NSW GOVERNMENT Planning & Environment

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Wind Energy: Visual Assessment Bulletin

For State significant wind energy development

December 2016

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Images contained within this document are provided by the NSW Office of Environment and Heritage.

Contents

Purpose

This *Visual Assessment Bulletin* has been developed to guide the appropriate location of wind energy development in NSW and to establish an assessment framework for the assessment of visual impacts associated with wind energy. Visual impacts are one of a range of issues considered in the assessment and determination of wind energy projects.

The Bulletin provides guidance on site selection, environmental assessment and decision-making. It is intended for use by wind energy proponents, professionals engaged in the assessment of landscape and visual impacts associated with wind energy projects, and the wider community in understanding the principles applied in the siting and visual assessment of large-scale wind energy projects.

This bulletin has been prepared by the Department of Planning and Environment (the Department) and should be read in conjunction with the more general assessment requirements outlined in the *Wind Energy Guideline*.

This Bulletin will be reviewed from time to time as required.

Application of this Bulletin

The Bulletin will apply to all new development applications for State Significant Development (SSD) wind energy projects through the Secretary's Environmental Assessment Requirements (SEARs) issued after the date of the Bulletin. It will also apply to any modification applications submitted after the date of the Bulletin that propose additional turbines, or a significant reconfiguration or increase in height to the approved turbines.

Objectives

The objectives of the Bulletin are to:

- provide the community, industry and decision-makers with a framework for visual impact analysis and assessment that is focused on minimising and managing the most significant impacts;
- facilitate improved wind turbine and ancillary infrastructure siting and design during the pre-lodgement phase of a project, and encourage early consideration of visual impacts to minimise conflicts and delays where possible, and provide for a better planning outcome;
- provide the community and other stakeholders with greater clarity on the process along with an opportunity to integrate community landscape values into the assessment process; and
- provide greater consistency in assessment by outlining appropriate assessment terminology and methodologies.

Background

The assessment of potential visual impacts on the landscape that may arise from wind energy projects is different from other forms of SSD in a number of ways:

- wind turbines are large structures which are often required to be located on ridgelines and elevated positions to capture wind resources;
- wind turbines have distinctive outlines and can be over 150 metres in height;
- the size, colour and movement of wind turbines contributes to their visibility within the rural landscapes where they are predominantly located;
- wind energy projects, including ancillary infrastructure, can cover large areas, sometimes more than 100 square kilometres; and
- other forms of development in these rural landscapes are unlikely to match the potential height of wind energy projects.

Generally, the visual impact of a wind energy project will depend upon the characteristics and values of the existing landscape, the extent to which the existing landscape is changed by the project and how these changes are perceived by individuals and the broader community.

This Bulletin is intended to drive good siting and design of turbines at the early stages of the project as well as provide a transparent framework of performance objectives to assess the project against. It is important that proponents engage with the community and potentially affected landholders early to establish landscape values and appropriate design responses that avoid impacts. If there is sound justification for maintaining a proposed turbine layout, proponents should consider other options to minimise or mitigate impacts as far as practicable. This may include relocating turbines, changing colours of the turbines to reduce contrast or providing additional vegetation and screening. Negotiated agreements with specific landowners regarding the management of those impacts should also be considered.

The consent authority will assess and confirm overall acceptability of landscape and visual impacts by reviewing the information required by this document, and balancing these matters along with other environmental, social and economic considerations, and the broader public interest. For example, in the case of Taralga[1], the Chief Judge of the Land and Environment Court found that, in that specific case, the public interest in renewable energy outweighed the visual, noise and other adverse impacts of the proposal.

1 *Taralga Landscape Guardians Inc v Minister for Planning and RES Southern Cross Pty Ltd (2007) 161 LGERA 1*

The visual assessment approach

This Bulletin outlines an approach that provides integration and easy transition between the key assessment stages. The steps in visual assessment are outlined in further detail at Figure 1.

The visual assessment process can be broken into **two main stages**, with key steps for the proponent in each stage. These two stages are:

1. Preliminary Environmental Assessment

At the Preliminary Environmental Assessment stage, a process consisting of community consultation regarding key landscape values and application of preliminary assessment tools has been developed. The tools include consideration of the potential impact of the proposals on dwellings and key public viewpoints.

The preliminary assessment tools have been designed to assist proponents to drive better outcomes. They will assist in identifying early in the process the locations where wind turbines may have impacts that warrant further consideration. This in turn provides an opportunity to refine the proposed wind turbine layout to avoid or minimise impacts, or justify the proposed design prior to lodgement of the application.

Proponents will be required to submit, with the request for SEARs, a Preliminary Environmental Assessment that includes a map with key information, results of community consultation and the application of the preliminary assessment tools. This will form the basis for the issue of the SEARs that will identify the matters that must be addressed in the Environmental Impact Statement (EIS).

Figure 1. Steps in Visual Assessment

2. Assessment and determination

A visual assessment will be required as part of the EIS. The SEARs will specify the requirements for visual assessment for the particular project. Standard SEARs will be applied in relation to visual impacts but additional project specific SEARs may also be required based on the outcomes of the preliminary assessment tools.

The visual assessment will include:

- a baseline study that includes analysis of the landscape character, scenic quality and visibility from viewpoints of different sensitivity levels;
- establish visual influences zones from viewpoints using data collected in the baseline study;
- assessment of the proposed layout against visual performance objectives; and
- justification for the final proposed layout and identification of mitigation and management measures.

The data collated for the baseline study will inform the visual assessment. The visual assessment will focus assessment on those turbines identified through application of the preliminary assessment tools. However, the assessment of visual impacts from all turbines and ancillary facilities and infrastructure will be required.

The proposal will be publicly exhibited and the proponent will have to respond to issues raised by the community and relevant government agencies and authorities. This may include further refinement to the design of the project and/or proposed additional mitigation and management measures.

In the final phase, the Department undertakes an assessment of the project against the visual performance objectives and considers the acceptability of the project, including the adequacy of mitigation and management measures. The consent authority will determine whether the project should be approved on its merits by considering the broad range of social, environmental and economic considerations applying to each project, and the broader public interest[2]. This will include consideration of whether the project could be approved subject to conditions that will mitigate impacts to an acceptable level.

When considering the public interest, consideration may be given to the public interest in increasing the supply of renewable energy. For example, in the Taralga[3] case, the Land and Environment Court considered the broad public interest in the establishment of viable renewable energy sources.

Professional assessment skills

Professional assessment skills are critical to the effective application of visual assessment.

The proponent is expected to engage professionals from relevant natural resource management and design professions (for example environmental planners, geographers, landscape architects, architects, or other visual resource specialists), with demonstrated experience and capabilities in visual assessment to carry out a wind energy project visual assessment. The name, qualifications and experience of the person preparing the visual assessment (or the principal preparer, if prepared by a team) should be provided, along with the date on which the assessment was completed. Within this context, the Bulletin provides guidance on methodologies and identifies performance criteria to facilitate transparent, rigorous and consistent visual assessment.

2 *Taralga Landscape Guardians Inc v Minister for Planning and RES Southern Cross Pty Ltd (2007) 161 LGERA 1.*

3 *Taralga Landscape Guardians Inc v Minister for Planning and RES Southern Cross Pty Ltd (2007) 161 LGERA 1.*

Stage 1: Preliminary Environmental Assessment (pre-lodgement)

At the scoping and design phase, the proponent must undertake a preliminary environmental assessment that considers the landscape in which a proposed wind energy project will be located. The analysis must include:

- undertaking community consultation to establish key landscape features valued by the community, key viewpoints in the area (both public and private) along with information about the relative scenic quality of the area;
- production of a map detailing key landscape features (informed by community consultation and any ground-truthing undertaken), the preliminary wind turbine layout, the location of dwellings and key public viewpoints and an overlay of the wind resource; and
- results of the application of the preliminary assessment tools for both the visual magnitude and multiple wind turbine parameters.

Community consultation

Consultation with the community at this early stage may be broad, but should include discussions about the proposed project area, likely corridors for development, or preliminary turbine layouts and must involve people from the visual catchment.

The purpose of early communications is to:

- establish the key landscape features, areas of scenic quality and key public viewpoints valued by that community;
- allow the community to have input into the ranking of those features and scenic quality into high, moderate or low visual significance;
- inform landholders about the proposed project area, likely corridors for development, preliminary turbine layouts and access routes; and
- inform the community about the proposed project, listen to the community's concerns and suggestions for alternative siting and location designs, and discuss potential visual impacts.

Key landscape features can include natural features of the landscape (for example, a distinctive mountain peak) as well as important cultural features (for example, an iconic church). Consideration of areas of scenic quality involves the identification of areas of the landscape that are of high scenic quality and those that are moderate or low. It is also important to establish which viewpoints are important to the community. An important source of information at this stage is likely to be the local council. A community survey or focus group could also be utilised to gather this information. Any surveys undertaken should reflect the population profile in the project area as indicated by the most up-to-date Census data available. Where a regional survey or study of landscape values has been undertaken, it must be considered. Proponents should confirm with the Department if there is any such recognised study in place.

Thoroughly gauging the landscape values of the project area at this stage provides a firm basis for designing a wind turbine layout that seeks to avoid or minimise impacts on key landscape features and key viewpoints and so minimises potential land use and community conflicts arising from wind energy development. The information gathered from the community through early engagement should inform the siting and design of the proposed wind energy project.

Preliminary assessment tools

Preliminary assessment tools have been developed to provide an early indication of where turbines require careful consideration because of potential visual impacts. The tools apply to both dwellings and key public viewpoints in the study area. The tools are not determinative and are not designed to provide a 'yes' or 'no' answer as to whether particular turbines are acceptable. Rather the tools provide an early indication of where placement of turbines will require further assessment and justification, and where consultation with potentially affected landowners needs to be focused – including discussions for landholder agreements.

The preliminary assessment tools involve rapid analysis of two key visual parameters:

1. Visual Magnitude

By mapping the dwellings, key public viewpoints and proposed turbines at scale, the potential visual magnitude of a turbine relative to that dwelling or public viewpoint can be established. This is based on the height of the proposed wind turbines to the tip of the blade and distance from dwellings or key public viewpoints shown in the graph at Figure 2.

The line depicted in the graph at Figure 2 provides an indication of where proponents should give detailed consideration to the visual impacts on dwellings or key public viewpoints from turbines located below the black line.

Application of the tool at the design stage provides an opportunity for other design solutions to be considered which may not involve the same level of visual impact.

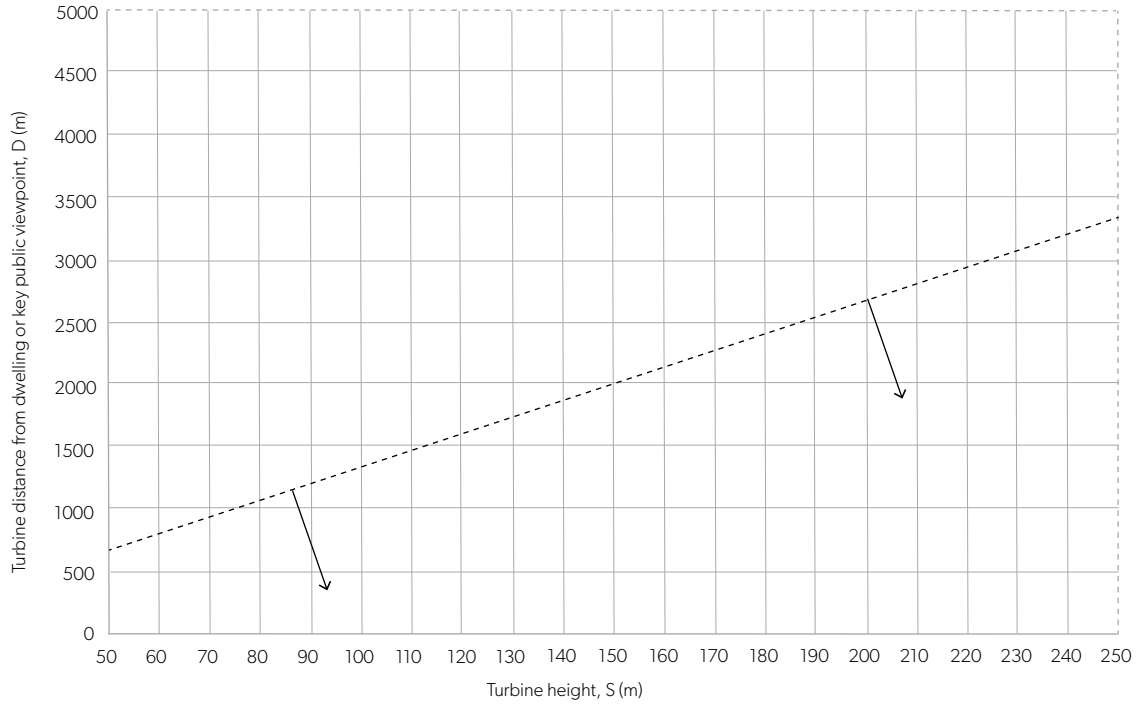
Proposed turbines below the black line must be identified, along with the dwellings or key public viewpoints as part of the request for SEARs.

Further assessment and justification for placement of turbines located in these sensitive areas in the EIS will be required, along with a description of the mitigation and management measures being employed to reduce impacts. This assessment may identify that factors such as topography, relative distance and existing vegetation may minimise or eliminate the impacts of the project.

Conversely, there may be circumstances where dwellings or key public viewpoints located above the line may require further consideration due to topography or other landscape features. The further detailed assessment and ground-truthing at the visual assessment stage must also consider impacts on these dwellings or key viewpoints. The relative position of the viewpoints in relation to a dwelling is also an important consideration that should be outlined in the EIS. For example, views to the turbines from the primary living areas of the dwelling would be considered more important than views from non-habitable areas [4].

4 See the Land and Environment Court Planning Principles on view sharing.

Figure 2. Preliminary Assessment Tool 1 indicating potential visual impacts for further detailed consideration



2. Multiple Wind Turbine Tool

This tool will provide a preliminary indication of potential cumulative impacts arising from the proposed wind energy project. To establish whether the degree to which dwellings or key public viewpoints may be impacted by multiple wind turbines, the proponent must map into six sectors of 60° any proposed turbines, and any existing or approved turbines within eight kilometres of each dwelling or key public viewpoint. Figure 3 below provides examples of where a dwelling or key public viewpoint may have views to turbines in multiple 60° sectors.

The distance from the turbine will be a relevant factor influencing the level of impact of a turbine at a particular viewpoint that will be considered in more detail during the EIS Stage. The apparent size (visual magnitude) of wind turbines decrease with distance.

The application of the cumulative tools to a distance of eight kilometres from a dwelling or public viewpoint is based on visibility research conducted by Sullivan[5] et. al. (2012), Bishop[6] (2002), Shang and Bishop[7] (1999) and others. At eight kilometres, turbines and objects recede into the background in terms of visibility. See Figure 3 and Table 6 in Appendix 1.

5 Sullivan, R.G., et. al., 2012. Wind Turbine Visibility and Visual Impact Threshold Distances in Western Landscapes. Argonne National Laboratory and the U.S. Department of the Interior, Bureau of Land Management. USA.

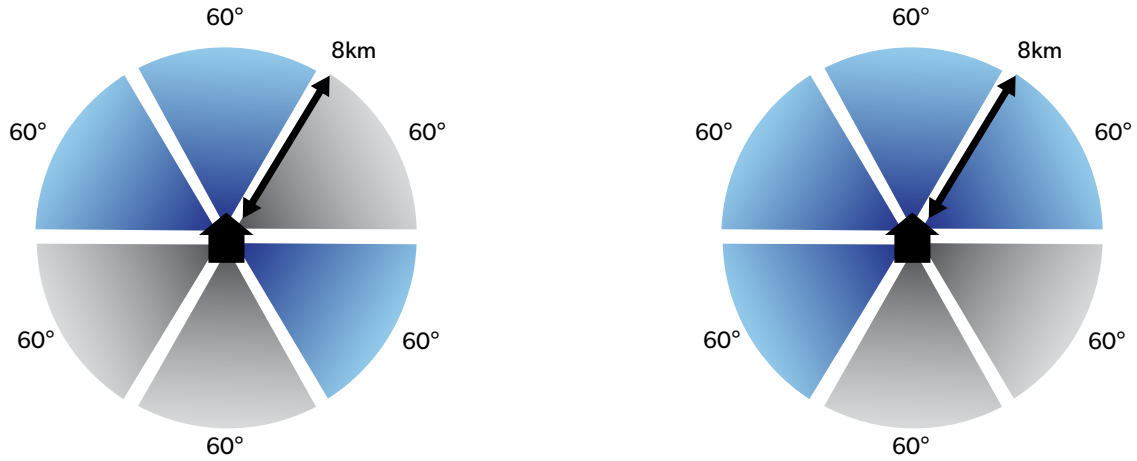
6 Bishop, Ian D. 2002. Determination of Thresholds of Visual Impact: The Case of Wind Turbines. Environment and Planning B: Planning and Design Vol. 29: pp. 707-718.

7 Shang, Haidong, and Ian D. Bishop. 2000. Visual Thresholds for Detection, Recognition, and Visual Impact in Landscape Settings. Journal of Environmental Psychology Vol. 20: pp. 125.

Again, application of this tool at the design stage provides an opportunity for alternative design solutions to be considered that do not involve the same level of cumulative impact. Where turbines are located in three or more sectors, proponents should give detailed consideration to the potential cumulative impacts of multiple turbines.

Where wind turbines are visible within the horizontal views of the dwelling or key public viewpoints in three or more 60° sectors, the proponents must identify the turbines, relative dwelling and key public viewpoint, along with the relative distance and submit these to the Department as part of the request for SEARs. These turbines will become a focus for assessment in the EIS.

Figure 3. Preliminary Assessment Tool 2 indicating multiple wind turbines



Further assessment and justification for placement of turbines in multiple sectors will need to be detailed in the EIS, along with a description of the mitigation and management measures being employed to reduce impacts. Such further assessment may identify that factors such as topography, relative distance and existing vegetation may minimise the impacts of the project. The relative position of the viewpoints in relation to a dwelling is also an important consideration that should be outlined in the EIS. For example, views to the turbines from the primary living areas of the dwelling would be considered more important than views from non-habitable areas. See also the Land and Environment Court Planning Principles on view sharing[8].

8 http://www.lec.justice.nsw.gov.au/Pages/practice_procedure/principles/planning_principles.aspx; Tenacity Consulting v Warringah Council [2004] NSWLEC 140 at 25-29.

Using technology to facilitate the preliminary assessment

While the preliminary assessment tools have been designed primarily as desktop tools, it is essential to have good field knowledge of the locality and the various sensitive locations involved, including dwellings. The use of Geographic Information Systems (GIS) to facilitate the application of the tools will streamline the evaluation phase of a project during the pre-lodgement stage. This can also assist refining the number of turbines and viewpoints that will ultimately need more detailed assessment. For example, most GIS systems can establish the theoretical 'zone of visual influence' of the proposal (the area from which the proposal is theoretically visible or the 'visual catchment').

There are also other tools and reference information that will aid the assessment process, including:

- the most recent satellite and aerial photography and available orthophotos at a scale of 1:25,000;
- topographic mapping, zoning and other land use information available on the Department's planning portal; and
- Google Earth™ mapping service and the most recent vegetation mapping, particularly vegetation information that gives an idea of the structure and height of vegetative cover.

Proponents may also consider the use of other technology such as animations and simulations to assist the community and other stakeholders in understanding the proposal. These methods will also be beneficial when applied to the visual assessment contained in the EIS phase of assessment.

Issue of SEARs

A request for SEARs must be accompanied by a preliminary environmental assessment, which includes:

- a map detailing key landscape features (informed by community consultation and any ground-truthing undertaken), the preliminary wind turbine layout, the location of dwellings and key public viewpoints, and overlay of the wind resources;
- the results of community consultation and any community survey or focus group meeting undertaken, including any landscape values or key public viewpoints identified (see *Wind Energy Guideline* for details of community consultation expected prior to the issue of SEARs); and
- the results of the preliminary assessment tools for both the visual magnitude and multiple wind turbine parameters.

In relation to visual assessment, SEARs for wind energy applications will require the proponent to provide a comprehensive assessment of the project in accordance with this Bulletin that analyses the proposed wind energy project in relation to the visual performance objectives.

Stage 2: Assessment and determination

Environmental Impact Statement preparation

The proponent must prepare a visual assessment as part of the EIS.

The visual assessment in the EIS is to include a full description of the proposed wind energy project design, the layout, structural elements and scenarios being considered. This description is to be accompanied by maps, photographs and illustrations showing such items as:

- type and height of turbines;
- roads / access tracks; and
- ancillary structures including substations and electricity distribution lines.

Steps in Visual Assessment

The visual assessment will involve the combination of desktop and field evaluations of the proposed wind energy project and its various components, turbines and ancillary facilities. The visual performance objectives form the principal framework and guide for assessing the proposed wind energy project when applied to individual viewpoints.

All key public viewpoints and individual dwellings within the 'visual catchment' (as defined above) should be identified and assessed.

However, where relatively close clustering of houses belonging to different landowners or occupants occur, representative viewpoints may be selected and assessed in lieu of every single dwelling in the following types of areas:

- rural residential clusters;
- rural villages; and
- urban residential and commercial areas.

When utilising representative viewpoints, the proponent must clearly identify the number of viewpoints being represented and assess impacts based on the 'worst case scenario' viewpoint, for example the closest turbine. For selected viewpoints, photomontages generated by the proponent and other experts may be used in conjunction with the performance objectives to assist in the judgements being made on whether or not the proposed wind energy project design will achieve the desired visual performance objectives.

The relative position of the viewpoints in relation to a dwelling is also an important consideration that should be outlined in the EIS. For example, views to the turbines from the primary living areas of the dwelling would be considered more important than views from non-habitable areas[9].

9 See the Land and Environment Court Planning Principles on view sharing.

Photomontages shall be prepared in accordance with the *Scottish Natural Heritage Visual Representation of Wind Farms, Version 2.1 December 2014* guidelines, noting they are generally consistent with the Land and Environment Court's Photomontage Policy. The visual assessment needs to include a concise description of the complete methodology used to create any photomontages presented in the visual assessment.

The EIS must incorporate the following elements:

- the visual representation of the proposed wind turbine and ancillary infrastructure layout and the visual landscape, including written descriptions, photographs, maps and diagrams;
- an assessment of the numbers of hours of potential 'shadow flicker';
- an assessment of the proposed wind energy project against each visual performance objective and demonstration of whether each objective is achieved and how the standard has been achieved;
- justification of proposed wind turbines that do not meet the visual performance objectives; and
- an outline of any mitigation and management options proposed, including consultation with affected property owners regarding the proposed mitigation works.

The SEARs will outline any further specific requirements for each project.

The visual assessment must assess, in accordance with the SEARs, the overall and broader landscape impacts of the proposed wind energy project. It will also address potential cumulative impacts of wind energy projects in the region (the proposed wind energy project, as well as existing and approved projects). This assessment and evaluation is made against the visual performance objectives in Table 2 of this Bulletin. These performance objectives are not determinative criteria that must be complied with, but rather provide guidance to proponents, the community and the consent authority on how the proponent should consider visual assessment and performance of the projects. A major focus of the visual assessment and consultation with affected landholders will be on those proposed turbines identified by the preliminary assessment tool.

Consultation

As part of the EIS, the proponent is required to further consult with the community to verify the community consultation findings from the scoping and design stage. The findings include scenic quality classes, key viewpoints (both public and private) and key landscape features in the area. The proponent must also verify the outcomes of the baseline study. Consultation with affected landowners is also required prior to submission of the EIS.

The basic steps of Visual Assessment

The visual assessment process for an EIS comprises three main steps:

- preparation of visual baseline study inputs, including consulting the community on aspects of the baseline study;
- establish visual influences zones from viewpoints using data collected in the baseline study; and
- visual performance evaluation requiring application of visual performance objectives to the proposed wind turbine layout.

Visual Baseline Study

A visual baseline study must be undertaken to establish the existing landscape and visual conditions. This forms the basis of determining the level of impacts of a proposed wind energy project. The baseline study is prepared and evaluated by the proponent prior to undertaking any visual analysis.

The baseline study should consider the following inputs in the 'visual catchment' for the project:

- elements of the landscape important to the community, including public and private viewpoints;
- the sensitivity of the viewers who use those viewpoints, and the distances at which they may view the landscape and potential wind turbines and other ancillary facilities;
- the character of the landscape involved, its key features and the relative scenic quality of the area; and
- the location of any existing operational or approved wind energy projects within both a regional and local context, including any nearby surrounding wind energy projects within eight kilometres which may have the potential to create direct or indirect visual impacts between the proposed and any other operational, approved or proposed wind energy projects.

The following inputs are required for the baseline study:

Table 1. Baseline Study inputs

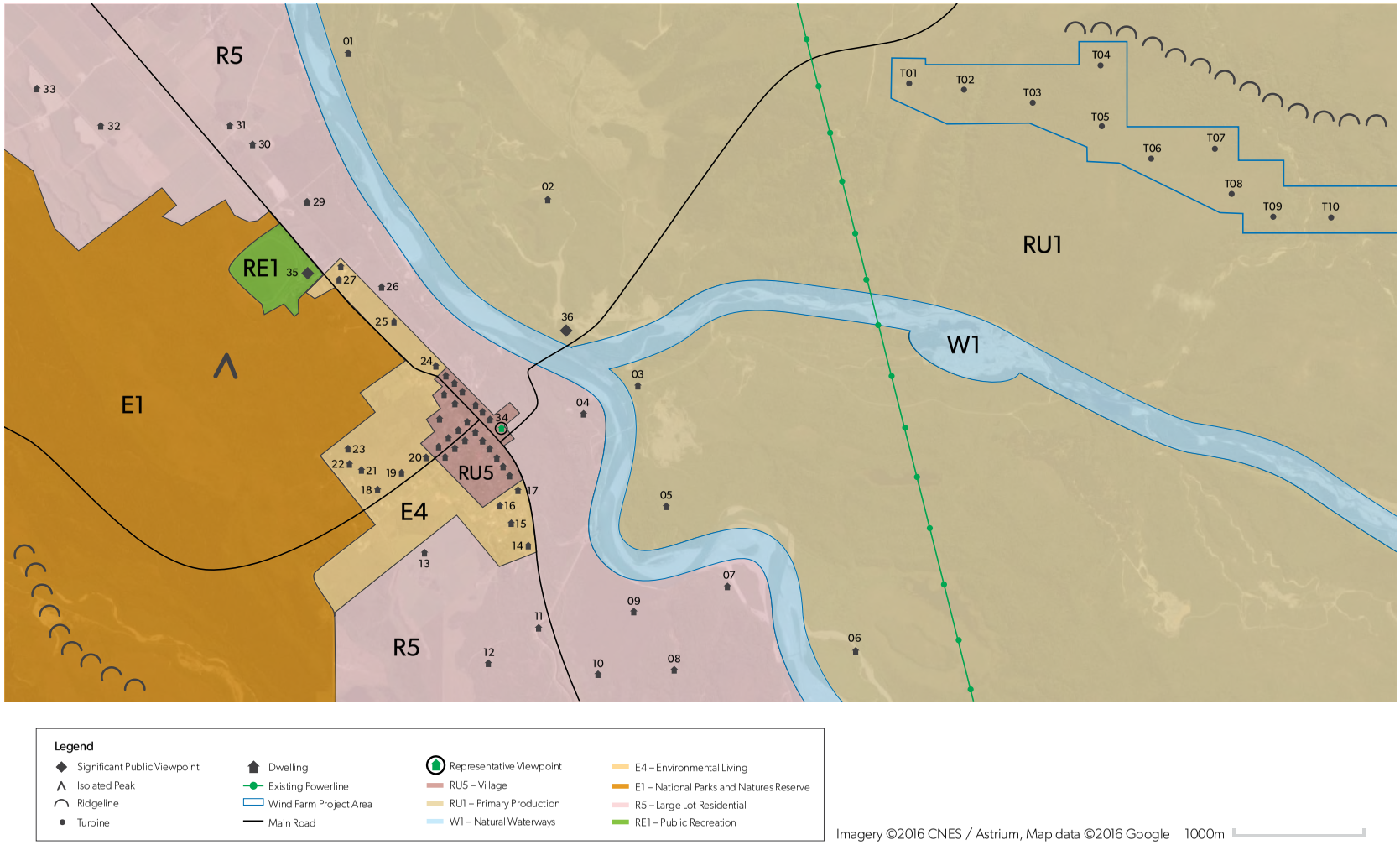
Baseline Study factors		
Sensitive Land Use Designations (See Table 3)	Map layer identifying National and state sensitive land use designations and LEP Zones (See Figure 4)	• the applicable land use zone and primary nature of the land use (agricultural, industrial, rural residential), including identification of sensitive land use designations. Sensitive land use designations are those types of land uses that wind energy proponents should be aware of when designing the project. Particularly sensitive land uses include those sites listed at the National and State level such as heritage sites and impacts on these sites should be minimised.
Landscape Character Type (See Table 4)	Descriptive text and photography	• the key identifying landform, vegetation, waterform and cultural characteristics of the relevant landscape type
Key Landscape Features	Map layer – prepared for baseline study map (See Figure 4)	• elements or attributes of the landscape associated with high visual interest or quality that stand out visually in the landscape, including natural and cultural features that may be of various scales and can occur in a fixed location or may occur frequently in a general area

Baseline Study factors		
Viewpoint inventory and sensitivity levels (See Table 5)	Map layer (See Figure 4)	• public and private viewpoints of high, moderate or low viewer sensitivity from which the proposed wind turbines and ancillary facilities may be visible
Visibility distance zones (See Table 6)	Visibility or viewshed mapping using GIS analysis of terrain contours when assessing what may be visible from a given viewpoint looking in selected directions or in 360°	• a range of distance zones from selected viewpoints in which proposed wind turbines and ancillary facilities may be visible in varying degrees and levels of visual magnitude (includes terrain and vegetation screening analysis from selected viewpoints, as well as zones of visual influence from proposed turbine locations and heights)
Wind Resource Categories	Map layer	• a map showing the relative wind resources of the proposed development area expressed as relative ranges of average wind strength in metres per second
Wind Turbine Locations & Heights (Optional Scenarios)	Map layer (See Figure 4)	• a series of maps or design layout iterations showing alternative scenarios for wind turbine and ancillary facility locations, heights and areas (to be prepared after the visual baseline study and visual influence zones are established)

The baseline study should describe, assess and map these factors in written and graphic forms, supported by photographic representations of the study area.

Appendix 1 (Visual Assessment process) outlines the steps involved in gathering the inputs required to establish a thorough landscape and visual baseline study.

Figure 4. Example Baseline Input Map



Scenic Quality Classes

Ultimately, the baseline study inputs, including key landscape features and sensitive land use designations, should lead to the identification of Scenic Quality Classes. Scenic quality refers to the relative scenic or aesthetic value of the landscape based on the relative presence or absence of key landscape features known to be associated with community perceptions of high, moderate or low scenic quality. It is both a subjective and complex process undertaken by experts in visual impact assessment, taking into account community values identified in early community consultation.

Appendix 1 (Visual Assessment process) includes further details of how to identify scenic quality classes.

Visual Influence Zones

Three zones of visual influence (low, moderate and high) are established for the project area from dwellings and key public viewpoints. This establishes the relative landscape significance against which the potential impacts of wind turbines may be assessed. The visual influence zones are determined utilising Table 8 in Appendix 1 and take into consideration data gathered for the baseline study, including viewer sensitivity levels, scenic quality classes, and visibility distance zones.

Each visual influence zone has a corresponding set of visual performance objectives that guide the proponent and the consent authority by establishing different visual objectives and levels of landscape protection for the assessment and determination of the project.

Visual performance evaluation

Visual assessment requires an evaluation of the proposed wind energy project and its various components, turbines and ancillary facilities against the visual performance objective of the project, using a combination of desktop and field evaluations.

Visual performance objectives are used as a framework for evaluation that enables potential impacts and management options to be considered objectively, against the varying levels of landscape significance established by the baseline study. Application of the visual performance objectives will allow for a transparent and robust assessment process, which still provides flexibility for proponents and consent authorities. The visual performance objectives are set out at Table 2.

The visual performance objectives that apply to all three visual influence zones, are outlined below:

Table 2. Visual Performance Objectives

Visual Performance Objectives	Visual Influence Zone 1	Visual Influence Zone 2	Visual Influence Zone 3
Visual Magnitude Visual magnitude is a key visual parameter in the preliminary assessment tool. The respective threshold lines on the graph at Figure 5 indicate where turbines may potentially have significant visual magnitude impacts based on their relative height and their distance from viewpoints. For the visual assessment, an additional threshold distance line has been added to the visual magnitude graph which identifies potentially high visual magnitude impacts, to allow more detailed assessment as part of the EIS. However, as stated above, the black and blue lines in Figure 5 are not determinative of acceptability. Instead, they provide a basis for the assessment to be undertaken. There may be reasons why the proposed turbine will not have the impact identified by Figure 5 and detailed justification can be provided for proposed turbines in the EIS – for example, ground-truthing may identify that existing vegetation or topography will screen views to a proposed turbine at a particular location. The assessment of potential impacts relating to visual magnitude is a key factor as it is acknowledged that wind turbines are very large structures that will be visible in the landscape.	Objective: Avoid turbines or provide detailed justification of turbines below the blue line.	Objective: Manage impacts as far as practicable, justify residual impacts, and describe proposed mitigation measures below the black line. Consider screening between the blue line and the black line.	Objective: Consider screening below the black line.

Figure 5. Visual magnitude thresholds for visual assessment

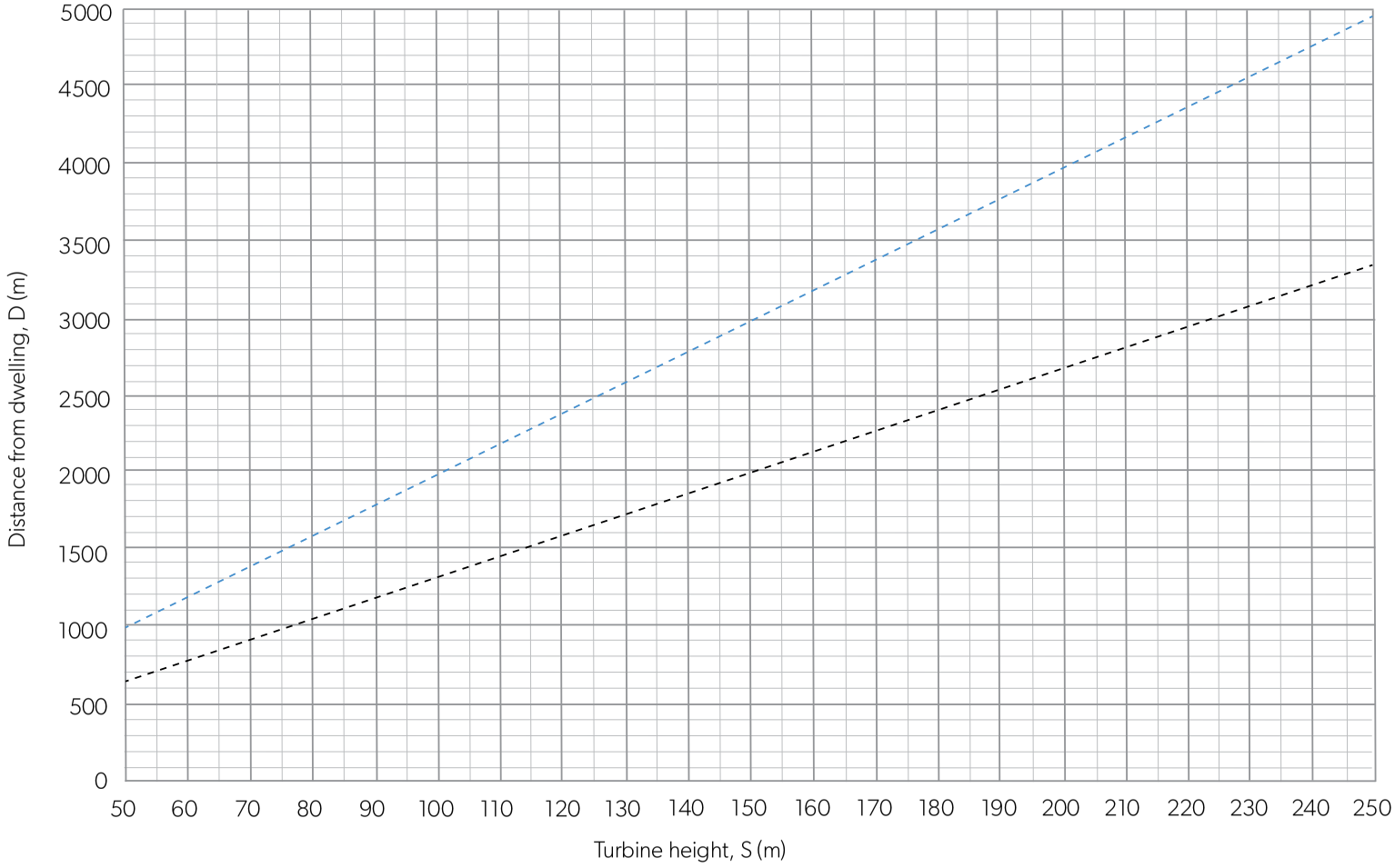


Table 2. Visual Performance Objectives

Visual Performance Objectives	Visual Influence Zone 1	Visual Influence Zone 2	Visual Influence Zone 3
Landscape Scenic Integrity In addition to the considerations for designing individual wind farms, there is a need to undertake assessment at a broader, visual catchment level of the impacts of multiple wind energy projects within a region. It is acknowledged that multiple wind energy projects are likely to occur in certain regions due to where the best wind resources are available in NSW, and this may result in a situation where wind turbines are seen as a key characteristic of the landscape, but not at a sufficient level to be a dominant characteristic of the area. However, it is important to ensure that the design and layout of wind energy projects prevent wind turbines appearing as the dominant characteristic of the area, seeming to define the character type of a particular region as a 'wind farm landscape character area'. The landscape scenic integrity criterion assesses the extent to which the current landscape character and scenic quality of the visual catchment would be maintained given a proposed landscape alteration, such as a wind energy project. The purpose of this performance objective is to determine the impacts of a wind energy project on the broader landscape of a region. The baseline study inputs, including the identification of the scenic quality class determine the visual influence zone. Other baseline study inputs such as the 'landscape character type' and 'landscape character options' also provide the context for determining the integrity of the existing landscape.	Objective: Wind turbines should not cause more than a low level modification of the visual catchment. Turbines are seen as either very small and/or faint, or as of a size and colour contrast (under clear, haze-free atmospheric conditions) that they would not compete with major elements of the existing visual catchment.	Objective: Wind turbines should not cause significant modification of the visual catchment. Turbines may be visually apparent and could become a major element in the landscape but should not dominate the existing visual catchment.	No Visual Performance objective applies.

Visual Performance Objectives	Visual Influence Zone 1	Visual Influence Zone 2	Visual Influence Zone 3
Landscape Scenic Integrity continued In the high scenic quality class, wind energy projects should not cause more than a low level modification of the visual catchment, where turbines may be visible and are unlikely to be missed by casual observers, but lack sufficient size or contrast to compete with major landscape elements. In the moderate scenic quality class, wind energy projects should not cause significant modification of the visual catchment. Turbines may be visually apparent and could become a major element in the landscape. In the low scenic quality class, wind energy projects may result in significant modification of the visual catchment. Turbines may be visually apparent and a major element in the landscape.			
Key Feature Disruption The key features disruption parameter describes proposed wind turbines that are likely to disrupt or interrupt the central line of sight and/or the central focal viewing field surrounding it, when seen from a viewpoint looking toward the identified key features of a landscape. Identification of these key landscape features will also be informed by community consultation undertaken for the proposal, as discussed above. Examples include visually prominent mountain peaks, large rock outcrops, waterfalls, rivers or creeks, distinctive stands of vegetation and distinctive cultural buildings.	Objective: Avoid wind turbines or ancillary facilities that result in the removal or visual alteration/disruption of identified key landscape features. This includes any major or visually significant landform, waterform, vegetation or cultural features that have visual prominence or are focal points.	Objective: Minimise impact of wind turbines or ancillary facilities that result in the removal or visual alteration/disruption of identified key landscape features. This includes any major or visually significant landform, waterform, vegetation or cultural features that have visual prominence or are focal points.	No Visual Performance objective applies.

Visual Performance Objectives	Visual Influence Zone 1	Visual Influence Zone 2	Visual Influence Zone 3
Multiple Wind Turbine Effects The multiple wind turbine effect is the other key visual parameter utilised in the preliminary assessment tool. For the visual assessment, the effects of multiple wind turbines visible from individual viewpoints as part of the proposed wind energy project, as well as the cumulative landscape and visual impacts must be considered having regard to existing and approved wind energy projects located within eight kilometres of the proposed wind energy project. Depending on the viewer sensitivity level, the location of the proposed turbines should avoid, where possible, views to turbines of one or more wind energy projects, within the effective horizontal views of two or more 60° sectors (from Level 1 viewpoints), or in three or more 60° sectors (from Level 2 viewpoints).	Method: Map into six sectors of 60° the proposed and any existing or approved turbines within eight kilometres of Level 1 and Level 2 viewpoints. (See Figure 3) Objective: Avoid views to the proposed, existing and approved turbines within eight kilometres from Level 1 and Level 2 viewpoints, exceeding the following thresholds, or provide detailed justification: • Level 1 (high sensitivity) – wind turbines visible within the effective horizontal views of two or more 60° sectors • Level 2 (moderate sensitivity) – wind turbines visible within the effective horizontal views in three or more 60° sectors		
Shadow, Flicker & Blade Glint The shadow flicker caused by certain sun angles in relation to the rotation of wind turbine blades on dwellings will be limited to 30 hours per year, and may require mitigation measures such as amended siting and design of turbines to minimise the amount of shadow flicker. Similarly, the direct reflection of the sun from the wind turbine structure (glint) is to be minimised through appropriate turbine treatments (such as the use of low sheen and matte finishes).	Objective (applies to all visual influence zones): • Finish turbine blades with a low reflectivity surface treatment to ensure that blade glint is minimised. • Minimise shadow flicker to not more than 30 hours per year and utilise available mitigation options to minimise shadow flicker at dwellings.		

Visual Performance Objectives	Visual Influence Zone 1	Visual Influence Zone 2	Visual Influence Zone 3
Aviation Hazard Lighting Wind turbines located in the vicinity of an aerodrome are subject to standards imposed by the *National Airports Safeguarding Framework*[10]. CASA must be notified by the proponent if a proposed wind turbine or wind monitoring tower is greater than 150 metres in height or infringes on the Obstacle Limitation Surface (OLS) of an aerodrome. CASA may determine, and subsequently advise a proponent and relevant planning authorities, whether night-lighting is required. If such lighting is required, the CASA guidelines recommend that to minimise visual impacts "*obstacle lights may be partially shielded, provided it does not compromise their operational effectiveness. Where obstacle lighting is provided, lights should operate at night, and at times of reduced visibility. All obstacle lights on a wind farm should be turned on simultaneously and off simultaneously.*" The lights should be fully shielded from the view of any dwelling within. As part of the assessment of visual impacts of wind energy projects, the Department will consider whether any obstacle lighting required is likely to result in any significant increase in visual impacts.	Objective: (applies to all visual influence zones) • Aviation hazard lighting (AHL) must meet the requirements of Australian Standard AS 4282 – 1997 and any prescribed or notified CASA requirement. Shield all AHL within two kilometres from any dwellings. Avoid strobe lighting.		

10 Guideline D – Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms) / Wind Monitoring Towers, National Airports Safeguarding Advisory Group (NASAG), 2012 (NASAG guidelines).

Assessment

The Department will undertake a thorough assessment of the visual impacts of a wind energy project drawing on all the relevant information provided through the assessment process. This will involve:

- consideration of the baseline study and specialist visual assessment submitted as part of the EIS;
- issues raised in any public submissions received;
- the proponent's response to submissions;
- site inspections and desktop reviews;
- consideration of the objects and other relevant sections of the *Environmental Planning and Assessment Act 1979* (EP&A Act), including to encourage ecologically sustainable development; and
- consideration of the *Environmental Planning and Assessment Regulation 2000*, relevant environmental planning instruments, and this Bulletin.

The Department adopts the widely accepted and commonly utilised approach that visual impacts can be determined from a combination of receiver sensitivity (a person's susceptibly to a specific type of change) and the magnitude of visual effect (the size, scale and overall extent of change). This approach is documented in numerous Australian and international guidelines, and is considered to be industry best practice.

The Department will assess and confirm an overall acceptability of landscape and visual impacts by reviewing the visual processes outlined above, and balancing these matters along with other environmental, social and economic considerations, and the public interest[11]. This would include the extent of the impacts, for example, the number of people impacted and the severity of the impact. Also relevant to key public viewpoints is the Land and Environment Court Planning Principle relating to impact on public domain views.[12]

Mitigation and management options

By applying the preliminary assessment tools early in the project design phase, wind farm layouts can be appropriately designed to incorporate appropriate setbacks to dwellings to minimise impacts. The identification of residual visual impacts through the assessment process will need to be considered against available mitigation and management options.

If there is sound justification for maintaining the proposed layout, proponents should also consider other mitigation and management measures. In some circumstances, it may be appropriate for proponents and landholders to negotiate agreements regarding the management of visual impacts.

If appropriate mitigation and management options are not proposed by the proponent and cannot be developed, the consent authority will consider whether those impacts are acceptable after weighing up all other environmental, social and economic benefits of the project.

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11 *Taralga Landscape Guardians Inc v Minister for Planning and RES Southern Cross Pty Ltd (2007) 161 LGERA 1.*

12 *http://www.lec.justice.nsw.gov.au/Pages/practice_procedure/principles/planning_principles.aspx* ; Rose Bay Marina Pty Limited v Woollahra Municipal Council and anor [2013] NSWLEC 1046.

Where significant impacts are predicted to occur, it is a possibility that the Department will recommend that these turbines be re-sited, or removed from the proposal, or only be recommended for approval if appropriate mitigation or management measures are in place.

Appendix 2 explains mitigation options. In addition, Attachment B of the *Wind Energy Guideline* provides general advice on negotiated agreements.

Determination and conditions of consent

Once the Department has completed its assessment, the consent authority must evaluate the visual impacts of a wind energy project. The consent authority will consider the proponent's visual assessment, including any proposed mitigation or management measures to be implemented before determining whether the impacts are acceptable.

It is the consent authority's responsibility to determine the acceptability of those visual impacts when balanced against other social, environmental and economic considerations. The matters that the consent authority will consider in relation to landscape and visual assessment include, for example:

- the consistency of the proposal with the relevant visual performance objectives;
- the significance and acceptability of impacts on the overall landscape and the amenity of landholders and communities;
- any cumulative environmental effects from the proposal along with other existing or proposed wind energy projects;
- the adequacy of any mitigation and management measures proposed; and
- the objects of the EP&A Act, including the principles of ecologically sustainable development and the broader public interest[13].

13 *Taralga Landscape Guardians Inc v Minister for Planning and RES Southern Cross Pty Ltd (2007) 161 LGERA 1.*

In determining the development application, the consent authority will consider whether conditions should be imposed that will mitigate impacts to an acceptable level. The consent authority may impose conditions requiring a proponent to implement a range of impact avoidance, minimisation and mitigation measures, depending on the level and nature of the impacts identified by the Department's assessment, the proponent's visual assessment and any additional consideration by the consent authority.

Conditions of consent may include:

- colouring wind turbine components and ancillary infrastructure so that they have minimal reflective properties and low visual contrast;
- undertaking on-site and off-site landscape treatments, including at any non-associated dwellings identified as having moderate to high visual impacts;
- deletion of specific wind turbines that are found to have a significant impact and where there are limited options for reducing the impact;
- not approving the most visually prominent turbines where the mitigation measures are insufficient, unless the proponent has developed other suitable management options, including reaching an agreement with affected landowners regarding the impacts of those turbines; and
- 'voluntary acquisition' for significantly affected landholders noting that such a condition would provide for 'voluntary acquisition' only at the request of the affected landowner.

Development consent conditions related to acquisition requirements will only be imposed where all other reasonable and feasible mitigation measures have been considered, and the consent authority is satisfied that the economic, social and environmental benefits of the project outweigh its impacts.

Monitoring and compliance

If a state significant wind energy project is approved, the Department is responsible for ensuring that the approved project is constructed and operated in accordance with the consent. The Department's compliance team will take steps to ensure that the consent conditions protecting against visual impact are complied with, including auditing of projects and enforcement of conditions.

Appendix 1: Visual Assessment process

Baseline Study

The following inputs are required for the baseline study:

Sensitive Land Use Designations

The Sensitive Land Use Designations identifies the key National and State sensitive land use designations along with potentially sensitive LEP land use zones in the Standard Instrument under the EP&A Act. These land use designations and zones are listed in Table 3.

Sensitive land use designations are those types of land uses that wind energy proponents should be aware of when designing the project. Particularly, sensitive land uses include those sites listed at the National and State level such as heritage sites and impacts on these sites should be minimised.

Where a wind energy project is proposed to be located in, for example, an environmental management zone, it is important that proponents provide sound justification for the proposed location along with an analysis of the proposal against the objectives of the zone or listing.

Table 3. Sensitive Land Use Designations

National and State Sensitive Land Use Designation	LEP Zones as per the NSW Standard LEP	
World Heritage Areas	RU5 Village	RE2 Private Recreation
National Parks	R1 General Residential	E1 National Parks and Nature Reserves
National Reserve System reserves	R2 Low Density Residential	E2 Environmental Conservation
Coastal Zone (under the *Coastal Protection Act 1979*)	R3 Medium Density Residential	E3 Environmental Management
Marine estate (under the *Marine Estate Management Act 2014*)	R4 High Density Residential	E4 Environmental Living
Commonwealth Heritage List Sites	R5 Large Lot Residential	W1 Natural Waterways
State Heritage Register Sites	SP3 Tourist	W2 Recreational Waterways
	RE1 Public Recreation	

Landscape character type

The landscape character type of an area represents the broad scale area of land in which the proposed wind energy project is located. The landscape character type should have common distinguishing visual characteristics primarily based upon landforms and major land cover patterns. These patterns are formed by combinations of vegetation, waterforms, landforms and land use, from which the key landscape features of the baseline study inputs can also be identified.

The geology, soils and climate of the area also influence these factors. A combination of descriptive text and photographs can be used to provide a visual profile of the region, including what types of features or landscape phenomena are considered to be typical, less common, rare or unusual and outstanding. Two good sources to use in identifying the type of regional landscape character the project may be located in are:

- Learmonth, Nancy and Andrew, 1971. *Regional Landscapes of Australia: Form, Function and Change*, Angus and Roberson Publishers, Sydney; and
- Australia's bioregional framework as delineated via the Interim Biogeographic Regionalisation for Australia (IBRA): https://www.environment.gov.au/land/nrs/science/ibra/australias-bioregions-maps

Landscape character options

Landscape character options similar to those listed in Table 4 below can also be selected to assist in the description of the existing landscape character type. In addition, they can be used during the performance evaluation phase to assess to what extent the existing landscape character may potentially be modified by the proposed wind energy project. It is important to note that within the proposed project area, more than one landscape character can exist in combination with each other. For example, a portion of the area could potentially be located in National Parks or State Forests that have naturally evolving or natural appearing landscape character, while other parts of the area may also reflect a cultural, pastoral or agricultural landscape character.

Table 4. Landscape character options

Landscape character 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.

Landscape character options	Description
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.
Wind Energy	Landscape character expressing dominant wind energy uses that exert a strong visual influence over the pre-existing character of the landscape primarily in the form of tall wind turbines with moving blades, access roads, substations and supporting infrastructure.
Urban / Rural villages	Landscape character expressing concentrations of human activity, primarily in the form of residential, commercial, industrial, cultural, educational, transportation structures and supporting infrastructure.

Key landscape features

Key landscape features should be identified and shown on the baseline study map for further reference. Key landscape features may include natural features such as a distinctive mountain peak or hill top, a large rock outcrop or cliff, a waterfall, a visually distinctive stand of trees, or even a single large tree that stands out visually in the scene. Key landscape features can also be cultural or agricultural, such as an iconic church with a steeple, a grain elevator that can be seen for miles around, a heritage listed property, or perhaps a large water reservoir. Some may stand out more or be visually enhanced if they are seen in a direct focal view, however, not always – sometimes a key feature can be in the middle of a very open landscape.

Small scale features can also exist and sometimes be important if there are many of them in the area such as drainage lines and local hills, however, these usually are not considered key landscape features.

Viewpoint inventory and Viewer Sensitivity Levels (public and private)

Landscapes are viewed from different locations to various degrees by viewers who have varying levels of concern for the scenic quality and integrity of the landscapes they see. The relative importance of different types of viewpoints will need to be described and ranked into relative levels of scenic concern or "Viewer Sensitivity Levels".

Viewer sensitivity levels provide a guide for classifying the degree of importance the community or visitors may place on landscapes viewed from public use areas, public travel ways and from private homes and properties. Table 5 outlines three viewer sensitivity levels that classify estimated viewer sensitivity levels.

Table 5 . Viewer Sensitivity Level classification of travel routes and use areas

Level 1 SENSITIVITY (High)	• Residential areas and rural villages (*defined as land zoned R1, R2, R3, R4, R5 and RU5 in the Standard LEP*) • Recreation, cultural or scenic sites and viewpoints of National or State significance. • Any buildings, historic rural homesteads/residences on the State or local Government Heritage List
Level 2 SENSITIVITY (Moderate)	• Rural dwelling • Tourist and visitor accommodation (definition in Standard Instrument Local Environmental Plan) • Recreation, cultural or scenic sites and viewpoints of regional significance
Level 3 SENSITIVITY (Low)	• Interstate and state passenger rail lines with daily daylight services • State highways, freeways and classified main roads, classified tourist roads • Land management roads with occasional recreation traffic • Walking tracks of moderate local significance or infrequent recreation usage • Other low use and low concern viewpoints and travel routes • Navigable waterways

All residential areas must be classified as Sensitivity Level 1 or 2, including all viewpoints from rural dwellings. Consultation with community and residents is encourages to accurately classify viewer sensitivity levels for viewpoints.

Visibility distance zones

The relative apparent size (visual magnitude) of wind turbines decrease with distance. Visibility or viewshed mapping is usually performed using GIS analysis of terrain contours when assessing what may be visible from a given viewpoint looking in selected directions or in 360°. This mapping can also be calibrated to map the distance zones for the visible areas, while distinguishing those areas that are unseen from the selected viewpoint.

It is very important for the establishment of visual influence zones that the GIS visibility-distance zone mapping be run from the identified viewpoints inward (toward the proposed wind turbines), not in the reverse from the turbines out – which many assessors refer to as the Zone of Visual Influence (ZFI) or the Theoretical ZFI (in the case of terrain-only analyses). Once the visibility and distance zones have been established using the identified viewpoints as the GIS search point, then the reverse analysis using each turbine as a search point looking outward can be useful to analyse and produce a series of maps showing the potential vertical extent to which the proposed wind turbines would be visible. Different levels that should be considered include: full turbine, bottom of rotor up, nacelle up, and partial upper rotor blades. This series of visibility mapping will generate an enormous amount of information that requires careful and comprehensive summary in the EIS to assist the community and the consent authority to clearly understand the visual implications of the proposed wind turbines.

Table 6. Visibility distance zones [14]

Distance of view	Distance zone	Relative Visual Magnitude and Influence
0 – 500 m	Near Foreground (NF)	Zone of Greatest Visual Influence
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 – 12 km	Near Background (NB)	
12 – 20 km	Mid Background (MB)	
20 – 32+ km	Far Background (FB)	Zone of Least Visual Influence

14 Based on visibility research conducted by Sullivan et. al. (2012), Bishop (2002), Shang and Bishop (1999) and others.

Scenic Quality Class

The scenic quality classes will be identified taking into account many of the baseline study inputs outlined above and the results of the community consultation undertaken for the project. Scenic quality refers to the relative scenic or aesthetic value of the landscape based on the relative presence or absence of key landscape features known to be associated with community perceptions of high, moderate or low scenic quality. This can be determined through community perception surveys and consultations and using an objective frame of reference. It is both a subjective and complex process undertaken by experts in visual impact assessment, taking into account community values identified in early community consultation.

In order to assess and map scenic quality classes (i.e., high, moderate and low), a descriptive scenic quality "*frame of reference*" will need to be developed that is suitable for identifying those landform, vegetation, waterform and, sometimes, cultural features that may be considered to be scenically outstanding or of high quality for the area. The frame of reference can categorise features that are more commonly occurring or of moderate scenic quality and those that may be considered low or below the average for the area due to their lack of variety, distinctiveness or their degree of alteration.

Table 7 shows an example of a scenic quality frame of reference, developed for the south east highlands of NSW. The "*frame of reference*" approach is patterned after that of Leonard and Hammond[15], simplified for practical application, based largely on scenic perception research findings of Williamson and Chalmers[16]. The proponent will be required to develop a similar frame of reference criteria for the other areas of NSW where the wind energy project is proposed. NSW IBRA Bioregions and Sub-bioregions provide a logical framework and basis for the identification of NSW landscape character types. Key NSW Bioregions relevant to the higher levels of wind resources may include:

- New England Tableland
- Sydney Basin (upper)
- Nandewar
- NSW Western Slopes
- Brigalow Belt South
- South-eastern Highlands
- Darling Riverine Plains
- South East Corner

15 Leonard, Michael, and Hammond, Richard 1983. Landscape Character Types of Victoria. Forests Commission Victoria.

16 Williamson, Dennis and Chalmers, John, 1982. Perceptions of Forest Scenic Quality in Northeast Victoria: A Technical Report of Research Phases I and II. Forests Commissions Victoria.

Table 7. Suggested Scenic Quality Classification South East Highlands

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 visually dominant • 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

When mapping scenic quality classes, aerial photos, topographic maps (and the like) and field visits should all be utilised. The frame of reference criteria should be used as a guide, however, it is not intended that boundary lines necessarily are placed around individual features unless they are of a larger scale or extremely outstanding within a much broader area of lesser scenic quality. Community views on the scenic quality classes also need to be canvassed in the community consultation required prior to issues of SEARs.

Landscape Setting Units

If a large regional area is involved, it is usually best to identify Landscape Setting Units (LSU) within the region that reflect local geographic settings or viewing basins that are often contained by topographic ridgelines or breaks in the terrain. The assessor should think of what the views may be like if they were standing in the middle of the LSU and whether they would have a sense of being visually cut-off from or at least partially separated by the terrain and vegetative cover from views to adjacent units.

In flatter terrain, it may sometimes be the presence or absence of certain types of landscape features, such as patterns of waterforms, vegetation types or land use types that are used to determine boundaries between different LSUs. The concept of water catchments and sub-catchments is often applicable, with the sub-catchments often forming ideal LSUs.

In applying the scenic quality frames of reference, the EIS should consider LSU in which either a combination of landscape features influences the overall scenic quality of the setting. If the relative presence of high scenic quality features is frequent or has a predominant visual influence over that LSU, then the entire LSU should be rated as high scenic quality. If, however, an LSU predominantly displays features of moderate scenic quality, but one or two features may be of high scenic quality, but are relatively isolated and do not exert significant visual influence over the rest of the LSU, then those features might be delineated as high scenic quality while the remainder of the LSU would be classified as moderate scenic quality.

Low scenic quality LSUs would generally be those that display a lack of terrain, vegetative or waterform diversity, along with being relatively lacking in visually outstanding/significant or notable features.

More mountainous and coastal regions tend to have a greater abundance of visually significant features than plains or tableland landscapes, however, the frames of reference should independently identify those types of features that are of high or moderate scenic quality within each landscape character type so that they can be recognised when scenic quality classification is conducted.

Visual Influence Zones

Three zones of visual influence (low, moderate and high), will be established for the project area from dwellings and key public viewpoints. This establishes the relative landscape significance against which the potential impacts of wind turbines may be assessed. The visual influence zones are determined utilising Table 8. This table is based on extensive research undertaken by the US Bureau of Land Management and others, and modified as suitable for practical application to the wind energy industry in NSW.

Table 8 relies on the data gathered for the baseline study and consideration of the following key factors:

- Viewer sensitivity level - the description and rank into relative levels of scenic concern or "viewer sensitivity levels" viewpoints. That is, the viewers have varying levels of concern for the scenic quality and integrity of the landscapes they see. Further information on ranking these viewpoints is found in Table 5.

- Visibility distance zones - nine distance zones based on visibility research have been established, ranging from near foreground to far background, which are based on the relative apparent size or visual magnitude of wind turbines and distance from the viewpoint. The distance zones are listed in Table 6.
- Scenic quality class – the scenic quality class (high, moderate and low) is a descriptive classification for identifying those landform, vegetation, waterform and, sometimes, cultural, features of varying levels of quality. Suggested scenic quality classifications are found in Table 7.

Each visual influence zone has a corresponding set of visual performance objectives that guide the proponent and the consent authority by establishing different visual objectives and levels of landscape protection for the assessment and determination of the project.

Visual influence zones are generated through the matrix in Table 8. In preparing this table, there has been consideration for viewpoints with different viewer sensitivity levels, including dwellings in towns and on rural farms, visibility distance zones and scenic quality classes.

Visual Influence Zone 1 (VIZ1) is associated with those areas with the highest level of visual significance. VIZ2 would have combinations resulting in a moderate VIZ rating, and VIZ3 is associated with those landscapes with the lowest level of combined significance – although maintaining some minimum levels of scenic quality and scenic integrity is generally important.

When mapping viewer sensitivity–distance zones, it is possible that the same area of land (or the same wind turbine) may be visible from viewpoints of varying viewer sensitivity levels and in different visibility distance zones. In general, viewshed areas seen by viewers of a higher viewer sensitivity level and from a closer visibility distance zone will take priority over views from viewpoints of lesser sensitivity and from more distance.

Table 8. Visual Influence Zones based on view sensitivity level – distance zones and scenic quality class combinations

Viewer Sensitivity Level – Distance Zone	Scenic Quality Class		
	High	Moderate	Low
Level 1 Viewpoints			
Near Foreground 0 – 500 m	VIZ1	VIZ1	VIZ1
Mid Foreground 500 m – 1 km	VIZ1	VIZ1	VIZ1
Far Foreground 1 – 2 km	VIZ1	VIZ1	VIZ1
Near Middleground 2 – 4 km	VIZ1	VIZ2	VIZ2
Far Middleground 4 – 8 km	VIZ2	VIZ2	VIZ2
Near Background 8 – 12 km	VIZ2	VIZ2	VIZ2
Mid Background 12 – 20 km	VIZ2	VIZ2	VIZ3
Far Background 20 – 32+ km	VIZ2	VIZ2	VIZ3
Level 2 Viewpoints			
Near Foreground 0 – 500 m	VIZ1	VIZ1	VIZ1
Mid Foreground 500 m – 1 km	VIZ1	VIZ1	VIZ1
Far Foreground 1 – 2 km	VIZ1	VIZ1	VIZ2
Near Middleground 2 – 4 km	VIZ2	VIZ2	VIZ2
Far Middleground 4 – 8 km	VIZ2	VIZ2	VIZ3
Near Background 8 – 12 km	VIZ2	VIZ3	VIZ3
Mid Background 12 – 20 km	VIZ2	VIZ3	VIZ3
Far Background 20 – 32+km	VIZ3	VIZ3	VIZ3
Level 3 Viewpoints			
Near Foreground 0 – 500 m	VIZ1	VIZ1	VIZ2
Mid Foreground 500 m – 1 km	VIZ2	VIZ2	VIZ2
Far Foreground 1 – 2 km	VIZ2	VIZ2	VIZ3
Near Middleground 2 – 4 km	VIZ2	VIZ3	VIZ3
Far Middleground 4 – 8 km	VIZ2	VIZ3	VIZ3
Near Background 8 – 12 km	VIZ3	VIZ3	VIZ3
Mid Background 12 – 20 km	VIZ3	VIZ3	VIZ3
Far Background 20 – 32+ km	VIZ3	VIZ3	VIZ3
Areas Not Visible	VIZ3	VIZ3	VIZ3

Note:

- Column 1 codes represent a combination of the viewer sensitivity level (1-high, 2-moderate, 3-low) and the distance zones
- Columns 2 – 4 indicate visual influence zones varying by row according to the combination of viewer sensitivity level-distance zone and scenic quality class.

Appendix 2: Impact mitigation options

A number of different impact mitigation options may be considered as potential methods of avoiding or minimising potential visual impacts. These include:

- re-siting of turbines to locations where they will have less visual impact (or removal if necessary);
- re-sizing of turbines and other alterations (to reduce their visual magnitude);
- re-colouring (for example to reduce hue and tonal contrast); and
- vegetation screening (for example to screen the alterations from view).

It is noted that mitigation measures may change or evolve over time. This section does not limit proponents from posing other mitigation measures, other than those listed, to be considered in the assessment process.

Re-siting

Re-siting of turbines to locations where they will be of lesser visual impact (or removal if necessary) should be considered during the preliminary assessment and design phases. A series of wind turbine layout options may be considered which may have different visual impact outcomes, but remain viable for wind energy generation. This should be a first point of consideration by proponents, and will also be considered by the Department during the assessment of the project.

Re-sizing

Re-sizing of turbines and other associated wind energy development facilities (i.e., roads, buildings, electricity transmission terminals, and distribution electricity power lines and poles or underground cabling) can be considered in two ways:

- using wind turbines or other structures that are of a lesser height or size in order to reduce their relative visual magnitude within the distance that they are viewed from critical viewpoints; and
- substituting larger wind turbines (that generate more electricity) or other structures for a significantly higher number of smaller wind turbines or other structures. This option may be useful where the sheer number of alterations spread throughout a landscape or extended horizontally across views or across key features such as ridgelines may create a greater visual impact or visual impacts seen from a greater number of viewpoints than would a fewer number of larger alterations.

There will likely be a range of considerations in determining whether turbines should be resized, including the nature and extent of visual impacts, changing technology and the overall efficiency of the wind energy project.

Re-colouring

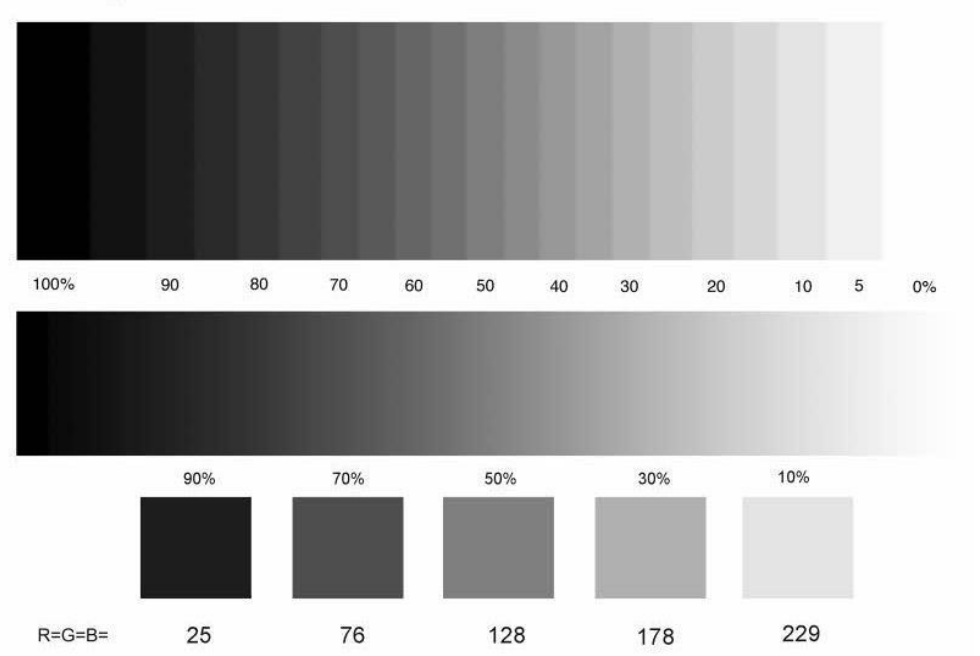
One of the key reasons that wind turbines and other alterations may be detected as alterations in the landscape is that they can be visually distinguished from their surrounding landscape due to their degree of colour contrast. If these alterations had no colour contrast at all with their surrounding landscape, they would be virtually undetectable.

Visual contrast depends on the difference in an introduced object's colour and brightness (luminosity) and that of its background landscape or sky. In general the human eye/brain has greater sensitivity to contrast than it does to changes in luminance or light intensity.

It is difficult to achieve complete colour contrast reduction in practicality, due to the combination of variable backdrop colours and lighting within the landscape. However, reducing the degree of colour contrast can have a significant effect on the negative perception of that alteration on the scenic quality of the landscape.

The importance of considering colour contrast is that wind turbines are usually coloured white, which is at an extreme end of the grey-scale (0 per cent) and colour brightness scale (100 per cent). Most of the natural colours found in Australian landscapes and sky colours occur within a more central range of the grey-scale, from about 15 per cent to 60 per cent darkness and within the middle range of the brightness scale, from approximately 40 per cent to 85 per cent. As such, if darker toned colours were to be used with wind turbines, the degree of colour contrast and visual impact would be reduced.

Figure 6. 256 Grayscale chart



As background colours change with different backdrops and lighting conditions, a wind turbine colour that is approximately half-way between the extremes of colour contrast levels found in the landscape would, on average, achieve the greatest possible general contrast reduction.

Reducing colour contrast with wind turbines when they are silhouetted against a changeable sky backdrop (potentially changing from backdrops of deep blue sky to white clouds) is the most difficult to achieve. However, white colours will always produce the most extreme colour contrast in every situation except when white clouds form the backdrop. Hence selecting turbine colours to achieve the greatest average contrast reduction under the various sky lighting conditions may provide a better solution when wind turbines are located on ridgetops.

Vegetation screening

Vegetation screening, or the planting of trees and shrubs, to visually screen wind turbines or other potential visual impacts from view may be an option for selected viewpoints. However, this mitigation option should not be the first that is considered. A key reason for this is that visual impact issues often cause conflicts between the community or individual residents and the proponent's proposed wind energy project, and people value landscapes and particular views of the landscape. Vegetation screening can potentially remove such views. Given this, it should be kept in mind that mitigation using vegetative screening will be subject to further consideration by the consent authority. However, in appropriate situations and where residents have requested vegetative screening of proposed wind turbines, this mitigation option can be useful.

Due to the great height of most wind turbines compared to that of surrounding trees, generally the vegetation must be relatively close to the viewer to be effective.

In addition to vegetation as a mitigation tool to screen views to wind turbines, consideration should also be given to the potential for existing vegetation to be lost, removing visual screening that may have been relied upon to ensure reduced visual impacts from wind turbines. Loss of vegetation can occur through circumstances such as trees falling over due to senescence, trees blowing over in wind storms, trees being chopped down, or trees burning down in bushfires.

Appendix 3: References

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