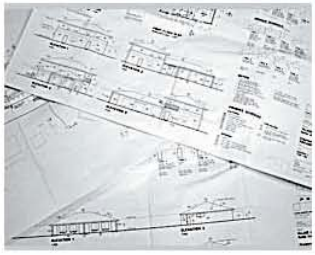
HARPER SOMERS O'SULLIVAN



Visual Impact Assessment

for

Black Springs Wind Farm

Prepared for

Wind Corporation Australia Limited
Level 42, AAP Centre
259 George Street
Sydney NSW 2000

Job Reference 23219 – November 2006

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PLANNING › SURVEYING › ECOLOGY

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PROJECT: **VISUAL IMPACT ASSESSMENT – BLACK SPRINGS**	
CLIENT:	ENERGREEN WIND PTY LTD FOR WIND CORPORATION AUSTRALIA LTD
OUR REF	23219
DATE:	NOVEMBER 2006
APPROVED BY:	S MCCALL
SIGNATURE:	
CHECKED BY:	T LAMBERT
SIGNATURE:	

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1 Introduction

Harper Somers O'Sullivan Pty Ltd (HSO) has been commissioned by Wind Corporation Australia (WCA) to undertake a Visual Impact Assessment for a proposed wind farm development near the small village of Black Springs, in the Oberon Shire of New South Wales (NSW). The report provides an assessment of the existing landscape and examines the potential visual impact of the proposed wind farm. Recommendations have been included to minimise the visual impacts.

1.1 Project Summary

The proposed Black Springs Wind Farm (BSWF) is to be located within the Shire of Oberon, west of the Blue Mountains on the Great Dividing Range. The site is west of the village of Black Springs and 25km southwest of Oberon. Figure 1 is a location map for the site.

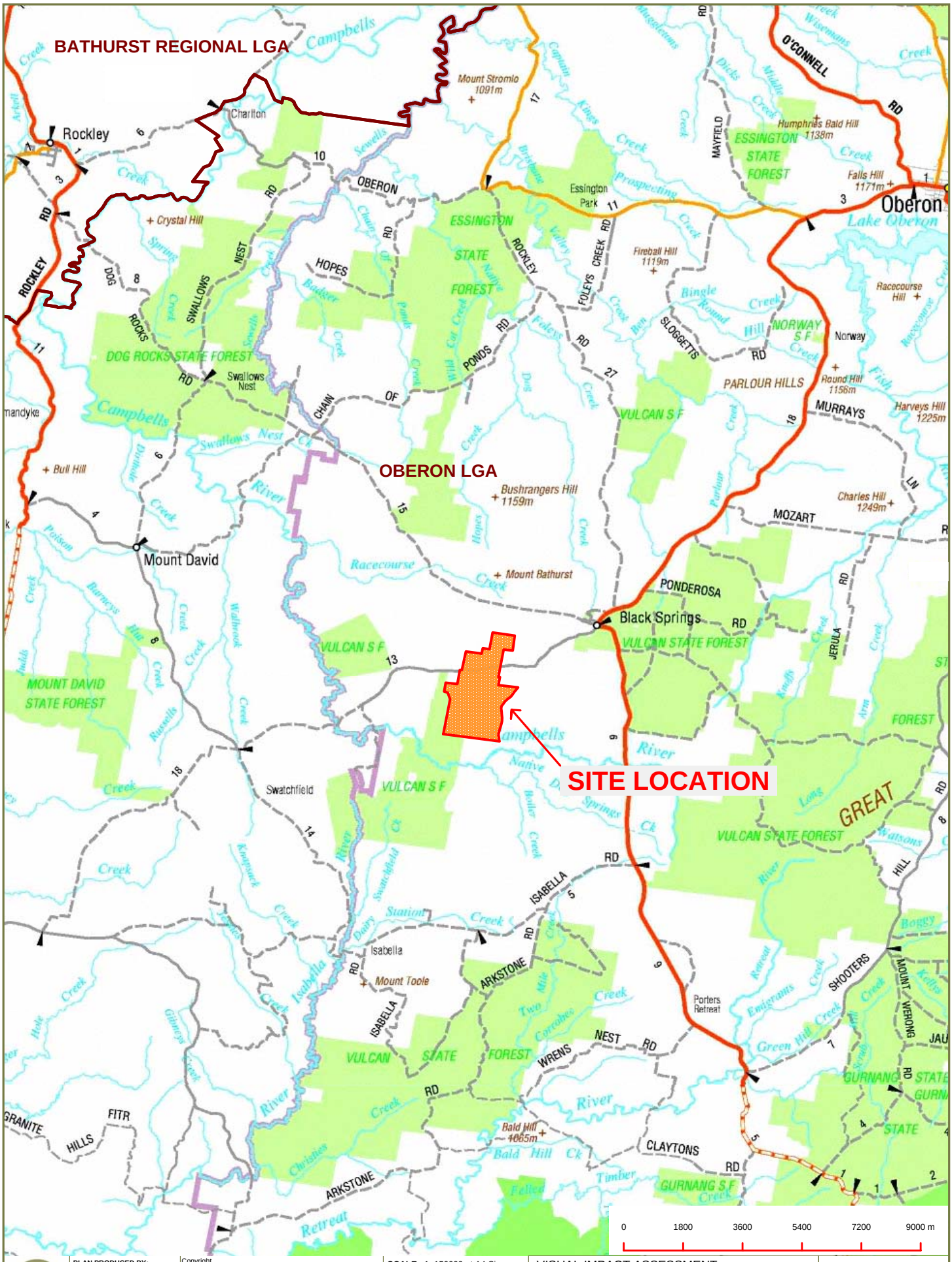
Wind Corporation Australia proposes to develop an 18.9 megawatt (MW) generating wind farm on the site. The BSWF has the potential to offset 43,600 tonnes of CO_2 per year through the operation of the proposed nine (9) wind turbine generators (WTG's). It is estimated that the generation capacity of the BSWF would be able to power around 6,000 homes (e.g. whole Oberon/Black Springs/Burraga + timber mill in Oberon), using an average consumption of 7,900 kWh per household.

The WTG's will span two (2) privately owned rural allotments. The southern property is known as "Daisybank", while the northern property is known as "Acquatoria".

The subject site consists of cleared, open paddocks with scattered vegetation and remnant patches. Sheep and cattle grazing are the predominant land uses. The topography of the wind farm site is characterised by rolling hills and gently - steeply rising ridges separated by shallow valleys. Several minor creeks occur and within Daisybank these generally drain south into the Campbell's River, while within Acquatoria they generallty drain to the north into Racecourse Creek, which also eventually joins Campbell's Creek. WTG's are to be located on existing cleared knolls, ridgelines and elevated flats.

The WTG's proposed for the BSWF project will be comprised of Suzlon S88 units or equivalent turbine generators, each with a rated output of 2100 kW (2.1 MW), signifying a project capability of approximately 47,000,000 kWh annually. Automatic controls enable the turbines to face into the wind and to vary operation speed according to wind speed. An 800 – 1,000 ton crane (crawler or wheel based) will be used to erect the WTG's. An auxiliary 200-ton crane will also be used to assist the primary crane during construction.

The turbines will be connected through a 33kV underground cable network to a substation within the wind farm area. This proposed substation will then be connected to the Country Energy Oberon – Burraga 66 kV transmission line which passes directly north of the proposed substation location. The cable laying process involves a trenching machine digging a trench approximately 300mm wide by 0.8m-1.0m deep followed by a cable trailer feeding out cable. The trench is partly filled with sand after which optical fibre is laid and the trench is back filled. Control cables will also link the turbines to a facilities building which will house an office, electrical and computer equipment, storage and amenities.



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AMENDMENT	DATE	TYPE
A		
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C		
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SCALE: 1: 150000 at A4 Size
DATE: 05/12/2006
DATUM: Longitude / Latitude (AGD 84)
CONTOUR INTERVAL:
DESIGNED: S. WATSON
APPROVED: T. LAMBERT

VISUAL IMPACT ASSESSMENT
BLACK SPRINGS WIND FARM, OBERON LGA

FIGURE 1

SITE LOCATION

LAYOUT REF:
J:\JOBS\23k\23219 - Black Springs\Drafting\Mapinfo \Planning\23219-Vis FIG 1 SITE LOCATION-C-A4.WOR

JOB REF: 23219

Access tracks required for the construction and maintenance of the wind farm are located on private land and typically follow the underground cable network and, if possible, existing farm tracks. Tracks will be graded and road base gravel applied to facilitate the high construction loads and will be returned to 4WD access tracks post construction depending on landholder requirements.

The main construction site will be the substation location where the operations and maintenance centre will also be based. It is anticipated that BSWF will commence construction in the late 2006 / early 2007, with construction completion expected in mid to late 2007.

2 Methodology

This Visual Impact Assessment has been prepared with regard to the Australian Wind Energy Association and Australian Council of National Trust's *Wind Farms and Landscape Values: Stage 1 Final Report – Identifying Issues, March 2005*, with particular emphasis on Appendix B: *Wind Farms and Landscape Values: Final Issues Paper*, the *Draft NSW Wind Energy Environmental Impact Assessment Guidelines* (Department of Planning, 2002) and a review of existing literature plus the visual impact assessments from similar wind farm projects, including the Cullerin Range Wind Farm and Capital Wind Farm.

The assessment methodology of the visual impact of the wind farm involves consideration of the visual or scenic quality of the area, the landscape values, the visual sensitivity and the visual effect. The methods undertaken as part of the assessment included the:

- review of existing literature;
- review of topographic maps and aerial photographs;
- review of the Zone of Influence Plan;
- review of Photomontages;
- review of the Shadow Flicker Analysis;
- visiting the site and surrounding area: and
- assessment of the visual catchment via ground truthing to examine the visibility with respect to the landscape and existing features.

Visual assessment relates to the aesthetics of an area and in most circumstances is largely a qualitative assessment. There are generally accepted landscapes and visual aspects that are continually preferred by the general community over other landscapes. Scientific research has resulted in the development of more quantitative methodology that is based on these generally accepted landscape values. The visual quality assessment of the BSWF also incorporates a Visual Quality Reference Table (Clouston and Brouwer, 1995) to provide a quantitative assessment of the existing landscape quality.

2.1 Wind Farms and Landscape Values: Stage 1 Final Report – Identifying Issues, March 2005, Appendix B: Wind Farms and Landscape Values: Final Issues Paper

The *Wind Farms and Landscape Values: Stage 1 Final Report – Identifying Issues, March 2005*, Appendix B: *Wind Farms and Landscape Values: Final Issues Paper* (*Draft Issues Paper*) prepared by Australian Wind Energy Association and Australian Council of National Trust is the first stage of a three stage process to develop methodologies for landscape assessments. The *Draft Issues Paper* outlines relevant landscape values and provides preliminary information on assessment methodologies and solutions that will be further developed in the subsequent stages. This visual impact assessment has been prepared with regard to the recommendations of the *Draft Issues Paper*.

The *Draft Issues Paper* refers to a number of international and Australian studies regarding the visual impact of wind farms in the landscape and on cultural perceptions. The perceptions and responses to the visual impact of wind farms cited through various studies, indicate a polarised view of residents living near completed wind farm developments, though the evidence illustrates a greater favourable response than a negative response.

The *Draft Issues Paper* refers to overseas studies (van de Wardt and Staats, 1988) that indicate that the number of turbines have been found to have a greater effect on landscape quality than the size of turbines, though this must also be considered in a context specific setting. The original BSWF proposal included 33 turbines over a much larger area than currently proposed. Due to concerns expressed by the Black Springs community over the scale of the project, the number of turbines has been reduced to nine, which significantly reduces the potential effect on the landscape quality of the area and mitigates some of the negative impacts the wind farm may have on the landscape.

3 Wind Farm Characteristics

The visual characteristics of the BSWF includes:

- Nine white SUZLON S88/2.1 MW turbines or equivalent turbine generators with a hub height of 80m. The rotor has 3 blades on the horizontal axis. The diameter of the blades is 88m and covers a swept area of 6082 m². The highest blade tip height would be 124m AGL.

- A substation incorporating a facilities building and car parking space. Cabling connecting each turbine to the substation will be located underground.

- Access roads for construction and maintenance.

- Signs, fencing and other infrastructure as required.

To mitigate ground turbulence and provide sufficient blade length for turbine operations, the hub of each turbine is significantly elevated 80m above ground level. The hub height and blade length, plus the contrast of the turbines against the skyline results in the wind turbines potentially being visible at long distances from the wind farm. Additionally, engineered structures are often highlighted in the rural landscape

because of their straight edges/lines, which are not often encountered in natural settings.

Windmills have long been part of the Australian landscape. The movement of blades driven by the wind have been utilised for a variety of farm related activities. The movement of the wind turbine rotor blades differ from this traditional windmill because of the size of the structures. The long blades, elevated above the landscape move in a large arc that naturally draws the eye. The cumulative impact of a number of turbines can result in a strong visual impression.

Therefore, wind farms result in a unique set of visual characteristics that can have a strong visual impression that within NSW and most of Australia are predominately uncommon.

4 Scenic quality

The existing character of the area between Black Springs and Burraga and the wider region may be described as undulating, moderately sloped rolling hills with shallow valleys in between, typical of the Oberon district. No significant ridgelines dominate the landscape. Cleared grass covered undulating terrain characterises the hills. Only very small patches of remnant vegetation remain across the precinct. No dominant permanent water sources are visible from public viewing areas within the visual catchment. A moderately sized dam exists in a natural depression adjacent to the eastern boundary of 'Winton Park', though this is not visible from any public viewing area.

The hills and the valley floors have been predominately cleared for agricultural purposes since European settlement. The site and the surrounding visual catchment has been moderately modified reflecting long-term agricultural use. The pine plantations reflect highly modified landscapes, particularly where clear felling has occurred. The existing pine plantations bound the north, east and western boundaries of the visual catchment.

The visual catchment has a number of distinctive existing anthropogenic structures located within the landscape. These include 500kV and 66kV transmission line towers, wind monitoring tower, pine plantations and the existing road network. The 500kv towers running adjacent to the site are prominent visual structures that exist within and beyond the visual catchment of the wind farm. The visual catchment beyond the site consists of undulating hills and valleys. Farm residences plus farm associated sheds and structures are scattered through the landscape.

The visual quality of the landscape within the visual catchment is summarised in Table 6, with the relevant visual quality classification shaded light grey. A quantitative value has been added to each rating, with Low = 1, Medium = 2 and High = 3. The overall visual quality of the landscape is rated as 'medium' to 'high' based on the criteria in Table 1 and the equivalent rating total score of 6 for both 'medium' and 'high'.

The overall scenic quality of the visual catchment and the broader area is predominately a moderately modified landscape where approximately 90% of the area has been cleared with small areas of remnant woodlands. Characteristic elements of the landscape include large cleared grassland areas with some shade trees. A number of engineered or built structures exist within the site and the immediate vicinity.

Table 1: Visual Quality Reference Table

Note: shaded text boxes indicate the assessment rating for the BSWF.

	LOW (score 1)	MEDIUM (score 2)	HIGH (score 3)
Relief/landform Diversity and Contrast	Flat terrain dominant. Ridgelines not often seen.	Undulating terrain dominant. Little contrast or ruggedness. Ridgelines prominent in only half or less of the landscape unit.	High hills in foreground and middleground. Presence of cliffs, rocks, and other geological features. High relief (eg steep slopes rising from water or plain). Ridgelines prominent in most of landscape unit
Vegetation Diversity and Contrast	One or two vegetation types present in foreground. Uniformity along skyline.	Patterning in only one or two areas. 3 or 4 vegetation types in foreground. Few emergent or feature trees.	High degree of patterning in vegetation. 4 or more distinct vegetation types. Emergent trees prominent and distinctive to region. Stands of specimen or accent vegetation (eg palms, pines, etc).
Naturalness	Dominence of development with many parts of a landscape unit.	Some evidence of development but not dominant. Traditional built character. Development in background and/or partially concealed.	Absence of development or minimal dominance within landscape unit. Presence of parkland or other open space including beach, lakeside etc.
Water Presence, Extent & Character	Little or no view of water. Water in background without prominence. Presence of polluted water or stagnant water.	Moderate extent of water. Presence of calm water. No islands, channels meandering water. Intermittent streams, lakes, rivers, etc.	Dominance of water in foreground and middleground. Presence of flowing water, turbulence and permanent water. Intricate shapes and river edges.
Development Form & Identity	Presence of commercial and industrial structures. Presence of large scale development (eg mining, infrastructure, etc). Newer residential development prominent.	Presence of established residential development. Small scale industrial development etc in middleground. Presence of sport and recreational facilities.	Presence of rural structures (eg farm buildings, fences, etc). Heritage buildings and other structures apparent. Isolated domestic scale structures.
Cultural	No evidence present. Area free of cultural landmarks. Presence of new development.	Presence of established, well landscaped development esp. in middleground and background.	Presence of established, maintained landscapes (eg farmland, forest, gardens etc) old towns and buildings etc.
Total Score	**1**	**6**	**6**

(Source: Modified from Clouston and Brouwer, 1995)

While the addition of nine wind turbines would attract visual attention within the landscape, other engineered structures currently exist that are equally visually significant, though probably more acceptable due to their common and accepted utilitarian contribution to modern society. This point accentuates the fact that the impact of the wind farm upon the scenic quality of the area is qualitative and subjective.

Consideration has been given to the community consultation feedback, personal conversations, current literature regarding visual impacts both within Australia and abroad plus the findings of other wind farm visual impact assessments when establishing public perceptions of the proposal. Public perception incorporates a range of views from across the spectrum of society, which sometimes does not fully fit the perceptions of all affected parties. Some members of the community see the wind farm as positive, promoting green energy and providing an opportunity for Oberon and Black Springs to be associated with alternative energy production and utilise this concept for tourism (personal communications with residents). Other members of the community may not dispute the benefits of green energy, but do not want the wind farm in their locality. It is well recognised that the community generally accept powerlines, masts, phone towers and similar structures in prominent locations, as acceptable and even necessary, despite the perceived visual impact, but object to wind turbines even though they provide an equally vital service to our community.

The community consultation indicated that several groups and individuals within the area are opposed to the proposal. It is understandable that those members of the community most affected by the location of the turbines may be perturbed by their presence and mitigation measures should be implemented to ameliorate the impacts.

5 Landscape values

Landscape value has traditionally applied to the visual character and aesthetic qualities of a particular landscape. To provide a more holistic approach to the visual assessment, the cultural landscape value must also be incorporated. Cultural landscape values relate to the social, indigenous, artistic and environmental values of the landscape.

The social landscape values relate to the connection the community and landholders feel with the land. The Black Springs landscape primary land use is agriculture with a balance of traditional European farming measures and forestry agriculture. The connection the landowners and community portray towards the landscape appears to value agricultural practices and is opposed by the intrusion of non-related land uses. An example of the varying degree of the social value given to the landscape was demonstrated by the initial opposition to the construction of Transgrid's 500kV transmission lines that pass adjacent to the BSWF site. Community members expressed concerns that the infrastructure would degrade the agricultural and natural appeal of the landscape, however, after the transmission lines had been constructed and operational for some time, community opposition or concern diminished (personal communications with Gavin Douglas). This does not demonstrate that the social value has diminished, but rather that the landscape value can accommodate change and the communities perceptions of values become more accepting with time.

The indigenous landscape value is considered high because of the inherent relationship between Aboriginal culture and the land. The Aboriginal Archaeological

Assessment undertaken by ERM discusses the Aboriginal occupation of the area. Many parts of the landscape hold significant value for the Pejar Local Aboriginal Land Council (PLALC). Members of the PLALC were invited to assist in the Aboriginal Archaeological investigation. The Aboriginal Archaeological Assessment assessed the scientific significance of the study area, however, any cultural significance can only be determined by the representatives of the PLALC. ERM were contacted by Denise Freeman in March 2005, who indicated that Mount Bathurst had cultural significance to the Pejar People due to its association with an Aboriginal tribal leader. No turbines in the revised proposal are to be located on or near Mount Bathurst.

The artistic values of Black Springs has been captured in a photograph taken by Peter Clark, of a fire trail during an intermittent rain and sunny period in a pine plantation around Black Springs. It is possible other artworks that are unrecognised may exist of the area, however, no specific artistic record of the BSWF site could be identified.

The environmental value of the landscape is addressed via both the Flora and Fauna Assessment for the project and in Section 4 Scenic Quality. The landscape supports a number of threatened species and the geomorphology results in the site draining to the Macquarie River, which is classed by the Department of Primary Industries – Fisheries Division as a waterway of high Conservation Value. The environmental significance of the landscape will be protected via the implementation of a number of precautionary measures to control runoff, soil erosion and waterway impacts, as well as monitoring for fauna impacts such as bird and bat strikes.

6 Distance to adjacent residences

The wind farm has been strategically located to avoid visual impacts upon any existing towns or villages within the Oberon Shire. The turbines will not be prominently visible from most of Black Springs Village. Only a few residences, located on the southwest outskirts of the village, are elevated and positioned sufficiently to overlook the proposal, though at a distance greater than 2700m from the nearest tower.

The turbines will not overshadow any occupied dwellings. The ‘Daisybank’ residence is located at a distance of approximately 1000m to the closest turbine and is host to the development. The second host property, ‘Acqualoria’ has its residence located at a distance of approximately 275m to the closest turbine. The turbines will be visible from both the ‘Daisybank’ and ‘Acqualoria’ residences.

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The ‘Winton Park’ farm residence is approximately 1100m to the east and the ‘Kringas Kalgoorrlie Hall’ farm residence approximately 1100m to the south of the closest turbines. The turbines will be visible from Kringas Kalgoorrlie Hall, though existing pine tree windbreaks adjacent to the ‘Winton Park’ residence should completely obscure any view of the turbines. The turbines within the ‘Daisybank’ property have been strategically located to maximise wind exposure while minimising the visual impact on the properties to the north and south of the site. Five of the turbines are positioned in a line along the ridgeline between the ‘Acqualoria’ and ‘Kringas Kalgoorrlie Hall’ farm residences, with two other turbines positioned near the western border of the ‘Daisybank’. The two western located turbines should be partially screened by remnant vegetation located between the ‘Kringas Kalgoorrlie Hall’ farm residence and these turbines. The ‘Mount Bathurst’ residence is located approximately 1800m from the most northern turbine. The remnant vegetation

between the turbine and the residence should mitigate most of the visual impacts of the wind farm on this residence.

To mitigate any impacts of the BSWF, for the operational life of the project, on an adjacent residence owned by NSW State Forest, a compensation agreement has been settled between the proponent and NSW State Forestry. The Forestry residence is located 450m southwest of the western most turbine on the "Acqualoria" property.

A zone of influence plan has been generated to demonstrate the relative viewing areas from which that the wind turbines may be visible. The zone of influence plan is shown in Figure 3. The zone of influence plan does not account for existing vegetation influences. Vegetation can greatly influence the view of each turbine, as demonstrated by the photomontages. The extent of vegetation screening is dependant upon is location is the foreground, middle ground and background with respect to the receptor location. Therefore, a visual catchment assessment has been undertaken that incorporates an assessment of the view towards the wind farm with respect to the receptor location and vegetation influences. The visual catchment assessment plan is shown in Figure 4.

7 Visual Sensitivity

Visual sensitivity is an estimate of the significance that a change within the landscape will have upon the visual receptor. The general principles of visual sensitivity include a decrease in visual sensitivity as viewer distance increases, a decrease in visual sensitivity as the viewing time decreases and a relationship between the view activity and sensitivity.

The wind farm will have an extensive view field in most directions given the elevation of the site. The main visual catchment is contained to an area approximately 7km wide (east to west) by approximately 10km (north to south), covering around 70km^2. The area between this immediate visual catchment and the background horizon is obscured by the hills forming the immediate visual catchment boundary. Figure 2 demonstrates the visual catchment and the distant horizon as viewed from 'Daisybank' trig station, the highest location within the wind farm site. As the length of the view increases the prominence of a structure such as a wind turbine will decrease. It is considered that the turbines visual sensitivity impact would be relatively minor beyond the immediate visual catchment.

Visual prominence of the wind farm to the surrounding area will be influenced by the topography and vegetation between the viewer and the turbines. The foreground and middleground vegetation elements will in some receptor locations partially or completely obscure the view of the turbines. The visual catchment assessment (refer to Figure 4) ground truthed the views of the wind farm from public viewing areas (along existing public roads) and for adjacent residences. The views are classified into clear, partially obstructed and completely obstructed. The two residences that will be most affected are; 'Kringas Kalgoorlie Hall' and 'Swatchfield'. The visual sensitivity from these adjacent residences is considered high because of the latent long viewing times and activities associated with residential dwellings. Selected screen planting with evergreen species close to the receptor source could be implemented to ameliorate the visual impacts on these residences. The viewer sensitivity from the 'Mount Bathurst' residence to the north is considered as moderate to low because the topography and existing vegetation between the residence and the turbines will partial block the views to the majority of the proposed turbines.

Residence located further than 2000m from the turbines are considered to have a lower view sensitivity than 'Kringas Kalgoorlie Hall' and 'Swatchfield' because of the greater distance to the receptor location.

The scenic impact of the turbines on the landscape is also dependant upon the perception of the observer. For example, generally motorists travelling through the area can be grouped into three categories:

- One group will be critical of the scenic impact that the turbines may have on the landscape.

- Another group will be supportive, even passionate about the advantages of re-newable energy and may even view wind turbines as a positive contribution to the landscape.

- A third group of potential observers, possibly the largest group, will not have a discernable opinion on the visual impact and may accept the changes to the landscape as necessary and inevitable.

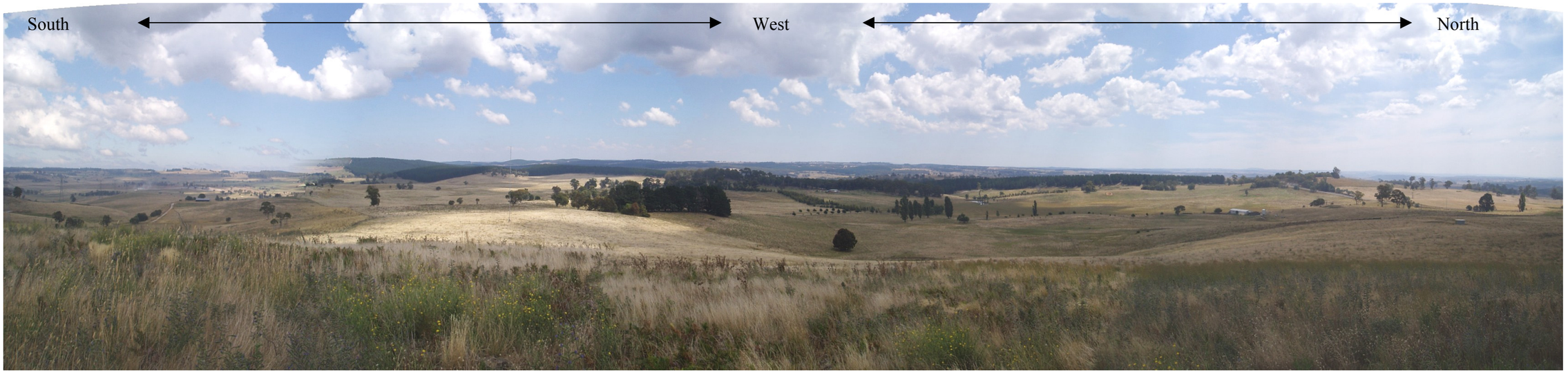
Similarly, individuals residing or working within the visual catchment will have a variety of opinions on the visual impact of the turbines depending on their preferences and perceptions. Public attitudes and perceived sensitivities to landscape changes are difficult to quantify and are highly subjective. The landholders of land on which the wind farm will be located indicated that they had no specific objections to the visual prominence of the turbines. Other Black Springs residents may be concerned with the prominence of the turbines to some residences and their prominence in the landscape. A line of 500Kv towers currently extends across the region and runs adjacent to the proposed wind farm site. Similar objections were raised to the construction and location of the towers, though, as indicated in the community consultation investigation, the attitudes to the towers is now one of acceptance and community opposition has dissipated. A similar situation has been experienced for wind farm developments, both within Australia and overseas. Public perceptions tend to change over time once the wind turbines are established.

The sensitivity of viewers of a wind farm is based on perception and is highly subjective. Studies of the wind farms in Searsburg, Vermont and Hull, Massachusetts showed that the support for the wind farm proposals increases after the completion of construction of the turbines. In Searsburg, Vermont, support grew from 66% support/neutral pre construction to 83% post construction. Similar results have been recorded in Europe. The proposed wind farm is expected to increase tourism within the area. Fact Sheets published by AusWEA indicate that hundreds of thousands of people visit Australian wind farms each year. The location of the proposed wind farm adjacent to Campbell's River Road should result in additional "green tourism" opportunities for Black Springs and the Oberon Shire. The wind farm also has the potential to reduce power disruptions to the local area. Therefore, the sensitivity of the viewer is dependent upon more factors than just the visual prominence of the turbines. The broader community and environmental benefits are critical factors that will influence the sensitivity of the viewer.

Figure 2: 360° panoramic views from the 'Daisybank' trig station illustrating the visual catchment and distant horizon.

Looking to the north from the left of the picture moving towards east and looking south on the right hand side of the photograph.

Looking to the south from the left of the picture moving towards west and then to the north again on the right hand side of the photograph.



8 Relative viewing height of the location

The viewing height of a receptor location is relative to the distance from the site. As the distance increases the prominence of the visual impact decreases. The site is not significantly elevated above the surrounding visual catchment. The site is around the same elevation as Black Springs, with distant interrupted middle ground views towards the south and west. The site is approximately level with Abercrombie Road, though vegetation and contours of the land restrict direct views from parts of the road. From the majority of Black Springs, most of the turbines should not be visible, because most of the residential area is located on a north facing slope and remnant vegetation in the foreground blocks most views to the southwest towards the wind farm site.

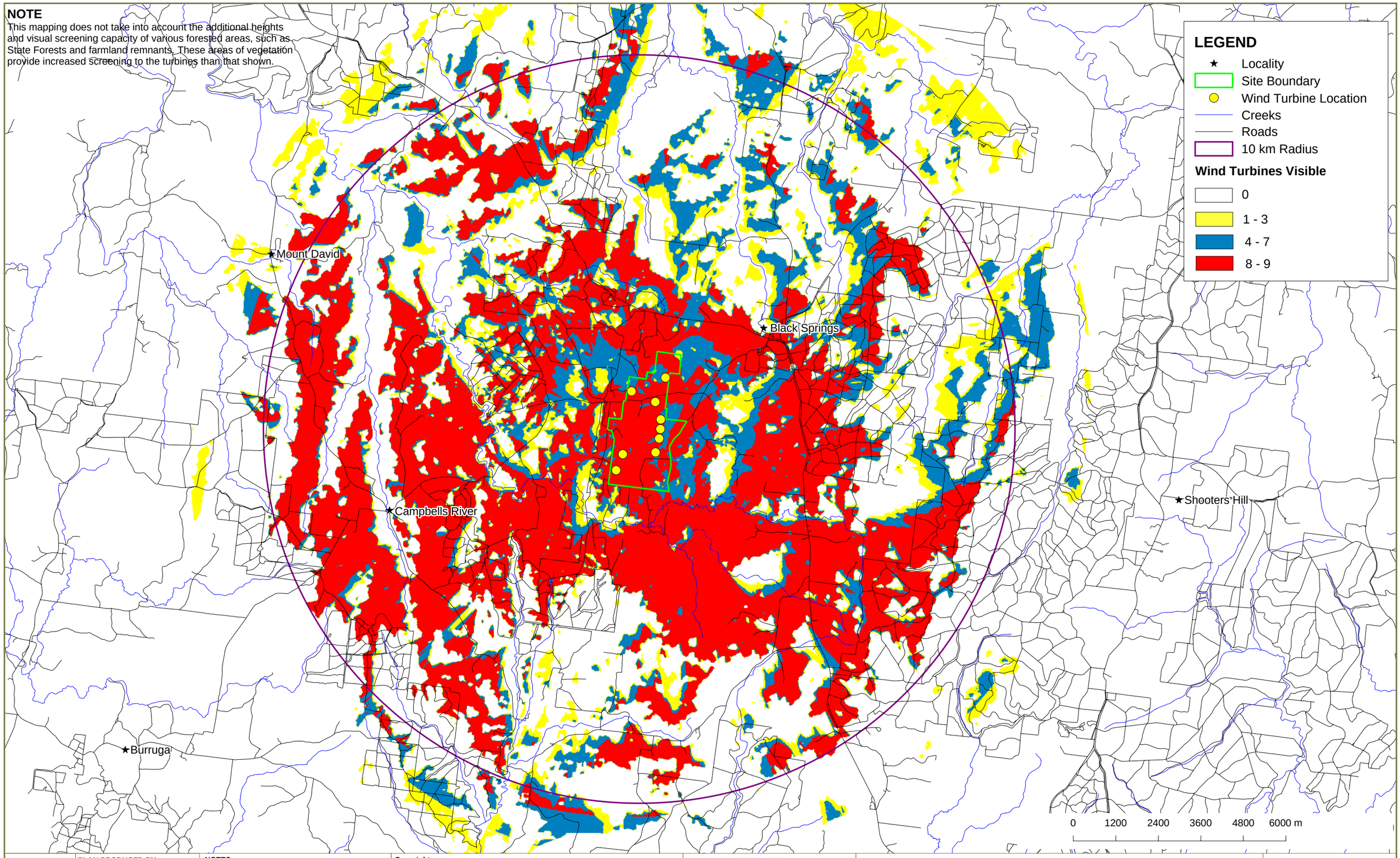
9 Colour

The turbine colour is proposed to be a matte finished white or off-white. White, off-white, pale blue or other muted colours have been demonstrated in wind farm projects globally as the least visually significant colour in all weather conditions and times of day. The colour and finish of the turbines has been designed to have the least visual prominence in the landscape and mitigate sun reflection concerns. The matte finish has been incorporated to reduce the potential for blade “glint”. The existing 500Kv towers are coloured light grey and as illustrated in Figure 2, their visual significance clearly fades with distance.

10 Number of potential viewers

The Bureau of Statistics 2001 Census showed around 5000 individuals live in the Oberon Local Government Area, with approximately 2700 living in Oberon Township and 496 people in the Black Springs area. The wind farm location is not predominately visible for the majority of the Black Springs village. Therefore, most of the potential viewers will result from traffic travelling within the visual catchment of the wind farm. No RTA Traffic Volume Data exists for traffic counts on the Campbell’s River Road or Abercrombie Road, though an estimated combined average is approximately 1200 vehicles per day. The average is based on the 2002 RTA Traffic Volume Data for Dog Rocks Road at 24km south of Oberon, which listed average daily traffic volume at 539 vehicle movements. Therefore, the estimated number of potential viewers per day would average 2400 people per day, with an allowance of two people per car and includes traffic movements at night when the wind farm would not be visible.

NOTE
This mapping does not take into account the additional heights and visual screening capacity of various forested areas, such as State Forests and farmland remnants. These areas of vegetation provide increased screening to the turbines than that shown.



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NOTES:

AMENDMENT	DATE	TYPE
A		
B		
C		
D		

SCALE: 1: 100000 at A3 Size
DATE: 5/12/2006
DATUM: AMG Zone 55 (AGD 66)
CONTOUR INTERVAL:
DESIGNED: GABOR VASARHELYI
APPROVED: TOBY LAMBERT

BLACK SPRINGS WIND FARM

FIGURE 3

ZONE OF VISUAL INFLUENCE 10 KM RADIUS

LAYOUT REF: 23219-ZONE OF INFLUENCE PLAN-B-A3.WOR

JOB REF: 23219

View corridor extends to NW >10km

DOGS ROCKS ROAD

Only partially obscured but new pine plantation growing up will block in years ahead - 2m tall now

Partial view obscured by topography & foreground vegetation

Downhill from ridge no view of windfarm

Hill blocks most of view to Daisybank turbine

Some turbines visible from southern edge of Black Springs

One residence has uninterrupted view towards windfarm but >2km away

Trees block view

ABERCROMBIE ROAD

Houses oriented to road - foreground vegetation provides partial screening to windfarm

Windfarm will be visible in distance - not dominating landscape. Broken up by foreground trees.

The view of the windfarm is partially filtered by trees when travelling along Abercrombie Rd. The windfarm is not dominant from this road due to middle and foreground vegetation and the distance to the turbines.

Pine plantation will block most visual impacts to the west.

a) & b)-close up

Turbines aligned to minimise visual impact from north and south

'Acqualoria'

Turbine 09

CAMPBELLS RIVER ROAD

Topography restricts view

Midground knoll and vegetation will block view.

House leased for life of project

Turbine 08

CAMPBELLS RIVER ROAD

Visibility of windfarm location starts from edge of forest

Turbine 07

Proposed windfarm not visible until rise of the hill due to pine trees

View from northeast partially blocked by hill

SWATCHFIELD ROAD

Turbine 06

Trig Stn

Turbine 05

'Daisybank'

Turbine 04

Turbine 03

Turbine 02

Turbine 01

View blocked by existing vegetation

Mid ground vegetation breaks up view

Knolls partially block views from southeast

Pine plantation will block most visual impacts to the west.

'Kringis Kalgoorlie Hall'

The five turbines are aligned in the Daisybank property to minimise the visual impact from Kringis & Swatchback

'Swatchfield'

Partial to full visibility along Abercrombie Rd

Ridgeline to the south bounds the visual catchment

0 400 800 1200 1600 2000 m

N

Legend

- Wind Turbine Locations
- Cabling
- Access Roads

View Classification

- Clear View
- Partially Obstructed View
- Completely Obstructed View
- Transmission Line
- Immediate Visual Catchment Boundary
- Photograph Location and Direction
- Black Springs village
- SubStation

TITLE: FIGURE 4 - VISUAL CATCHMENT ASSESSMENT
BLACK SPRINGS WIND FARM, OBERON LGA

CLIENT: WIND CORPORATION AUSTRALIA

PLANNING SURVEYING ECOLOGY

HARPER SOMERS O'SULLIVAN

AMENDMENT	DATE	TYPE
A		
B		
C		
D		

SCALE: 1: 25000 at A3 Size
DATE: 15/08/2006
DATUM: AMG Zone 55 (AGD 66)
CONTOUR INTERVAL: 10 metres

DRAWN: P. HILLIER
DESIGNED:
SURVEYOR:
APPROVED: S. McCALL

JOB REF: 23219
SHEET 1 OF 1

LAYOUT REF: J:\JOBS\23k\23219 - Black Springs\Drafting\Mapinfo\23219-VISUAL IMPACT ASSESSMENT-B-A3.wor

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Figure 5: Visual Impact Assessment Photographs

The photographs provide a graphic impression of the views towards the site and the landscape context. The location of each photograph corresponds to the photograph numbers shown in Figure 4: Visual Catchment Assessment.

1. Turbines may be partially visible in the distance though existing vegetation may screen some of the turbines on the 'Daisybank' property.

2a Turbines may be partially visible in the distance though existing knolls may screen some of the turbines on the 'Daisybank' property.

2b Turbines may be clearly visible in the distance on the “Acqualoria” property.

3b A close up view of the middle ground knoll that may block some of the lower views of the turbines, though the blades may be clearly visible on the ‘Acqualoria’ property, as demonstrated by the 500kV tower in the middle of the photograph.

3a The middle ground knoll may block some of the lower views of the turbines, though the blades may be clearly visible on the ‘Acqualoria’ property.

4a The middle ground hill and vegetation will block most of the views to the turbines.

4b The middle ground hill and vegetation will block most of the views to the turbines.

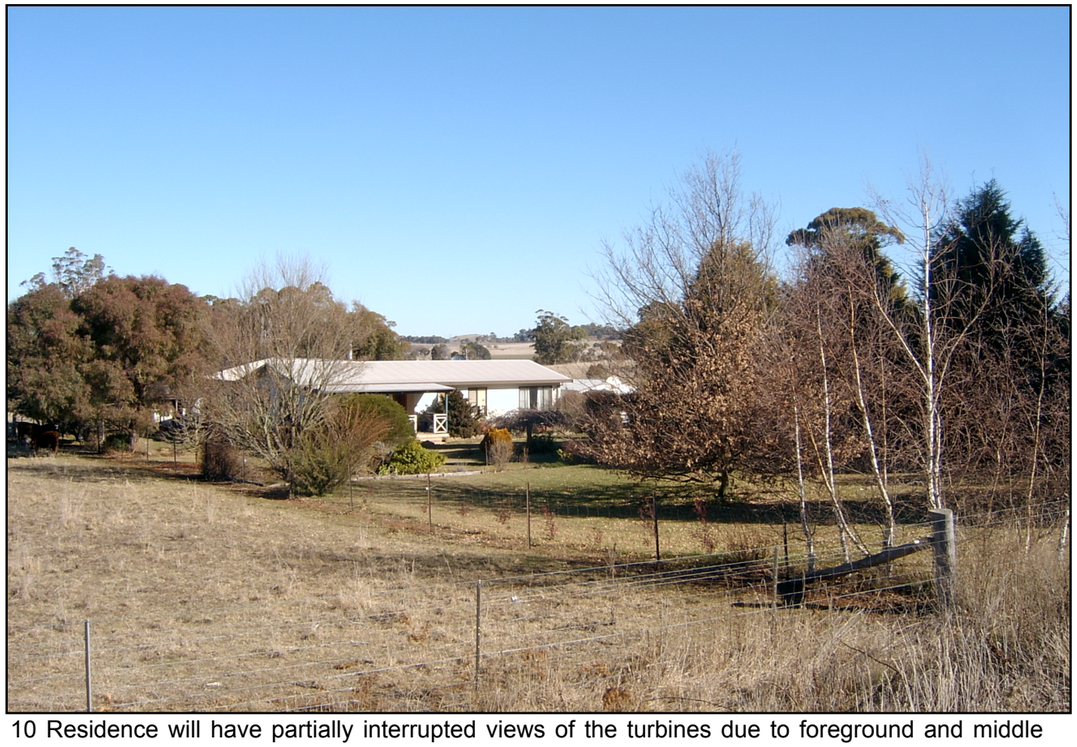
5 The turbine blades may be visible from Campbell's River Road, though the middle ground knoll will block some of the view.

6 Turbines will be clearly visible from the Forestry property, though the residence will be leased for the life of the project.

7 Pine forest will grow up over time to screen the turbines.

8 The view from Dog Rocks Road will have some areas with uninterrupted views to the turbines.

9 The view from opposite the entry to the 'Mount Bathurst' residence will have some turbines clearly visible, though most turbine views will be blocked by foreground and middle ground vegetation and knolls.



10 Residence will have partially interrupted views of the turbines due to foreground and middle ground vegetation.

11 Views to the south from Dog Rocks Road towards the wind farm will be partially interrupted by foreground and middle ground vegetation.

12 View from intersection at Black Springs will have partial views towards the “Daisybank’ Trig Station.

13 View from Abercrombie Road provide a clear view of wind farm, though at a distance of greater than 3.5km.

14 View from Abercrombie Road provide a partially interrupted view of wind farm, though at a distance of greater than 4km.

15 View from Swatchfield Road will have clear views of the turbines.

11 Duration of exposure to viewer

The duration of exposure of the proposed turbines to the viewer will vary greatly upon the position of the viewer and any activity being undertaken at the time. Motorists travelling along the Abercrombie Road will experience periods of exposure over approximately 10 minutes when travelling the first 6km of the road south of Black Springs village. Motorists travelling towards and from Burraga will have an opportunity to view the wind farm when they approach and pass the project in the 2.5km stretch along Campbell's River Road, providing a short period of exposure over 2-3 minutes.

Residences within the scenic catchment will experience the longest durations of exposure. The impact of this exposure is directly related to the perception the individual holds in regards to wind farms and alternative energy options. The duration of exposure and the related impacts, whether positive or negative, is also related to the distance of the viewer from the turbines. Therefore, residences in close proximity to the site, including 'Kringas Kalgoorlie Hall' and 'Swatchfield', would experience the greatest exposure, though mitigation options such as tree planting and other screening methods would reduce the level of exposure at these locations. Additionally, the orientation of residences and their main view corridors will influence the opinion of the residents. A number of residences in the visual catchment are orientated away from the wind farm or have existing vegetation screens that block most of the view.

Many of the surrounding landholders use their property to derive an income. Therefore, consideration must be given to these activities across an entire landholding rather than just the farm residence when considering the exposure of the viewer to the wind farm. General agricultural and farm maintenance activities would result in potentially long exposure times to the visual influence of the wind turbines for adjacent landholders. However, these activities generally require concentration thereby reducing the visual awareness of a turbine compared to periods of passive activity which are normally associated with relaxation times within or around a farm residence. Therefore, the potential visual impact of the wind farm is not considered as great for activities across the landholding compared to areas of passive recreation such as farm residences, where unscreened or unfiltered views tend to be valued highly.

12 Scale, dominance and size of objects

The scale of the turbines in relation to the surrounding landscape is graphically illustrated in the photomontages. The wind farm will be a prominent feature of the landscape south west of Black Springs. The scale and dominance of the turbines within the landscape will vary with the location from where the turbines are viewed. The wind farm location will act as the background from Abercrombie Road. The foreground and middle ground elements within the view corridor, such as trees and buildings and other structures, will influence the perception of scale and dominance of the turbines within the landscape. The turbines will be prominent in the foreground when viewed from Campbell's River Road. Each of the photomontages provide examples of the foreground and middle ground elements that influence the scale and dominance of the turbines.

The final size of the turbines are still to be determined depending upon the type of turbine to be used for the project. The proposed turbine hub height will be around 80m with a typical blade length of 44m. The height of the turbines is a design

constraint that balances the length of the rotor blades and the efficiency of the turbine. Turbines are constructed at typical heights of 60m or more to reduce the interference of friction and turbulence resulting from the interaction between the wind and the land surface. The heights of the proposed turbines are based on current available turbine models. Reducing the height, in general reduces the blade length and therefore efficiency and would result in the need for additional turbines to maintain the viability of the wind farm. Additional turbines result in other unwarranted effects such as increased land area and visual clutter. The original BSWF was for 33 smaller turbines, though community concerns about the scale of the project led to a significant modification of the proposal. The revised wind farm has nine larger turbines than the original 33. The larger turbines, but reduced turbine number is considered a better outcome for the landscape and alleviates some community concerns.

13 Compatibility with the landscape

The Black Springs area representative of a typical rural landscape that has been modified through agriculture and forestry practices. The land is used primarily to obtain revenue and landscape values are considered secondary. Works such as tree planting serves to improve the landscape for primary production (wind breaks or stock shelter) or prevent further degradation of soils but are rarely undertaken to improve the scenic quality of the landscape just for the intrinsic visual value they provide. Therefore, the existing Black Springs landholdings are generally utilised to derive an income through primary production activities. Windmills have long been part of the agricultural landscape and have become an iconic part of the typical rural landscape. Wind farms are considered compatible with agricultural landscapes due to their small environmental footprint and ability for agricultural activities to continue un-interrupted to the base of the turbines. Wind farms present another contemporary form of revenue for the landholder and therefore should not be viewed with any great indifference compared to the existing primary production activities. The amount of area and environmental impact resulting from wind turbines and access tracks and other associated infrastructure are significantly smaller per megawatt of power produced compared to the traditional coal fired power station. Additionally, engineered or built structures such as transmission line towers, phone towers, roads, pine plantations, clear felling operations and monitoring masts currently exist within the landscape. The introduction of nine turbines is considered consistent with the existing infrastructure and compatible with the agricultural use of the landscape.

14 Affects on listed heritage items

There is no consistently applied approach to define the visual impact of wind farms on the curtilage and visual catchment of significant heritage items. The impact the turbines will have on the visual catchment of items of significant heritage is related to the distance between the turbines and the heritage item. There is one heritage item listed in the Oberon Local Environmental Plan 1998, a lone grave on Springvale, Rockley Road, 6km WNW of Black Springs. It is not considered that the proposed wind farm will have a significant visual impact on the lone grave as the distance between the wind farm and the lone grave is greater than 2km, with scattered remnant vegetation and pine plantations located between them.

15 Shadow Flicker

A Shadow Flicker Study has been undertaken by Energreen Wind to assess the potential impact shadow flicker may have upon adjacent receptors (homes). Shadow flicker is a term used to describe the change in light intensity observed when a turbine blade casts an intermittent shadow upon a receptor. With regard to wind farms, the effect is caused by the rotating blades casting a moving shadow over a residence. Shadow flicker can cause disturbance to residents if the orientation of the turbines and a home are such that the residence experiences significant periods of flicker impact. For example if a person is within a building, shadow flicker from a turbine will result in an intermittent variation in the natural light intensity. If the regular changes in light intensity levels are high or experienced for significant periods of time, then the shadow flicker may cause a nuisance.

It has been scientifically established that frequencies of light flicker above 2.5 hertz may cause disturbance and nuisance to people. This was established for both the general population and the 2% who suffer from epilepsy. Of those that suffer epilepsy, 5% have exhibited an adverse reaction to flicker effects above 2.5 to 3 hertz. The rotational speed of the SUZLON S88 turbine is 15.79 rpm at rated power resulting in a flicker frequency of approximately 0.6-1.0 Hertz which is significantly lower than that considered to be the cause of nuisance or disturbance as described above. Although an impact cannot be neglected it is considered to be less severe than that for higher flicker frequencies and more generally related to receptor's comfort. To minimize the potential impact from Shadow Flicker, sufficient distance between houses (having large windows and sides facing the turbines without screening through vegetation) and wind turbines has been considered in the design.

There is only one residence not participating in the project and potentially experiencing flickering shadows for a maximum of 21 hours per year. This property is surrounded by trees masking any shadow generated by turbines and therefore no impact from shadow flicker is expected. No consideration of screening due to vegetation or structures is considered in the calculation model and such features are in reality, likely to further reduce any shadow flicker impact. The affected residence is the residence proposed to be leased for the life of the project. Therefore, the potential for shadow flicker associated with the proposal on existing residences is considered negligible. A copy of the Shadow Flicker Study is contained in Appendix B of the Environmental Assessment.

16 Driver distraction

In general an observers impression of a modification to the landscape within the visual impact area will decrease as distance to the turbines increases. Therefore, visual impact decreases as the observation distance increases, providing plenty of lead time for motorists travelling along Abercrombie Road and a small lead time for Campbell's River Road.

Abercrombie Road is greater than 3.5km from any turbine at its closest point. At this distance the wind farm should be slightly noticeable with the visual prominence increasing at the motorists approach and depart Black Springs. Photomontage Plate 6.4 and 6.5 illustrate the view from Abercrombie Road towards the wind farm. This lead up time will allow the motorist plenty of opportunity to view the turbines and minimise the potential for driver distraction. Motorists travelling to and from Burraga will have less lead up time from the initial observation of the turbines because of the topography and the smaller distance to the turbines from the first viewing point. The

potential for driver distraction is greatest for motorists travelling along Campbell's River Road, as shown in Photomontage Plate 6.2.

Driver distraction could also result from shadow flicker effects across Campbell's River Road and Swatchfield Road. Traffic along these roads will experience shadow flicker during various times of the day and vary with the seasonal path of the sun across the sky. Sections of each road will be influenced by shadow flicker for between 31 and 1171 hours per annum.

17 Photomontages

A set of photomontages has been produced and provided in Figure 6 to illustrate the turbines within the landscape. The photomontages have been produced using a Single Lens Reflex (SLR) camera using a 35mm film and 50mm focal length lens that is considered to be representative of what the human eye sees. The photomontages have been reproduced at a height of approximately 20cm to more accurately represent what is perceived by the human eye [based on findings from a study undertaken by the Countryside Council for Wales (2003) *Visual Perception versus Photomontage – Non-Technical Study*]. The photomontage locations were chosen to be representative of the key locations around the wind farm and to provide a view of the proposal from each of the potential public viewing locations (ie Campbell's river Road, Swatchfield Road, Abercrombie Road and the main intersection at Black Springs). The location selected provide a number of different viewing angles and distances and illustrate the effects of foreground, middleground and background focal objects.

The photomontages illustrate the visual prominence of the wind turbines particularly from Campbell's River Road. A plan relating to the location where each photomontage picture was taken has also been incorporated. The photomontages illustrate the visual impact the turbines will have on the landscape. Plates 6.1a, 6.1b and 6.2 demonstrate the visual prominence of the turbines in the immediate vicinity of the wind farm, though as the distance from the turbines increases, particularly beyond 2km, the foreground, middleground and background topography and vegetation greatly influence the visual prominence of the turbines. This is clearly shown in Plates 6.3, 6.4 and 6.5. Interestingly, the view from Black Springs Village shown in Plate 6.4 demonstrates the lack of visual prominence of the wind farm from the main portion of the Village.

Figure 6: Photomontages

Plate 6.1a: View of the wind farm from Swatchfield Road.

Plate 6.1b: Close up view of the wind farm from Swatchfield Road.

Plate 6.2: View of the wind farm from Campbells River Road.

Plate 6.3: View towards the wind farm from the intersection of Campbells River Road and Swatchfield Road.

Plate 6.4: View towards the wind farm from the Abercrombie Road and Campbells River Road, Black Springs.

Plate 6.5: View looking west towards the wind farm from Abercrombie Road.

Plate 6.6: View looking west towards the wind farm from Abercrombie Road.

Plate 6.7: View looking south west towards the wind farm from Dog Rocks Road, Black Springs Village.

Plate 6.8: View looking south towards the wind farm from Dogs Rocks Road.

Plate 6.9a: View looking east towards the wind farm from a track entrance adjacent to Campbells River Road.

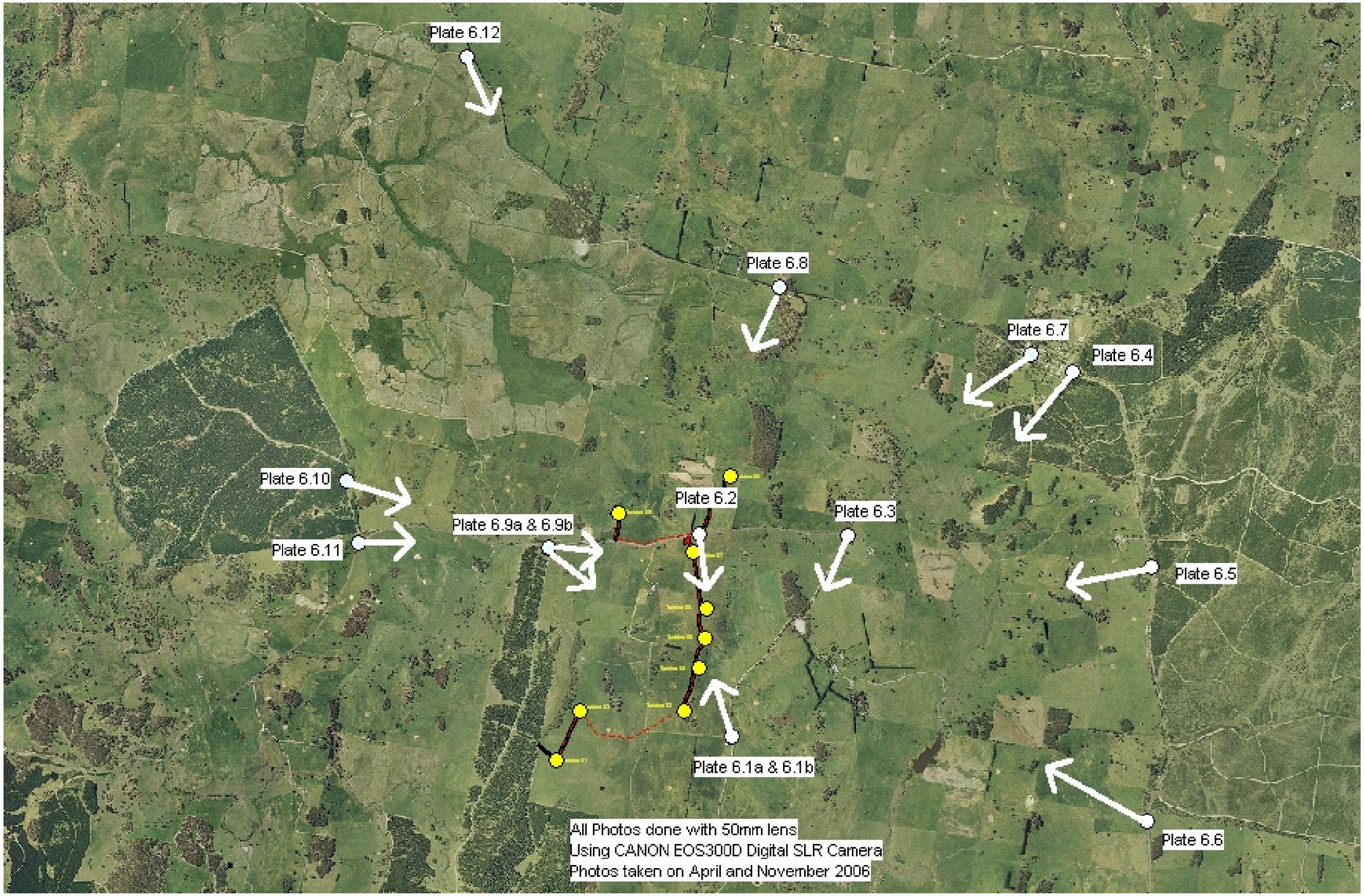
Plate 6.9b: View looking south east towards the wind farm from a track entrance adjacent to Campbells River Road.

Plate 6.10: View looking east towards the wind farm across a new pine plantation from the State Forest unnamed road adjacent to Campbell's River Road.

Plate 6.11: View looking east towards the wind farm from Campbell's River Road.

Plate 6.12: View looking south east towards the wind farm across a pine plantation within the Vulcan State Forest adjacent to Dog Rocks Road.

Plate 6.13: Photomontage location map



18 Impact on surrounding National Parks / Nature Reserves

The visual impact of the wind farm on a number of National Parks and Nature Reserves surrounding Black Springs has been investigated. All of the National Parks (NP) and Nature Reserves (NR) are located at a distance greater than 20km from the Black Springs Wind Farm. The *Draft Issues Paper* discusses the debate on the threshold distance of visual intrusion. The debate varies between statements that wind generators can be seen up to 20km away in clear weather, a single wind turbine becomes insignificant at 13.75km and that beyond 5km the visual impact reduces to imperceptible. Therefore, it is considered that beyond 20km the visual intrusion of a wind farm within the context of the Oberon Local Government Area is negligible based on the undulating topography, large number of State Forests surrounding the site and varying weather conditions that influence the visible distance through the landscape.

The following National Parks and Nature Reserves have been identified and there location mapped with respect to the Black Springs Wind Farm:

- **Abercrombie River NP** – located 22km south of the Black Springs Wind Farm. Views from Abercrombie River NP towards the wind farm are blocked by elements of the Vulcan State Forest which is located at a higher elevation than the NP. The wind turbine layout predominately runs along ridgeline orientated north/south which serves to reduce the prominence of the wind farm when viewed from locations to the north or south. The Black Springs Wind Farm is considered to have a negligible visible impact on this NP.

- **Blue Mountains NP** – located 50km to the east of the Black Springs Wind Farm. The distance of the NP from the wind farm plus the high terrain and Vulcan State Forest located between the Blue Mountains NP and the wind farm serves to screen the proposal. The Black Springs Wind Farm is considered to have a negligible visible impact on this NP.

- **Kanangra-Boyd NP** - located 25km to the east of the Black Springs Wind Farm. The distance of the NP from the wind farm plus the high terrain and Vulcan State Forest located between the Kanangra-Boyd NP and the wind farm serves to screen the proposal. The Black Springs Wind Farm is considered to have a negligible visible impact on this NP.

- **Copperhannia NR** - located 43km to the west of the Black Springs Wind Farm. The distance of the NP from the wind farm plus the high terrain and Dog Rocks State Forest located between the Copperhannia NR and the wind farm serves to screen the proposal. The Black Springs Wind Farm is considered to have a negligible visible impact on this NR.

- **Razorback NR** - located 43km to the southwest of the Black Springs Wind Farm. The distance of the NP from the wind farm plus the high terrain and Mount David State Forest located between the Razorback NR and the wind farm serves to screen the proposal. The Black Springs Wind Farm is considered to have a negligible visible impact on this NR.

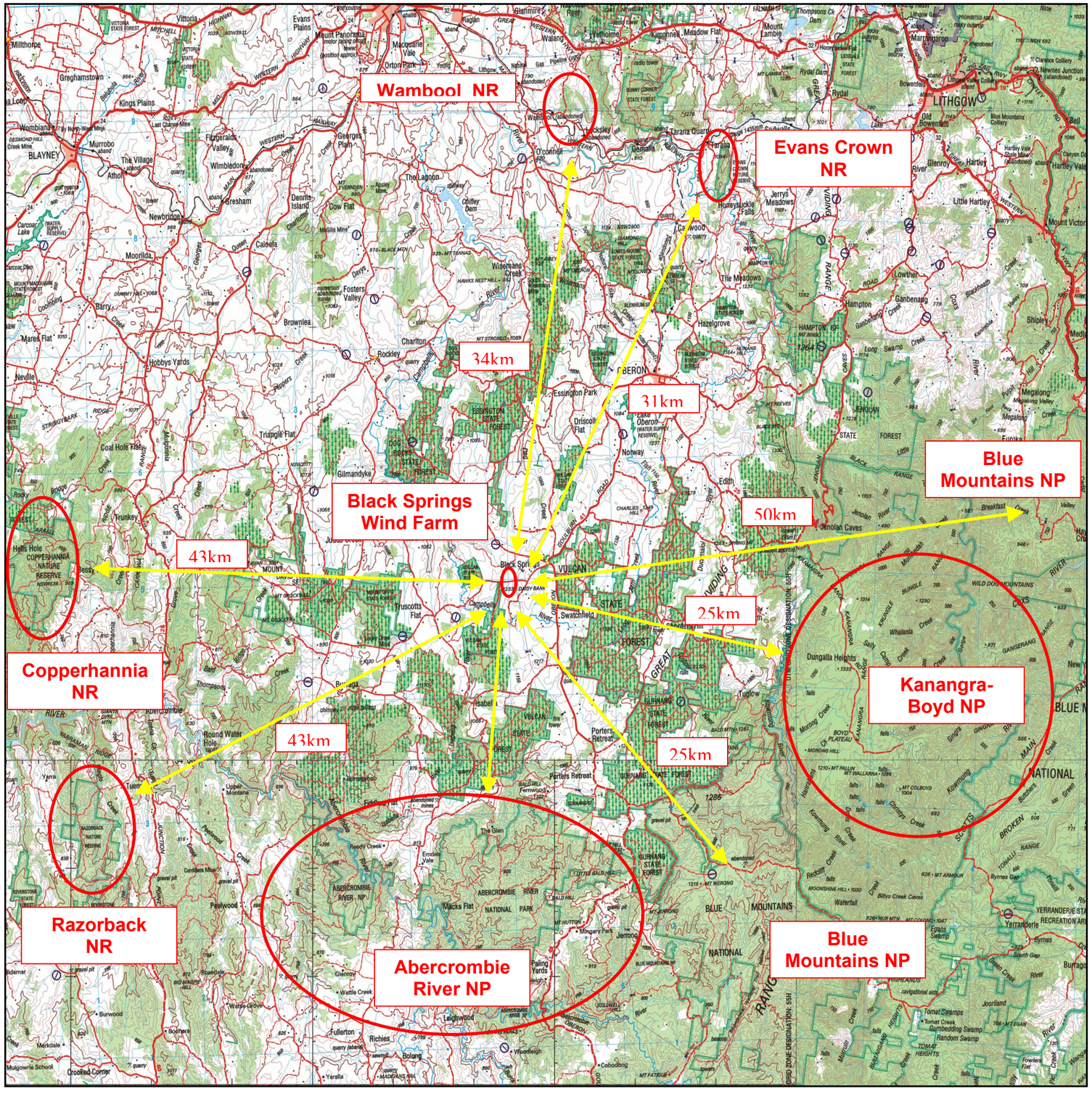
- **Evans Crown NR** - located 31km to the northeast of the Black Springs Wind Farm. The distance of the NP from the wind farm plus the level terrain and Essington State Forest located between the Evans Crown NR and the wind farm serves to

screen the proposal. The Black Springs Wind Farm is considered to have a negligible visible impact on this NR.

- **Wambool NR** - located 34km to the north of the Black Springs Wind Farm. The distance of the NP from the wind farm plus the elevated areas around Mount Oberon and Mount Airey and the Essington State Forest located between the Wambool NR and the wind farm all serve to screen the proposal. The Black Springs Wind Farm is considered to have a negligible visible impact on this NR.

Figure 7 illustrates the location of the National Parks and Nature Reserves with respect to the Black Springs Wind Farm. Considering the location of the National Parks and Nature Reserves is greater than 20km and the elevated undulating terrain of the area, it is considered that Black Springs Wind Farm will have a negligible visual impact on these lands.

Figure 7: Location of National Parks and Nature Reserves



19 Recommendations

To mitigate the potential visual impacts that may result from the Black Springs Wind Farm a number of recommendations to be implemented by the developer are suggested:

- To mitigate visual impacts on adjacent residences within 2km of the wind farm, an offer of planting evergreen tree species to screen the wind turbines will be extended. Other residences which claim to be affected and are located further away than 2km will be investigated on a case by case basis to determine if potential mitigation measures are required.

- To mitigate the visual impact and shadow flicker effects, warning or indicator signs along both the eastern and western approaches of Campbell's River Road and southern and northern approaches of Swatchfield Road. The signs would advise the motorists of the impending turbines and shadow flicker effect and could be located in several positions creating a series of warnings before the motorists arrive at the initial viewing opportunity of the wind farm. Additionally, an opportunity for a viewing area for motorists to stop and view the turbine may be possible along Campbell's River Road. The viewing platform would serve as a location for interested tourists to safely stop and view the wind farm. Clear sign posting of the viewing area would assist in further reducing driver distraction by informing motorists of a safe area to stop and observe the turbines.

20 Conclusion

The turbines will impact the scenic quality of the area, though the perception of the impact will vary according to each individual's perception of wind farms and their attitude towards renewable energy production. The landscape cultural values, including the social, indigenous, artistic and environmental values have been reviewed to provide a more balanced appraisal of the existing landscape value. The existing landscape character incorporates built elements into the landscape including infrastructure such as the Transgrid 500Kv powerline and other electrical powerlines which combined with the landscape modification, as a result of agricultural activities, lessens the impact of the wind farm.

It should be noted that a high visual impact does not necessarily equate with a reduction in scenic quality. The turbines have been located so as to provide a balance between the community needs and perceptions, the environmental issues and energy output. The wind farm location is not within the main visual catchment of Black Springs or any other residential area. The site has a relatively small immediate visual catchment, though some residences within this catchment will be impacted visually by the proposal. Mitigation measures such as plant screening are possible for those residences most impacted by the proposal.

When assessing the visual impact of a wind farm the preponderance of the environmental benefits must also be included in the assessment. The visual and environmental impact of a wind farm is considerably lower than impacts associated with other traditional energy production facilities, such as coal-fired power stations. Therefore, even though the wind farm will impact the visual catchment the environmental benefits associated with renewable energy also provide significant remuneration and the impacts in this circumstance can be mitigated to a level where the environmental benefit outweighs the potential visual impact.