind farm options are recommended for elimination because the do not provide adequately meet desired performance standards, especially regarding issues of landscape character maintenance, protection of scenic integrity and minimisation of adverse visual impacts on high sensitivity residential properties:

- Option 1
- Option 2
- Option 3
- Option 4

Again, in keeping with the recommended course of action, the following options are eliminated from consideration due to conditions that would probably be too onerous economically for the project developers to bear:

- Option 10
- Option 11
- Option 12
- Option 13
- Option14
- Option 15

Wind Farm Options Recommended for Consideration and Negotiation

The following remaining options are considered by Scenic Spectrums to be fair and reasonable, responding to the recommended course of action:

- Option 5
- Option 6
- Option 7
- Option 8
- Option 9

6.3 Wind Farm Options Recommended for Further Consideration

Remaining Wind Farm Options

From a visual resource standpoint, Scenic Spectrums favours the following three of the five options remaining for consideration:

- Option 6
- Option 8
- Option 9

Option 6: Remaining for Consideration

Option 6 remains for consideration because it provides the development applicant the opportunity of retaining some of it's Cluster 2 wind turbines along the Goulburn-Crookwell Road, but compensates with the following conditions:

- exclusion of turbines from within 1 km of high sensitivity residences (or relocation to less visually sensitive areas)

- relocation of turbines from local landmarks and focal points (or relocation to less visually sensitive areas)

- special individual colouring of wind turbines to reduce their visual contrast and impact , allowing them to better blend into the landscape

- provision of tree plantings along the Goulburn-Crookwell Road and on intervening spur ridges to screen the turbines and direct motorists and residents visual attention away from the turbines as much as possible.

The greatest drawback of Option 6 would be the continuation of many turbines within a relatively short distance of the Goulburn-Crookwell Road given local concerns for the views from this section of road.

Option 8: Remaining for Consideration

Option 8 would allow the proposed wind farm under the following conditions:

- relocation of turbines to areas outside a 500 m setback from Goulburn-Crookwell Road (or relocation to less visually sensitive areas)

- relocation of turbines from within 1 km of high sensitivity residences (or relocation to less visually sensitive areas)

- relocation of turbines from local landmarks and focal points (or relocation to less visually sensitive areas)

- provision of the planting of intervening ridges, gullies and the Wollondilly River Valley to achieve vegetative screening and scenic enhancement.

The major drawback of Option 8 is the lack of colouring of turbine towers and blades to better blend in with the landscape.

Option 9: Preferred by Scenic Spectrums

Option 9 would allow the proposed wind farm under the following conditions:

- relocation of turbines to areas outside a 500 m setback from Goulburn-Crookwell Road (or relocation to less visually sensitive areas)

- special individual colouring of wind turbines to reduce their visual contrast and impact , allowing them to better blend into the landscape

- relocation of turbines from within 1 km of high sensitivity residences (or relocation to less visually sensitive areas)

- relocation of turbines from local landmarks and focal points (or relocation to less visually sensitive areas)

- planting of intervening ridges, gullies and the Wollondilly River Valley to achieve vegetative screening and scenic enhancement.

Option 9 is Scenic Spectrums' most preferred option for the following reasons:

- it does the most to retain the existing landscape character and scenic integrity
- it does the most to minimise adverse visual impacts on local residents
- it retains much of the existing viewing experience of the Goulburn-Crookwell Road, while also addressing to some extent potential motor vehicle safety concerns regarding driver distraction.
- It provides a great deal of vegetative screening and scenic enhancement through the planting of ridges, gullies and the Wollondilly River Valley, matching sustainable energy production values with sustainable land management principles
- It provides for colour contrast reduction through the specific painting of individual wind turbines to blend into the landscape and sky better than they have in the past.

END OF SUMMARY WORKING DOCUMENT