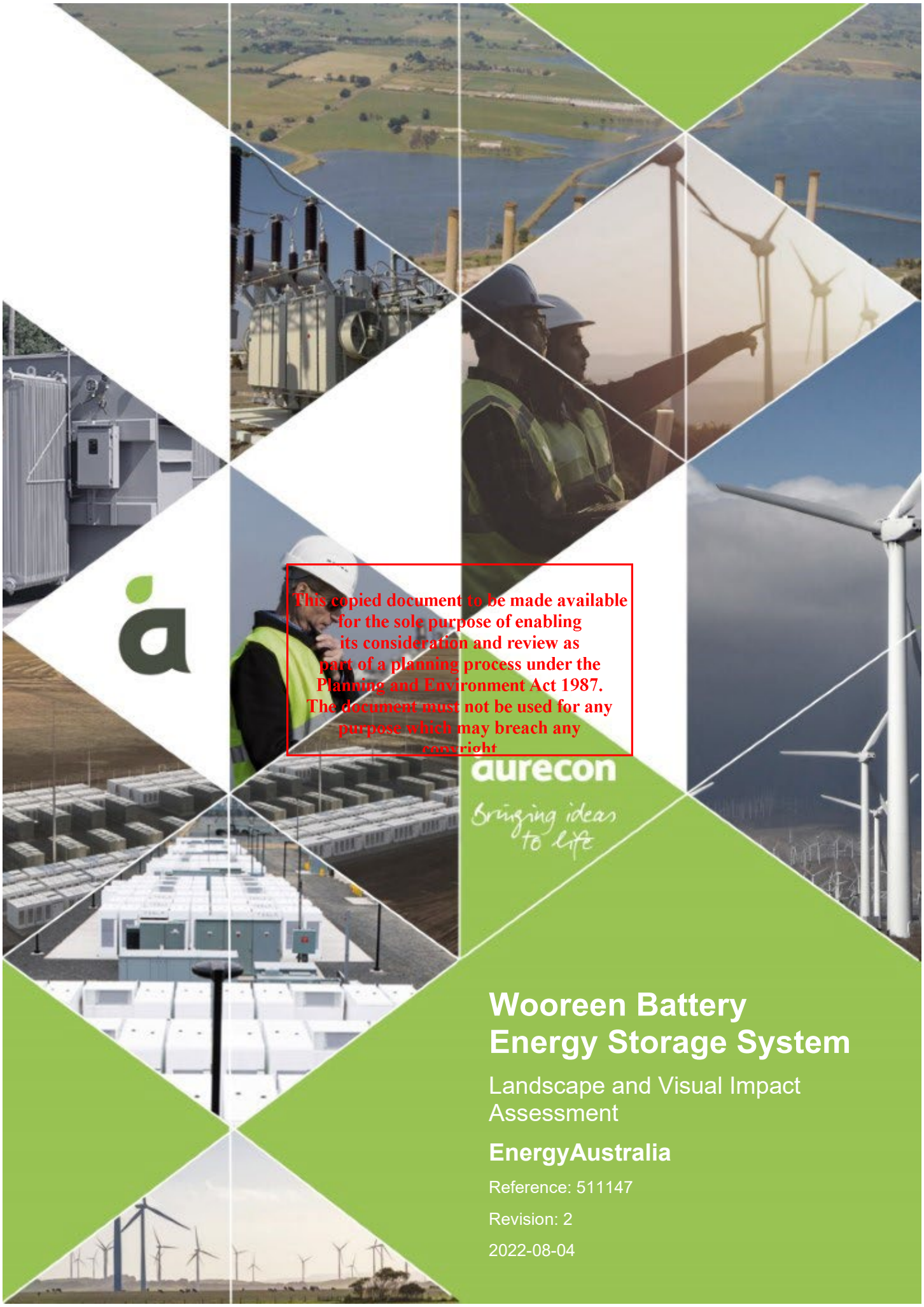
Appendix H- Landscape Assessment



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Bringing ideas to life

Wooreen Battery Energy Storage System

Landscape and Visual Impact Assessment

EnergyAustralia

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Contents

Appendices

Figures

Tables

Abbreviations

Term	Definition
BESS	Battery Energy Storage System
CHMP	Cultural Heritage Management Plan
ESO	Environmental Significance Overlay
Foreground	The area that immediately surrounds the project up to a distance of 0.5 kilometres.
HO	Heritage Overlay
Km	kilometre
LVIA	Landscape and visual impact assessment: The assessment of the impacts of the WESS on landscape and visual values.
Landscape	Its constituent elements, its character and the way this varies spatially, its geographic extent, its condition, the way the landscape is experienced, and the value attached to it.
LCT	Landscape Character Types
LPPF	Local planning policy framework: Local planning policies are tools used to implement the objectives and strategies of the Municipal Strategic Statement.
M	metre
MWTS	Morwell Terminal Station
Study Area	The area designated relevant for assessment of the project, determined by viewshed analysis
the Project	Tilt Renewables Morwell BESS
The Site	Proposed location for the Project
Viewpoint	Moderate or high sensitivity location from which views to the construction process or components of the project may be possible.
Viewshed	The area visible from a particular viewing location.
Visual amenity	The qualities of a landscape setting that are appreciated and valued by a viewer.
Visual catchment	The area over which an object can be seen within the landscape based on the line of sight.
Visual impact	The result of assessing the sensitivity level of a viewer and the modification level of a development.
Visual sensitivity	The degree to which various user groups would respond to change based on their expectation of a particular experience in a given setting for example the expectation of a high level of visual amenity in a national park.
WESS	Wooreen Energy Storage System

Executive summary

The purpose of the report is to prepare a Landscape and Visual Impact Assessment to seek the Minister for Planning's approval under the Latrobe Planning Scheme to install a Battery Energy Storage System in Hazelwood North, to help maintain reliable and affordable energy supply for Victoria. The intention is to combine the operation of the Battery Energy Storage System with renewable energy generation to support Victoria's transition away from reliance on fossil fuels.

The Project Land is located approximately four kilometres southeast of the township of Morwell, in the Latrobe Valley area of Gippsland and spans across two sites on Bonds Lane in Hazelwood North, adjacent to the existing Jeeralang Power Station.

The following contains an indicative list and quantities of the elements required to enable the WESS to function:

- Approx. 280 BESS enclosures (or equivalent) equating up to 1400MWh of lithium batteries with low voltage inverters and 33kV to low voltage transformers;
- A 220/33 kV substation including two 220kV/33kV transformers, 220 kV isolators and auxiliary services such as two 33 kV zig-zag transformers;
- One 220kV overhead powerline proposed to connect the BESS transformers to the switchyard;
- Four 220kV connection towers up to approximately 30m high;
- One control room likely located adjacent to the BESS enclosures;
- Four 33kV switchrooms likely located adjacent to the BESS enclosures;
- Provision of an office, an operation and maintenance shed/room, and two car parking spaces for maintenance staff;
- Multiple indicative noise walls approx. 6m in height;
- Secondary access from Bonds Lane into the BESS facility;
- Installation of fire detection equipment;
- Perimeter road encompassing BESS footprint and internal roads for access;
- Retention pond and/or water storage tank
- Replace internal fencing and install CCTV
- Temporary construction laydown areas

Methodology

The approach for the Landscape and Visual Impact Assessment is based on an assessment of the change to the landscape setting, including the ability of the landscape to absorb the change, and the sensitivity of the receptor viewing the landscape. The outcome has been considered as a 'visual impact' experienced by the viewer.

The impact assessment entailed the following interrelated tasks:

- Existing conditions analysis of the Study Area - the existing conditions analysis was used to establish the Study Area and provided a baseline assessment of landscape values and visual impacts; and
- Visual appraisal – comprised of an appraisal of the landscape of the Project Land, assessment from the area surrounding the Project Land to determine to determine the approximate visual envelope of the Project Land and a detailed viewpoint assessment. A detailed assessment of every viewpoint in the vicinity of the WESS is not practicable. Therefore, it is accepted practice to undertake a detailed assessment at selected viewpoints that are representative of high sensitivity areas in the vicinity of the WESS. These results can be inferred for other proximate viewpoints with similar views and levels of sensitivity.

As such, five viewpoints were identified from publicly assessable locations. These were selected from the baseline analysis and the field visit.

The landscape and visual baseline

The assessment examined the existing landscape and visual conditions of the Study Area (both physical and statutory) to establish a baseline against which potential impacts of the WESS could be assessed.

The Landscape and Visual Impact Assessment Study Area was defined within a radius of two kilometres from the location of the Project Land. This area captures where the WESS would be observable, based upon the topographical characteristics and intervening elements in the surrounding area.

Relevant planning policies and legislation were reviewed to understand any specific landscape or visual designations relating to the Study Area, as well as a desktop study and field work to understand the various physical elements that combine to create landscape and visual character.

The WESS is located in an area subject to the planning scheme of Latrobe City Council. There are no specific planning designations attributing any specific landscape or visual value within the Study Area.

The baseline assessment identified a total of three distinct Landscape Character Types (LCTs) within the Study Area, including:

- LCT 1: Energy and industrial infrastructure;
- LCT 2: Rural landscape; and
- LCT 3: Rural living.

These LCTs were determined to have varying ability to absorb the change as proposed by the WESS.

There were five representative viewpoints from publicly assessable locations identified within the Study Area that were determined to be assessed which include the following:

- Viewpoint 01 (VP1): From residential driveway off Church Road, approximately. 1.15km northeast of the WESS. Viewpoint is representative of residential dwellings within farmland.
- Viewpoint 02 (VP2): From residential driveway off Tramway Rd approximately 600m southeast of the WESS. Viewpoint is representative of residential dwellings within farmland.
- Viewpoint 03 (VP3): From Bolding and Hazelwood roads, approximately 2.7km southeast of the WESS.
- Viewpoint 04 (VP4): From Hazelwood North Reserve, approximately 1.6km northeast from the WESS.
- Viewpoint 05 (VP5): From Monash Way, approximately 1.6km northwest from the WESS.

Landscape and visual assessment findings

The level of visual modification due to the WESS is a combination of the degree of change and the ability of the landscape setting to absorb the change. The prominence and level of intrusion of the development within a landscape setting is a key determinant of the level of visual modification.

The landscape characters identified within the Study Area have been assessed to have the ability to absorb change, as proposed by the Project, given the high level of modification already experienced.

The visual impacts of the WESS resulted in negligible impacts for four of the detailed assessment of representative viewpoints (VP01 to VP04). This is derived from the landscape appraisal of the Project Land and its assessment from the surrounding area to determine its approximate visual envelope. The Project Land comprises low-lying topography and combined with the perimeter planting along the north-eastern and eastern boundaries these landscape elements provide enclosure and containment to the Project Land. Furthermore, the localised undulating topography formed by the creek lines and intervening vegetation across the landscape, control any middle to background views afforded towards the Project Land from the surrounding area. Energy and industrial infrastructure punctuate the skyline which either limit or truncate views towards the Project Land and as such, the visibility zone is limited to foreground views from within 5oo metres of the Project Land.

This assessment concluded that the four proposed 220kV connection towers, are likely to be visible at least partially from all assessed viewpoints, however the visual modification is assessed as negligible. These proposed components do not intrude in regard to the size, scale and geographical extent to the those within the Jeeralang Power Station which comprises of larger and bulkier structures than those proposed.

Furthermore, electrical infrastructure including substations, transmission towers and powerlines are frequent and clearly evident within the Study Area.

VP05 was determined to be the only viewpoint that would experience partial and filtered views from Monash Way due to the proposed 6m high noise wall facing Bonds Lane located in front of the existing Jeeralang Power Station. It is noted that the planted vegetation corridor along the north-eastern boundary of the Project Land adjacent Bonds Lane would filter the bulk of the noise walls. Furthermore, the gas turbines of the Jeeralang Power Station are strong vertical elements within the landscape setting.

There has been no landscape mitigation design proposed for the indicative concept plan. It is recommended that the existing planted vegetation corridors and groups within the immediate areas surrounding the Project Land are retained to assist in minimising adverse visual impacts to the WESS when viewed from the surrounding landscape.

The operational lighting impacts for the WESS is low and is not expected to generate significant levels of lighting above that is currently experienced within the rural landscape. Accordingly, the lighting assessment demonstrates that the Project Land is not sensitive to the introduction of new lighting.

Overall, there would be a minimal visual change from Monash Way, Bonds Lane and Tramway Road (within 500m of the Project Land). This is due to the compositional contrast in form and shape values between the proposed noise wall fronting Bonds Lane and the verticality and pattern typically experienced in the landscape from the energy infrastructure. Furthermore, the existing planted vegetation corridors in the immediate areas surrounding the Project Land either filter or inhibit views to the WESS. It is acknowledged that these views would be transient and experienced for a short duration, resulting in a minor deterioration to the view for the road users.

1 Introduction

1.1 Overview

Aurecon Australasia Pty Ltd (Aurecon) has been engaged by EnergyAustralia (EA) to prepare a Landscape and Visual Impact Assessment (LVIA) to seek the Minister for Planning's approval under the Latrobe Planning Scheme.

1.2 The WESS

The Proponent is proposing to install a Battery Energy Storage System (BESS) in Hazelwood North, to help maintain reliable and affordable energy supply for Victoria, known as the Wooreen Energy Storage System. The intention is to combine the operation of the Proposal (the WESS) with renewable energy generation to support Victoria's transition away from reliance on fossil fuels.

1.3 Location

WESS is located approximately four kilometres southeast of the township of Morwell, in the Latrobe Valley area of Gippsland as illustrated in Figure 1.1. WESS spans across two sites on Bonds Lane, Hazelwood North, adjacent to the existing Jeeralang Power Station (the Project Land).

1.4 Purpose and scope of this report

This report outlines the findings of the LVIA of the WESS.

The objectives of this landscape and visual appraisal are to assess the landscape characteristics of the land at Bonds Lane and its surroundings, and to consider its visual quality, its function in the landscape, and its relative qualities within the wider landscape. The work undertaken included an assessment of the existing landscape features of the Project Land, together with a visual appraisal and its context. The next step was to identify any landscape mitigation for the proposed development.

The process used to undertake this landscape and visual impact assessment included desk-top research and field survey, identification of the landscape and visual values and the analysis and documentation of the findings.

1.5 Structure of the report

The structure of the report is outlined below.

- Section 1 – introduces the report.
- Section 2 – describes the methodology for the assessment.
- Section 3 – identifies relevant landscape and visual policy and legislation pertinent to the Project Land.
- Section 4 – describes the existing Project Land conditions and landscape setting.
- Section 5 – describes the WESS features and operation.
- Section 6 – identifies the landscape character types within the Study Area.
- Section 7 – assesses the potential visual impacts of the WESS.
- Section 8 – provides guidelines for mitigating potential impacts.
- Section 9 – summarises the assessment findings.

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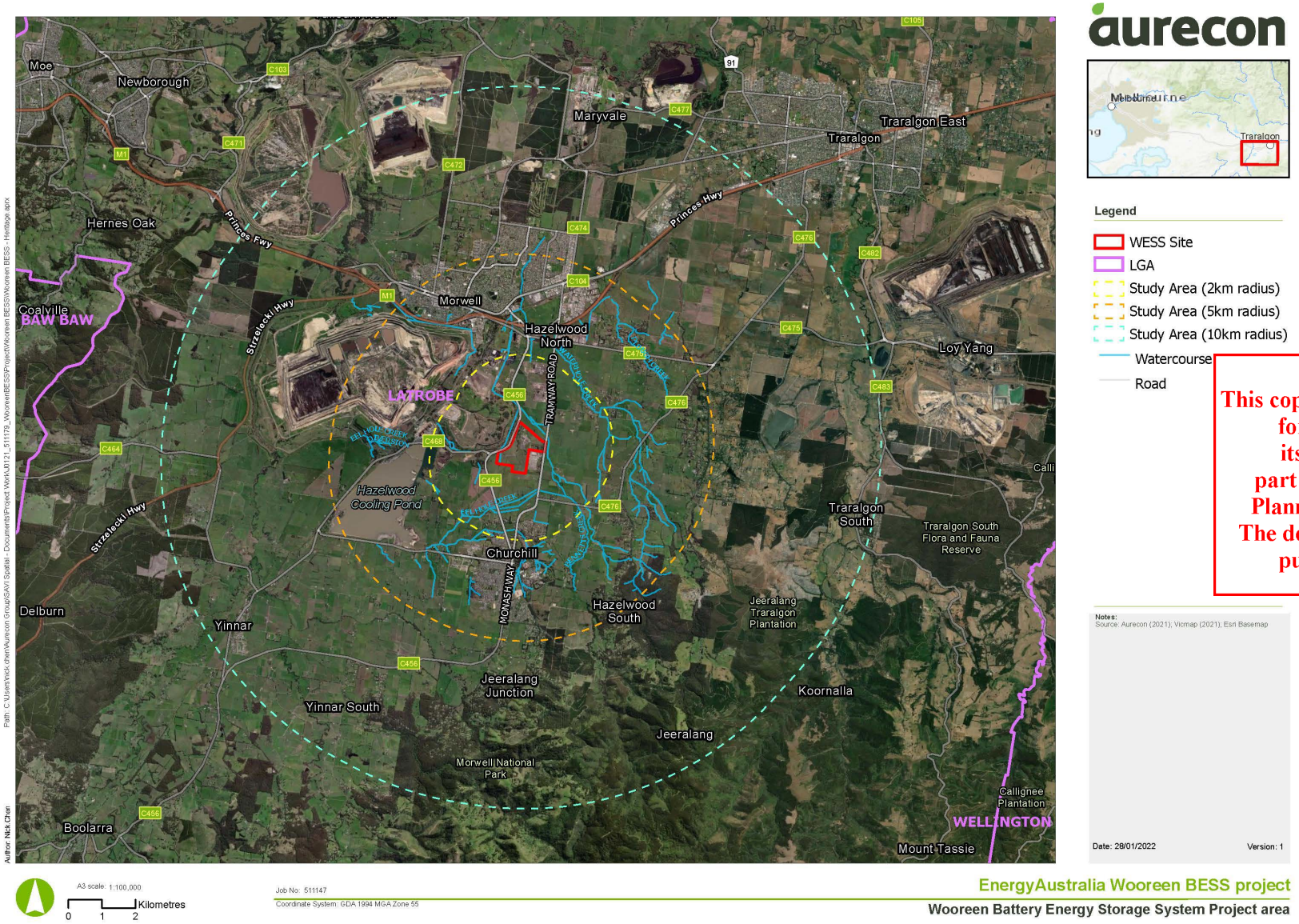


Legend

- WESS Site
- LGA
- Study Area (2km radius)
- Study Area (5km radius)
- Study Area (10km radius)
- Watercourse
- Road

Notes:
Source: Aurecon (2021); Vicmap (2021); Esri Basemap

Date: 28/01/2022 Version: 1

Figure 1.1 WESS location plan

2 Methodology

2.1 Approach to the assessment

The Project Land is predominately located in land zoned Special Use (SUZ1) with the southern section of the grid connection footprint and temporary construction laydown areas within Farming Zone (FZ). The Project Land is adjacent to the existing Jeeralang Power Station and in close proximity to the Hazelwood Terminal Station. The WESS is not seeking a planning scheme amendment to change land use. As such, determination of the prominence of the proposed development within a landscape setting is treated as being of a lower relevance to assess the visual impact than the sensitivity or perception of a viewer.

This report's key focus therefore is on the visual sensitivity being the tolerance of the viewer to a change to a landscape setting as a result of the WESS. The visual impact of the WESS is therefore determined by evaluating the degree of its visual fit in the context of the visual sensitivity of the surrounding land uses (based on the land use zones of the applicable planning scheme).

This approach is supported within Section 4 *Guidance note EIA-N04 Guidelines for Landscape Character and Visual Impact Assessment (2013) and Landscape Aesthetics – A Handbook for Scenery Management (1995).* The assessment also supported by *The Guidance for Landscape and Visual Impact Assessment (GLVIA)*, Third Edition (2013), prepared by Landscape Institute and Institute of Environmental Management & Assessment (IEMA, UK).

2.2 Study Area

To determine the Study Area a viewshed analysis was undertaken. A viewshed is defined as the surface area visible from a given viewing location. As the distance increases from any proposed development, the field of view decreases causing the visibility of components to diminish. Views at or greater than two kilometres would visually be insignificant or the degree that it intrudes on the view would be minimal. Appendix A defines this diminishing visual prominence rationale.

The limit of the Study Area for this LVIA is therefore derived from a conservative viewshed analysis of a two-kilometre radius from the Project Land. Key projects elements have the potential to be visible within this Study Area.

The extent of the Project Land's potentially visible surface area from a given viewing location within the Study Area was identified during a desktop study using topographical data. Potential viewpoints were identified within varying distances from the WESS (refer to viewer sensitivity) and then validated during a field visit to account for potential screening and filtering effect on these views from topography, existing vegetation and built form.

2.3 The study method

Figure 2.1 illustrates the key steps for the methodology of the assessment.

The level of visual impact resulting from the proposed development has been assessed against the following components:

- Visual sensitivity made up of the following:
  - Viewer sensitivity: the sensitivity of the viewer to the development/change and distance from the viewpoint; and
  - Landscape sensitivity: the ability of the landscape setting to absorb the development/change.
  - Scale of modification: how well the development/change contrasts or blends with the surrounding land use based on varying levels of visual prominence.

Establishing the level of visual impact involves assigning levels of visual sensitivity and modification such as high, medium low or very low. A determination matrix is then used to assign an overall level of visual impact.

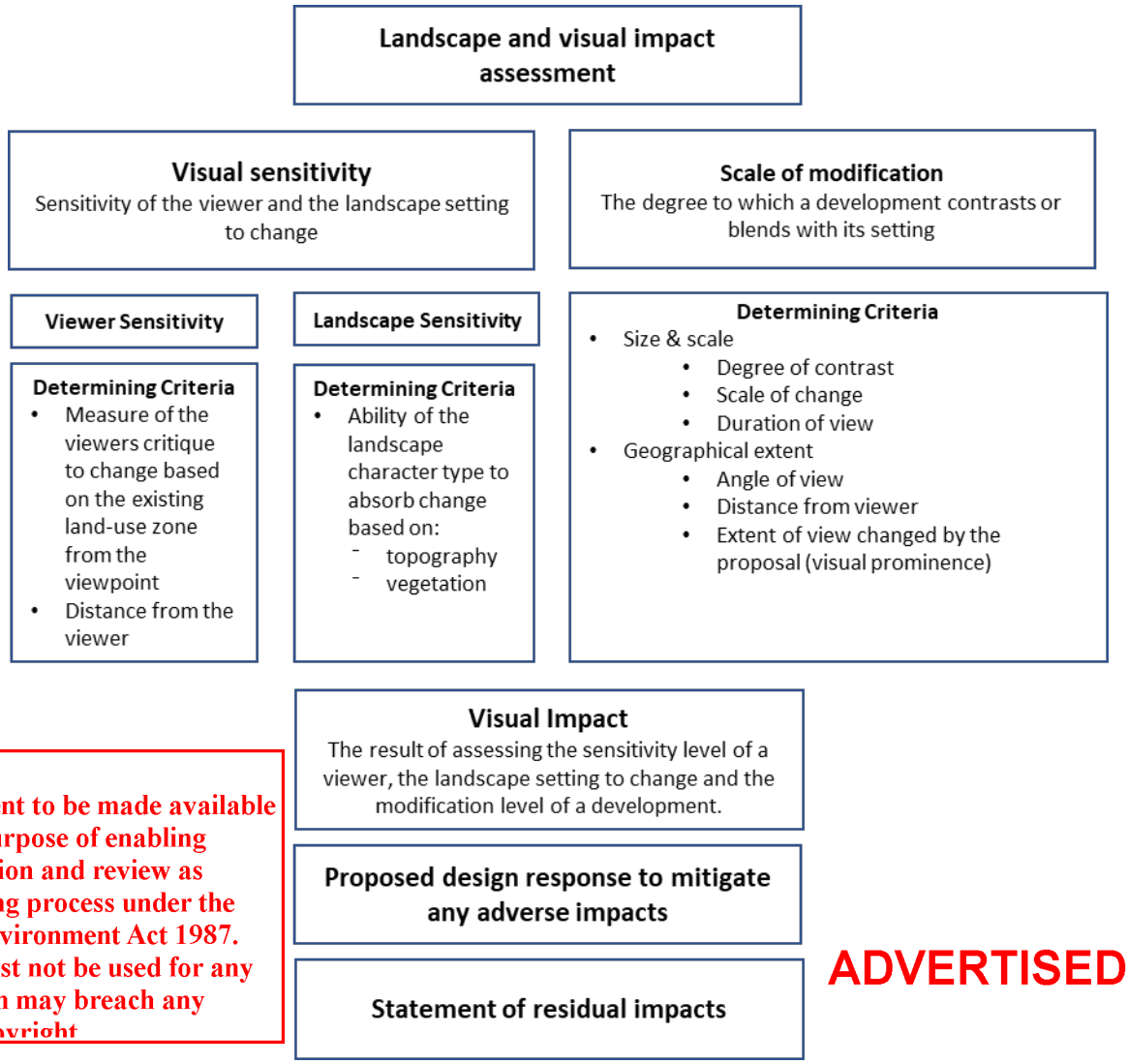


Figure 2.1 LVIA study method

2.3.1 Visual sensitivity

Visual sensitivity is composed of two parts: viewer sensitivity and landscape sensitivity.

Viewer sensitivity

Viewer sensitivity is a measure of how critically a change to the existing landscape setting would be regarded based on the use of the area and distance from where it is viewed.

Various landscape settings have differing indexes to the relative importance the viewer places on them. For example, individuals would view changes to the visual setting of their residence more critically than changes to the visual setting in which they travel or work.

As such, levels of viewer sensitivity are based on land use because this largely defines a viewer's expectation of what they would typically expect within a particular setting. This approach is consistent with the visual management system (*Landscape Aesthetics – A Handbook for Scenery Management*, United States Department of Agriculture& Forest Service, 1995).

The viewer sensitivity levels relating to existing land use zones within the Study Area are outlined in Table 2.1.

The next critical component to rating the viewer sensitivity is the distance of the WESS from the identified land use area. As illustrated in Table 2.1, there are three viewing distances to consider:

- Foreground (0 – 500 metres);
- Middleground (501 – 2000 metres); and
- Background (> 2000 metres).

As outlined in Appendix A, as the distance increases from the land use area the field of view decreases causing the visibility of the proposal components to diminish or be absorbed in the landscape setting. Consequently, as distance from the viewer to the proposal increases, the level of viewer sensitivity reduces.

Table 2.1 Viewer sensitivity determination matrix

LAND USE (Sensitivity of the viewing location)	DISTANCE FROM THE PROJECT				
	FOREGROUND		MIDDLEGROUND		BACKGROUND
	0 – 200 m	201 – 500 m	501 – 1000 m	1001 – 2000 m	> 2000 m
Residential / Accommodation	H	H	H	M	L
Parks and reserves	H	H	H	M	L
Educational facilities	H	H	M	M	L
Townships and settlements	H	M	M	M	L
Arterial road	M	M	M	L	L
Collector road	M	M	L	L	VL
Local tracks (unsealed)	L	L	L	VL	VL
Agricultural areas	L	L	VL	VL	VL
Energy and industrial areas	VL	VL	VL	VL	VL
Legend - H = High, M = Medium, L = Low, VL – Very Low					

Landscape Sensitivity

To understand the sensitivity of a landscape and its ability to absorb change, landscape character types (LCTs) need to be identified and defined. Identifying the LCTs of an area provides the basis for understanding the features that are important, and how different types of development would sit within a particular landscape

LCTs are defined based on physical characteristics such as:

- topography;
- vegetation;
- drainage patterns;
- geology; and
- land use patterns.

Once the LCTs are defined, an assessment of how well the landscape units are able to accommodate or absorb change such as a development is undertaken.

The key factors considered in determining a LCTs absorptive capability are:

- topographic variation;
- presence of and patterning of vegetation and density; and
- human modification such as presence of built from and/or extensive clearly resulting in a highly altered landscape.

In areas of elevated topography with no or lowland vegetation, open, unobstructed views towards a proposed development is highly likely. The ability for the setting to absorb the development and/or screen views using vegetation for example would be hard to achieve. Consequently, the ability to absorb the development in this scenario would be very low.

In areas where there are bands of dense vegetation in the surrounding landscape or the presence of built form that inhibit views towards the proposed development, the setting would have a greater capacity to absorb change compared to a cleared, expansive landscape or no structures.

Areas that contain signs of human modification such as farming land and industrial areas are typically not considered as high-quality landscape settings compared to natural landscapes such as mountain ranges. As such, the higher level of human modification the greater capacity the landscape has to absorbing change.

The absorptive capability levels relating to landscape sensitivity are outlined in Table 2.2.

Table 2.2 Landscape absorptive capability level

Landscape absorptive capability level	Description
Very Low	■ The extent of alteration would result in the landscape losing significant natural landscape features, its character and/or sense of place. ■ Open, expansive and bare landscapes. ■ Elevated, bare and/or groundcover vegetation. ■ The viewer is highly sensitive to changes in their immediate surroundings such as residents or 'natural' areas such as National Parks.
Low	■ The extent of alteration would result in the landscape partially losing some natural or designed landscape features, its character and/or sense of place. ■ Open, expansive and moderately vegetated landscapes including canopy trees. ■ Elevated and vegetation landscape including canopy trees. ■ The viewer is moderately sensitive to changes in their immediate surroundings such as users of regional and local reserves.
Moderate	■ Modified landscapes with an abundance of built form and limited natural characteristics. ■ Built-up landscapes typically interspersed with canopy trees. ■ The viewer is aware of the change but not overly sensitive to changes in their immediate surroundings such as users of commercial areas.
High	■ Highly modified and/or degraded landscapes with limited to no natural characteristics. ■ Undulating or elevated topography with dense tree cover. ■ The viewer is not critical/sensitive to changes in their immediate surroundings such as industrial areas.

Assigning a level of visual sensitivity

The visual sensitivity is a result of combining the viewer sensitivity level with the landscape absorptive capability level using the visual sensitivity determination matrix illustrated in Table 2.3.

Table 2.3 Visual sensitivity determination matrix

Landscape absorptive capability level	Viewer sensitivity level			
	H	**M**	**L**	**VL**
VL	H	H	M	L
L	H	M	L	VL
M	M	L	L	VL
H	L	VL	VL	VL

VL = Very low
L = Low
M = Moderate
H = High

Level of visual sensitivity

2.3.2 Visual modification

Visual modification is not easily predicted objectively, and interpretation and professional judgment is applied. A clear picture of the modification is determined from a combination of the degree of change to the view due to the project including the extent of the area over which changes would be visible, the period of exposure to the view and reversibility.

The assessment of visual modification does not include an evaluation of the merit of the aesthetic quality of the design. It is recognised that that assessment of aesthetic quality is highly subjective, therefore an assumption has been made that the changes are adverse. Table 2.4 outlines the four categories of modification used for determining the degree of visual modification potentially resulting from a proposed development.

The key considerations in determining the level of visual modification as outlined in Table 2.4 include:

- Size and scale;
  - The scale of the change in the view with respect to the loss or addition of features in the view, and changes to the composition including the proportion of the view occupied by the project components;
  - The degree of contrast or integration of the project components in the landscape setting with the existing or remaining elements including form, mass, line, height, colour, texture and materiality; and
  - The nature of the view towards the project components in terms of duration of the view.
- Geographical extent;
  - The angle of the view in relation to sensitive land use;
  - The distance of the viewpoint from the project component(s); and
  - The extent of the area over which the changes would be visible.

Table 2.4 Criteria for determining the visual modification level

MODIFICATION LEVEL	DESCRIPTION
High	The Project is highly visible and intrusive in regard to the size, scale and geographical extent, and would disrupt views currently experienced from sensitive land use areas and/or strongly contrasts with the existing landscape setting which has limited capacity for change.
Moderate	The Project partially intrudes in regard to the size, scale and geographical extent or somewhat obstructs current views from sensitive land use areas and/or a noticeable compositional change to the existing landscape setting in which there is moderate capacity for change.
Low	The Project is barely perceptible resulting in minor deterioration to the view currently experienced from sensitive land use areas; and/or results in a small change to the existing landscape setting in which change is possible without harm.

Very low	There is minimal compositional contrast and a high level of integration of form, line, shape, pattern, colour or texture values between the Project and the environment in which it sits. In this situation, the Project may be noticeable, but does not markedly contrast with the existing landscape setting.
Not apparent	There are no views of the Project components and as such, there is no impact.

2.3.3 Assigning a level of impact

The visual impact therefore is a result of combining the visual sensitivity level with the degree of visual modification using the visual impact determination matrix illustrated in Table 2.5.

The consequence of the application of the matrix is that (except where the proposed development cannot be seen) the proposed development would have some adverse impact, whether low, moderate or high, depending on the level of visual modification and viewer sensitivity from the location at which the proposed development can be viewed.

Table 2.5 Impact determination matrix

Degree of modification*	Visual Sensitivity			
	H	**M**	**L**	**VL**
H	H	H	M	L
M	H	M	L	VL
L	M	L	L	VL
VL	L	VL	VL	VL

VL – Very low
L = Low
M = Moderate
H = High
Level of Visual impact*

***Adverse, Neutral or Beneficial**

2.3.4 Consideration of night lighting impacts

There is little guidance locally on the assessment of night time visual impact. Therefore, the methodology applied to this report is drawn from the United Kingdom. The Institute of Lighting Professionals (ILP) Guidance Notes for the Reduction of Obtrusive Light (2020) includes four categories or zones with which to describe the lit situation of the landscape. These environmental zones are supported by design guidance for the reduction of light pollution which can then inform proposed mitigation techniques (refer to Appendix B).

A full night time visual assessment has not been undertaken, however this report has included a broad assessment of likely impacts. This assessment includes identification of existing lighting levels within the Study Area (referencing the ILE environmental zones), identification of the likely sources of lighting associated with the project and consideration of likely lighting impacts.

2.3.5 Mitigation measures

Once the landscape and visual impacts have been determined, mitigation actions are recommended. The purpose of mitigation is to avoid, reduce or where possible remedy or offset any significant adverse effects on the environment arising from the proposed development. Recommendations for mitigation and management measures to reduce potential visual impacts as a result of the proposed development during construction and operation are discussed in Section 8.

2.3.6 Residual impacts

The residual impact assessment level has considered the existing view in comparison to the view ten years after commencement of operations (Year One). Generally residual impacts would be reduced by at least one level where mitigation measures have been proposed that either filter or inhibit views to the proposed development.

2.4 Limitation and assumptions

2.4.1 Limitations

There are the following limitations associated with this assessment:

- There are limited specifications for the assessment of landscape and visual impacts specific to Australia. Therefore, the below guidelines have been used as a basis for the methodology for this assessment.
  - Landscape Aesthetics – A Handbook for Scenery Management, United States Department of Agriculture & Forest Service, (1995);
  - The Guidance for Landscape and Visual Impact Assessment (GLVIA), Third Edition (2013), prepared by Landscape Institute and Institute of Environmental Management & Assessment (IEMA, UK);
  - Guidance note EIA-N04 Guidelines for Landscape Character and Visual Impact Assessment, NSW State Government, Roads and Maritime Services (2013);
  - Guidance Note for Landscape and Visual Assessment (June 2018), Australian Institute of Landscape Architects (AILA) (Queensland chapter); and
  - Guideline for Landscape Character and Visual Impact Assessment (August 2020), Transport for New South Wales.
- The LVIA process aims to be objective and, as such, seeks to describe any changes factually. Potential changes resulting from the WESS have been defined. However, the significance of these changes requires qualitative (subjective) judgements to be made. Therefore, the conclusions to this assessment combine both objective measurement and subjective professional interpretation. This assessment has attempted to be objective, however it is recognised that visual assessment can be highly subjective, and individuals are likely to associate different visual experiences to the Study Area;
- This LVIA is based on Wooreen Energy Storage System Overall Site Plan (511147-0000-DRG-EE-0102) produced by Aurecon (refer to Figure 5.2);
- The impact assessment is focused on the current land uses and zoning;
- Access to viewpoints on private land, such as residences or accommodation, were not undertaken for this LVIA. However, where there are expected impacts from private properties, representative viewpoints are assessed adjacent the property boundaries looking towards the WESS to capture the typical existing visual conditions. It is noted that the accuracy of these viewpoint assessments for private land are limited to what is visible in the viewpoint;
- Methodology, program and timing of the construction works are currently indicative and dependent upon planning approvals. Consequently, construction impacts have not been assessed in this report. However, it would be acceptable to predict that there would be impacts during construction and would be similar degree of visual impact to the operational phase assessment findings; and
- As this report is based on an indicative site layout plan, the detailed design of above ground components has not been undertaken. Consequently, no mitigation measures for built form have been considered at this stage. Residual impacts therefore remain the same impact level as at operation.

2.4.2 Assumptions

This report has been developed based on the following assumptions:

- Desktop investigations and a field study were undertaken 29th April 2022, to inform the findings of this report;
- No stakeholder consultation or engagement on environmental matters has occurred;
- The landscape and visual impact assessment was based on the Project Land area mapped in the DA. Any additional Project Land has not been considered and therefore has not been considered in this report;
- The LVIA is based on the Project Description as outlined in Section 5;

- The methodology adopted for this landscape and visual impact assessment assumes that if the works would not be seen, there is no impact; and
- For the purpose of the assessment, an unobstructed viewpoint from a publicly accessible location has been used as a worst-case scenario of potential visual impacts.

2.4.3 Production of photosimulations

Two photosimulations were prepared from photographs of the existing conditions to assist with understanding the landscape and visual impacts from the WESS. These were selected based on the findings from the visual assessment which comprised of an appraisal of the landscape of the Project Land, assessment from the area surrounding the Project Land to determine to determine its approximate visual envelope and the detailed viewpoint assessment.

These viewpoints have been presented to illustrate the following scenarios:

- Existing view; and
- Indicative project view at Operation (Day 1).

3 Legislation and Policy

Legislation, policies and guidelines that have been reviewed and that are applicable to this impact assessment are outlined below.

3.1 Municipal planning schemes

The *Planning and Environment Act 1987* (PE Act) provides the framework for land-use and development in Victoria. Planning schemes prepared under the provisions of the Act apply to each municipal area in Victoria.

The Project land is located in an area subject to the planning schemes of Latrobe City Council. The relevant planning schemes control the use and development of land and are structured to include:

- State Planning Policy Framework;
- Local Planning Policy Framework;
- Municipal Strategic Statement;
- Local Planning Policy;
- Zones and overlays;
- Particular and general provisions; and
- Definitions and incorporated documents.

3.1.1 State Planning Policy Framework

The State Planning Policy Framework (SPPF) provides a context for spatial planning and decision making in Victoria. The following Table 3.1 is a summary of the key documents assessed:

Table 3.1 State Planning Policy Framework documents

Legislation/Policy reference	Brief description legislation, salient parts and intent	How legislation/policy is relevant to the study
Latrobe PS Ordinance	15.01-6S Design for rural areas ■ Ensure that the siting, scale and appearance of development protects and enhances rural character. ■ Protect the visual amenity of valued rural landscapes and character areas along township approaches and sensitive tourist routes by ensuring new development is sympathetically located. ■ Site and design development to minimise visual impacts on surrounding natural scenery and landscape features including ridgelines, hill tops, waterways, lakes and wetlands.	Project Land is predominately within existing Special Use Zone (SUZ) with Farming Zone (FZ) adjoining. Proposed would be compatible to the SPPF.

3.1.2 Local Planning Policy Framework (LPPF)

Table 3.2 is a summary of the key documents assessed.

Table 3.2 Relevant local planning policies

Legislation/Policy reference	Brief description legislation, salient parts and intent	How legislation/policy is relevant to the study
Municipal Strategic Statement and Local Planning Policy	The Latrobe MSS includes policy direction that reflects the diverse land uses and development intensity in the municipality. **Clause 13 Environmental Risks and Amenity:** encourages new energy opportunities in order to avoid and minimise environmental risks. **Clause 14 Agriculture:** There will be minimal additional infrastructure added to the farming zone component of the Project Land **Clause 15 Built Environment and Heritage** **Clause 17.01-2R**: Innovation and Research – Gippsland and 17.01-2L Innovation and Research. Supports the creation of new and alternative energy related jobs and investments within the municipality. It seeks to make use of existing energy infrastructure and distribution networks. **Clause 19 Infrastructure:** The WESS would use the latest WESS technology to facilitate a safe, efficient and reliable electricity system.	Proposed land use would be compatible to the LPPF

3.1.3 Zones and overlays

Zones

The Project Land lies predominantly within the Special Use Zone Schedule 1 - Brown Coal (SUZ1), with a small section within Farming Zone (FZ). The area surrounding the Project Land has a variety of land uses including rural living, farming zones, industrial sites and utilities as shown in Table 3.3 and mapped in Figure 3.1 Land use zones.

Table 3.3 Land uses

PLANNING ZONES	Land Use Features
IN1Z: INDUSTRIAL 1 ZONE	Morwell Terminal Station and Pinegro green waste site north-west of the Project Land off Monash Way. Unbuilt area to the north-west of the Project Land off Tramway Road.
IN2Z: INDUSTRIAL 2 ZONE	Industrial area east of Monash Way including Morwell waste transfer (Tip) and Omnia Specialities (soil and fertilizer manufacture).
RDZ1: ROAD ZONE	Monash Way and Tramway Road.
FZ1: FARMING ZONE	Area to the north, south and east of the Project Land.
RLZ1: RURAL LIVING	South-east of the Project Land off Boldings Drive Road (RDZ1).
SUZ1: SPECIAL USE ZONE	Project Land with the land adjoining to the south forming the Jeeralang Power Station. Land area to the south-east of the Project Land forms the Hazelwood Power Station. Land to the west off Monash Way forms part of the Hazelwood Power Station.
PUZ1: PUBLIC USE ZONE 1	Hazelwood Pondage and wetlands located south of Monash Way.
PPRZ: PUBLIC PARK AND RECREATION ZONE	Hazelwood South Reserve is located west of Tramway Road (RDZ1), south of the Project Land.

Overlays

The Study Area falls within the Gippsland Plain bioregion, the West Gippsland Catchment Management Authority (CMA) area and the Latrobe Local Government Area (LGA). The south-western portion of the Project Land is affected by Land Subject to Bushfire Management Overlay (BMO). Although the Project Land is not directly affected by any environmental significance overlays, there is an Environmental Significant Overlay (ESO1) to the south of the Project Land within the Study Area. Refer to overlays listed in Table 3.4 and mapped in Figure 3.2.

Table 3.4 Planning overlays

PLANNING CODE	Components
DD01- DESIGN AND DEVELOPMENT OVERLAY – SCHEDULE 1 MAJOR PIPELINE INFRASTRCUTURE	DDO1 specifically identifies high pressure pipelines to avoid. The DDO1 is located across the western portion of the Project Land, where no permanent works are proposed.
SRO1 – STATE RESOURCE OVERLAY – SCHEDULE 1 GIPPSLAND BROWN	The whole Project Land is covered by State Resource Overlay (SRO1). This overlay supports Gippsland Coalfields to provide a secure long term energy source for base load power generation in Victoria.
BMO: BUSHFIRE MANAGEMENT OVERLAY	The BMO is located across the south-western portion of the Project Land, however, there are no implications regarding the designation of the Project Land for the WESS under Clause 13.02-1S of the Latrobe Planning Scheme
ESO1: ENVIRONMENTAL SIGNIFICANCE OVERLAY	Environmental Significant Overlay (ESO1) to the south of the Project Land. This urban buffer protects urban settlements from the impact of radical change to the environment from the coal industry.
FO: FLOODWAY OVERLAY	To the west of the Project Land.
LSI0: LAND SUBJECT TO INUNDATION OVERLAY	To the north of the Project Land including Bennetts Creek and Waterhole Creek.

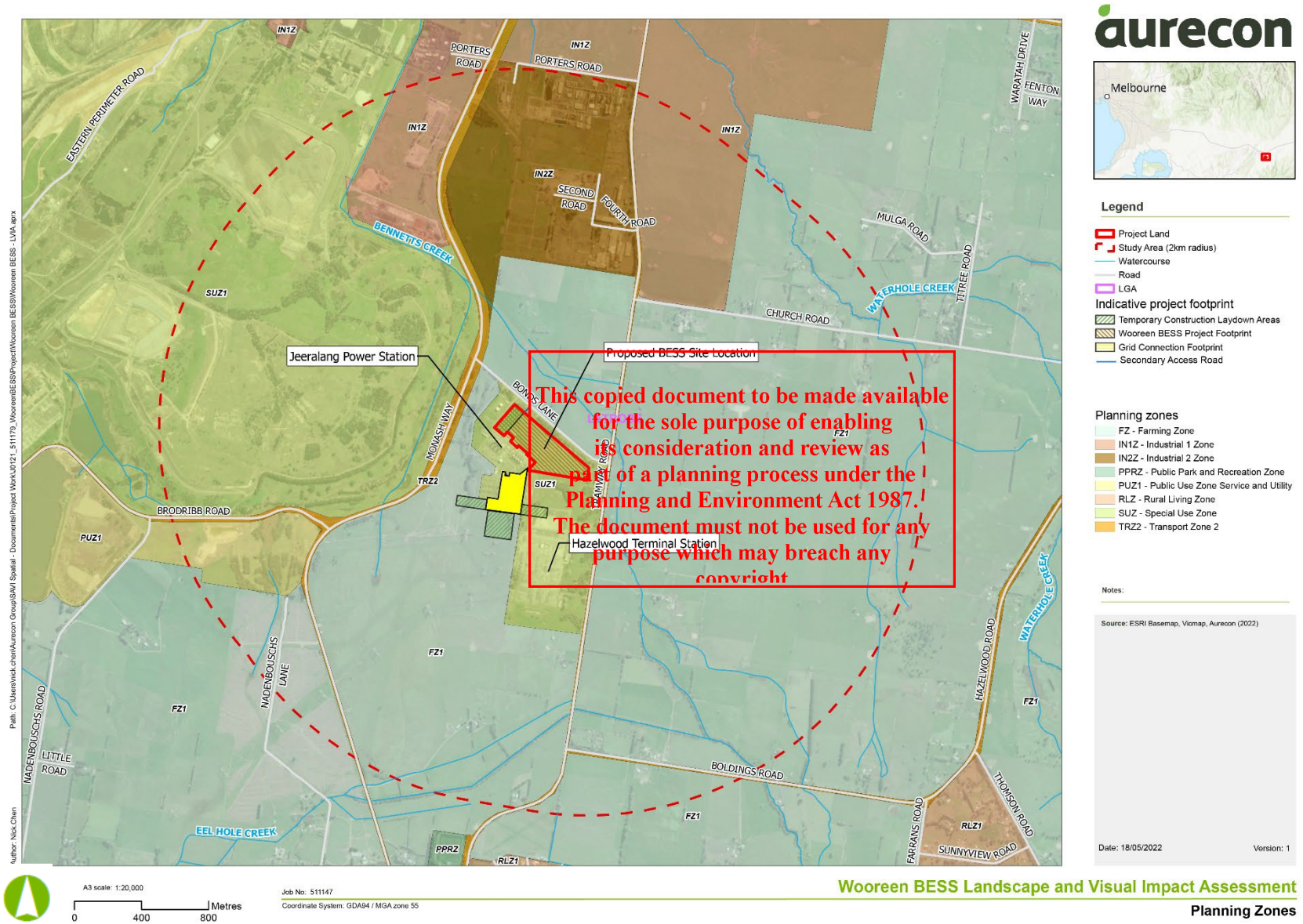


Figure 3.1 Land use zones within Project Land

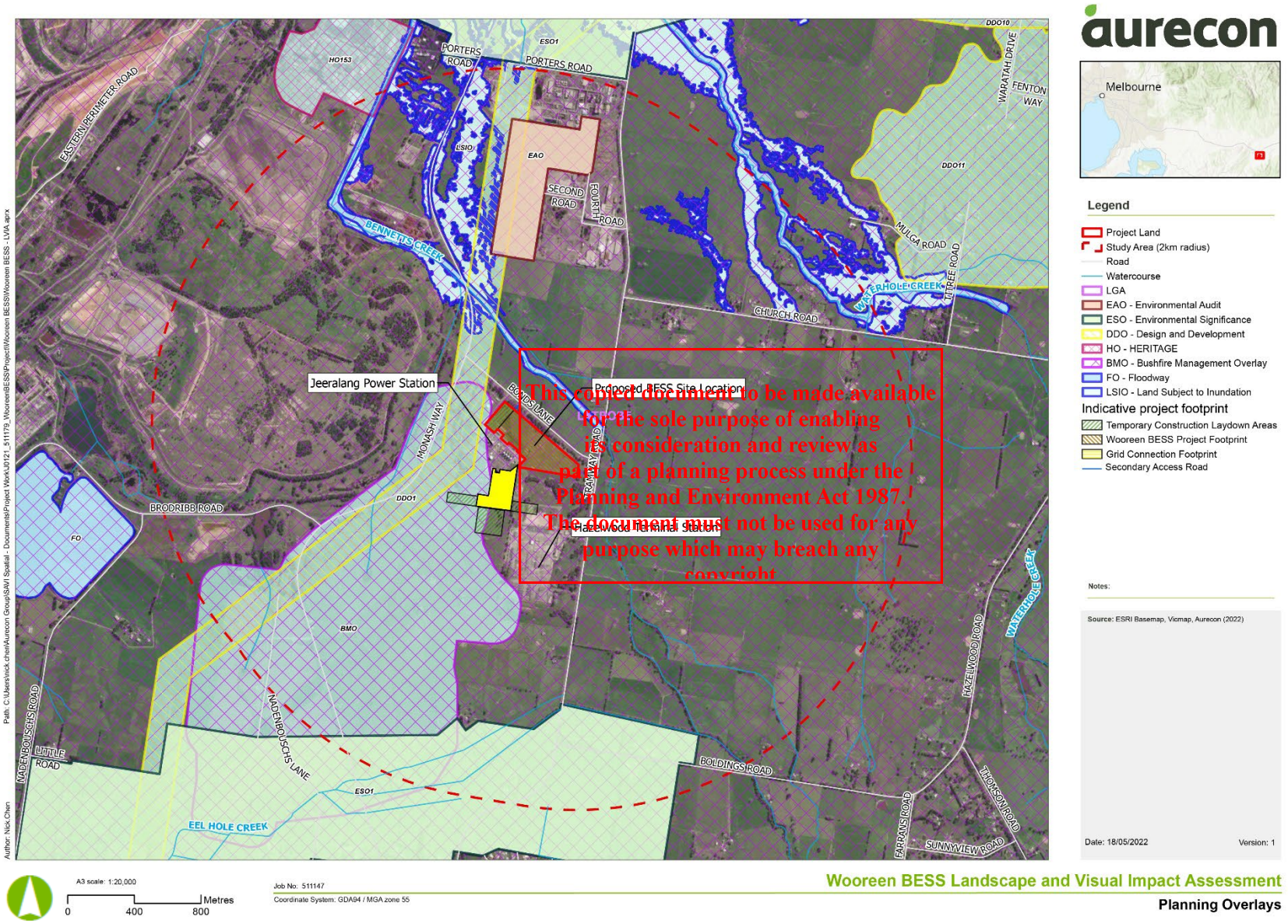


Figure 3.2 Planning overlays within Project Land

4 Project Land context and appraisal

4.1 Project Land context

The following section provides a brief description of the existing conditions, associated land uses and key landscape features surrounding the Project Land.

4.1.1 Land Use

Land use within the Study Area predominantly consists of agricultural land, industrial land and land used for power generation. The Project Land lies adjacent the Jeeralang Power Station and the temporary construction areas are located within farming land. Approximately 250m to the south of the Project Land is the Hazelwood Terminal Station off Tramway Road.

The nearby Morwell Power Station and Hazelwood Power Station (refer to Figure 4.2) and open-cut mine occupy land to the west of the Project Land. The power station was a brown coal-fired thermal power station and was decommissioned in 2014.It was previously used to supply electricity to the retail market as well as produce briquettes in the adjacent Energy Brix briquette works. The power station and mine have ceased operation and are now in a closure, demolition and rehabilitation phase. Hazelwood Pondage to the west of the Project Land (refer to Figure 4.3) was formed and used as part of the power station operations. The pondage is often used as a recreational lake along its western shores and for boating activities.

Industrial land lies to the north of the Project Land including the Morwell Terminal Station, Pinegro green waste site, Morwell waste transfer (Tip) and Omnia Specialities (soil and fertilizer manufacture).

Land use directly surrounding the remainder of the Project Land is farming land. There are rural residential dwellings scattered across this agricultural land with the nearest dwelling being approximately 750m from the Project Land to the south-east.

Monash Way is facilitated by VicRoads arterial road the M1 freeway, which allows access to major nearby Victorian ports for any imported equipment (Melbourne and Geelong).

4.1.2 Topography, landform and waterways

The land within the Study Area rises south-easterly from approximately 70m AHD near Porters Road to 110m AHD at Boldings Road as illustrated in Figure 4.1. The Project Land gently slopes north-west towards Monash Way from an elevation of approximately 90m AHD to 80m AHD.

There are a number of waterways and landforms within the Study Area that are highly modified as the result of diversions around and reclamation of the Morwell open-cut coal mine.

To the west of the Project Land, lies the Hazelwood overburden mound (Figure 4.4). This was created from overburden (including interseam, ash and debris materials) from mining activity and shaped to form a natural-appearing hill, with minimal soil placed to allow vegetation to grow. The Project Land is surrounded by undulating topography with background views to rising foothills as seen in Figure 4.6.

Being within a valley (Latrobe Valley), there are a number of natural waterways with the largest being the Latrobe River, north of Yallourn. There are also a number of smaller tributaries winding through undulating land. To the south of the Project Land is Eel Hole Creek diversion (refer to Figure 4.5) and Bennetts Creek to the north (refer to Figure 4.7).

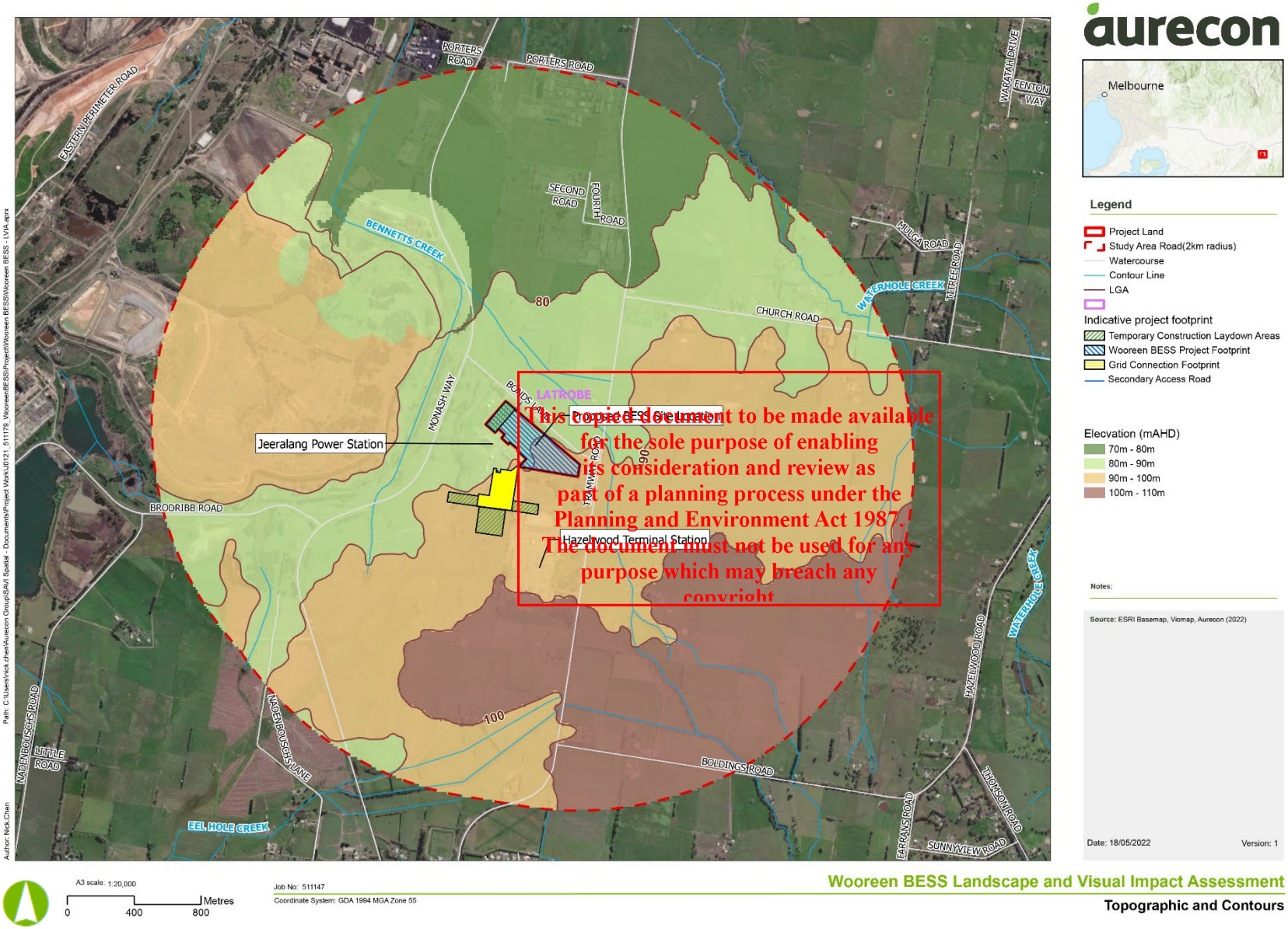


Figure 4.1 Topographic and contour plan

Figure 4.2 Hazelwood power station (image: N.Lamb 2012)

Figure 4.3 Hazelwood pondage (image: N.Lamb 2012)

Figure 4.4 Revegetated overburden mound, west of the Project Land (image: R. Smithers 2020)

Figure 4.5 Eel Hole Creek diversion – altered waterway to the west of the Project Land (image: N.Lamb 2012)

Figure 4.6 Undulating landscape with background foothills (image: R. Smithers 2020)

Figure 4.7 Bennetts Creek – area of darker ephemeral grasses (image: Google street view)

4.1.3 Vegetation

The Project Land has been heavily altered for farming and/or energy generation, and as such lack extensive areas of native vegetation or significant ecological values. Extensive areas of planted vegetation exist adjacent the Project Land, all of which was considered to be for the purpose of amenity and/or screening. Refer to the Phase 2 Ecological Assessment – Revision 03, Aurecon, 2022.04.01 for the impacts to flora and fauna. The report states, *'Native vegetation was largely limited to small, disconnected patches that were heavily altered from their natural state' and 'No threatened species listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) were recorded in the Study Area* (Project Land) *and none were considered to have a moderate or high likelihood of occurrence.'*

There is planted vegetation and a few patches of remnant native vegetation within the Project Land as listed in Table 4.1.

Table 4.1 Vegetation types and conservation status

Conservation status	EVC / Conservation reserve	Location
Endangered	EVC 55- Plains Grassy Woodland	Row of Blackwood along southern side of Bonds Lane. Treeless patches of Plains Grassy Woodland along the south of Bonds Lane, one large patch of treeless and heavily grazed Plains Grassy Woodland in the Ausnet property. Native flora species included Kangaroo Grass and spear grass at low cover levels. High cover of grassy weeds.
Endangered	EVC 53- Swamp Scrub	Small patch of Swamp Scrub comprising a sparse canopy of Swamp Paperbark, occurred either side of a drainage line in the south west of the study area
Endangered	EVC 83- Swampy Riparian Woodland	Four disconnected, treeless patches of native vegetation located in the low-lying sections of the study area along a drainage line.

Within five km of the Project Land, there are EPBC Act listed Gippsland Red Gum (*Eucalyptus tereticornis subsp. mediana*) Grassy Woodland and Associated Native Grassland (listed as Critically Endangered).

4.1.4 Cultural Heritage

A summary of findings from the Phase 2: Heritage Due Diligence Assessment Revision 3, (Apr 2022), includes the following.

- A search of the Victorian Aboriginal Heritage Register (VAHR) revealed that there are no Aboriginal places within the Project Land.
- No areas of cultural heritage sensitivity (CHS) intersect with the Activity Area. An area of CHS associated with Bennetts Creek is located to the north and east of the Activity Area.
- There is one Victorian Heritage Register (VHR) listed heritage place, Morwell Power Station and Briquette Factory (H2377) as seen in Figure 4.8, situated approximately 1.8 km north-west of the Project Land and will not be impacted by the WEFS.

There are heritage places located within close proximity of the Morwell township, approximately 2.5 km north-west of the Project Land, as detailed in Table 4.2. Many of the heritage sites below are associated with the Hazelwood Power Station, open-cut coal mine and associated development.

Table 4.2: Historic heritage register search results

Register	Listing	Site ID	Proximity to Project area
VHR / Local Planning Scheme	Morwell Power Station and Briquette Factory	H2377 / HO153	Outside of the Project area, the heritage curtilage abuts the western extent of the Project area.

VHR	No 21 Dredger	H2130	Outside of the Project area, approximately 1.4 km northwest (refer to Figure 4.9).
VHI	Tramway Road 1	H8121-0022	Outside of the Project area, approximately 2 km northeast.
Local Planning Scheme	Washingtonia Palms	HO69	Outside of the Project area (off Princes Drive, Morwell), approximately 1.5 km north.

Figure 4.8 VHR H2377 Briquette factories with chimneys (View west from Site, photograph by A. Carr, 29 July 2020)

Figure 4.9 VHR H2130 No. 21 Bucket dredger (image: VHD National Trust Database)

5 Project Description

5.1 Overview

The proposed project footprint is shown in Figure 5.1 and the works will include:

- installation of BESS;
- development of access track/s and associated car parking;
- ancillary use and development including construction lay down; and
- connections to existing Jeeralang Power Station.

5.2 Project components

Refer to Figure 5.2 for the WESS indicative site layout plan. The key aspects of the indicative WESS, which is relevant to this LVIA are as follows:

- BESS site works include:
  - Approx. 280 battery enclosures (or equivalent) equating up to 1400MWh of lithium batteries with low voltage inverters and 33kV to low voltage transformers;
  - Two 220kV/33kV substation including two 220kV/33kV transformer, 220 kV isolators and auxiliary services such as two 33 kV zig-zag transformers;
  - One 220kV overhead powerline proposed to connect the BESS transformers to the switchyard. This could include four 220kV connection towers up to approximately 30m high;
  - One control room likely located adjacent to the BESS enclosures
  - Four 33kV switchrooms likely located adjacent to the BESS enclosures
  - Provision of an office, an operation and maintenance shed/room, and two car parking spaces for maintenance staff
- BESS ancillary infrastructure to support the proposed site works and upgrades includes:
  - Multiple indicative noise walls approx. six metres in height. Noise wall fronting Bonds Lane is approximately 400m in length with a 90 degree return along Tramway Road for approximately 100m;
  - Secondary access from Bonds Lane into the BESS facility;
  - Installation of fire detection equipment;
  - Perimeter road encompassing BESS footprint and internal roads for access;
  - Retention pond and/or water tanks.
  - Replace internal fencing and install CCTV
  - Temporary construction laydown areas; and

The exact location of batteries and associated infrastructure will be confirmed in more detail as the project moves to the detailed design stage.

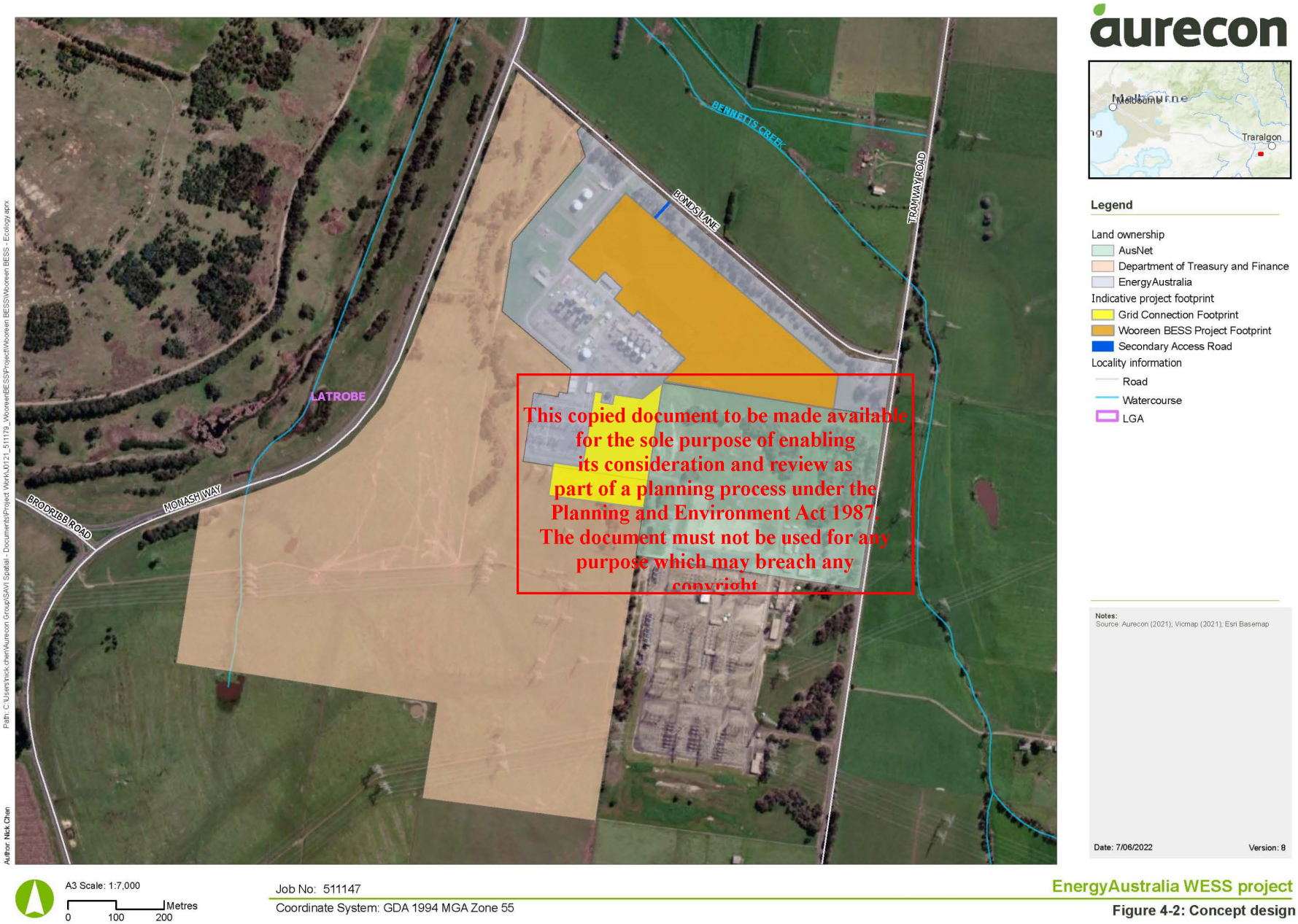


Figure 5.1 Proposed WESS footprint

WOOREEN SITE PLAN
SCALE 1 : 2000

LEGEND:

- INDICATIVE BATTERY STORAGE
- INDICATIVE INVERTER
- INDICATIVE TRANSFORMER
- HV TRANSFORMER
- 33/220kV TRANSFORMER LAYDOWN AREAS
- CONTROL AND SWITCH ROOMS
- ACCESS ROAD
- INDICATIVE NOISE WALL
- INDICATIVE STORMWATER RETENTION POND
- EXISTING DRAINAGE PIPE
- 220kV OHW

GENERAL VISUAL RENDERING ONLY
TO BE FINALISED BY APPOINTED EQUIPMENT SUPPLIER

CONSULTANT: aurecon www.aurecongroup.com
CLIENT: EnergyAustralia

REV	DATE	REVISION DETAILS	APPROVAL
A	11/02/22	ISSUED FOR REVIEW	TJ/

SCALE	As indicated
SIZE	A1
DRAWN	N. LE CORDEUR
DESIGNED	T. UNDERWOOD
CHECKED	K. MEKKI
APPROVED	A. VAN DER MERWE
DATE	-

PRELIMINARY

PROJECT	WOOREEN ENERGY STORAGE SYSTEM P/511147
TITLE	OVERALL SITE PLAN
DRAWING No.	511147 - 0000 - DRG - EE - 0102 - A

Figure 5.2 Indicative WESS Concept Design

Figure 5.3 below provides indicative illustrations of battery storage units, inverter and MV transformer station.

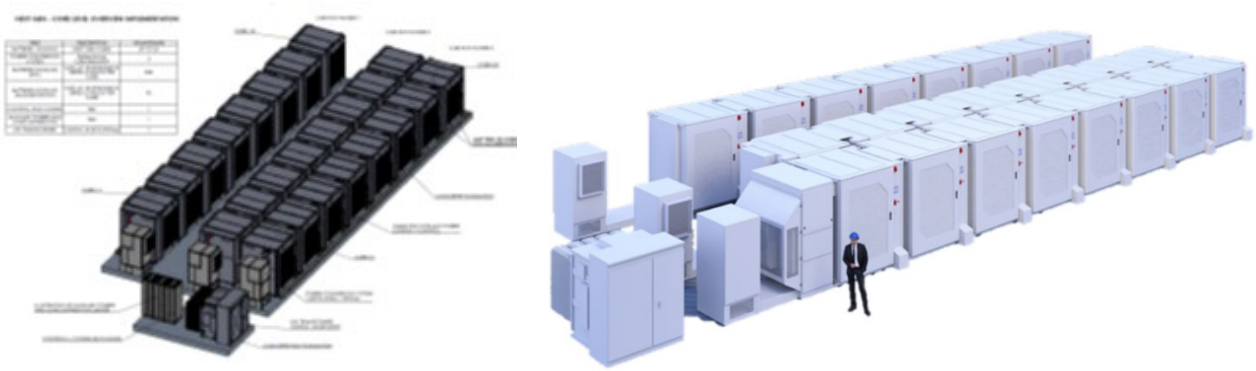


Figure 5.3 Example of battery storage units, inverter and transformer station

5.3 Construction

Methodology, program and timing of the construction works are currently indicative and dependent upon planning approvals. Consequently, construction impacts have not been assessed in this report.

Construction is anticipated to commence from the 3rd quarter of 2023 (pending permit approvals). The construction stage is anticipated to take up to 24 months consisting of a civil works, mechanical and structural component, electrical works, testing and commissioning. The proposed laydown, construction site offices and carparking will likely be in the three areas, as configured in Figure 3.1. It is anticipated that the construction activities will occur over two main phases:

- Site pioneering and civil works:
  - Site clearing, fencing and establishment of laydown areas;
  - General earthworks, storage and removal of spoil (including the treatment of contaminated soil, where required); and
  - site benching, access roads and drainage.
- BESS installation and other works:
  - Construction of batteries, inverters and associated infrastructure;
  - Construction of transmission connection; and
  - Testing and commissioning.
- Site access for construction and operation is proposed via an existing accessway from Bonds Lane and a proposed additional accessway from Bonds Lane.

6 Landscape Character

6.1 Landscape Character Types

Landscape Character Types (LCT) help to identify unifying aspects of the landscape and distinguish why one landscape is visually distinct from another. The character zones have been determined through a desktop assessment and confirmed through a site visit. Each character type identified is based on the consideration of the following attributes:

- landscape value, i.e., landscape designated for their scenic or landscape importance or valued recreational function;
- landscape elements that contribute to defining character, i.e., residential, commercial and landform;
- landscape character attributes, including scale, grain, perceptual characteristics such as connection to natural landscape, industrial nature of the area;
- observed land uses and current and future land use zones outlined in strategic planning documents and local Environmental Plans; and
- topography and vegetation.

The LCTs identified within the Study Area are shown in Figure 6.1 and include LCT 1 – Energy infrastructure and industrial, LCT 2 – Rural landscape and LCT 3 – Rural Living, as described in the following sections. Roads are assumed to take on the character of adjacent LCTs.

6.1.1 LCT 1: Energy and industrial infrastructure

The Project Land lies within LCT 1 which is dominated by energy infrastructure and industrial elements. These heavy industrial operations have extensively modified the landscape through earthworks and built structures as shown in Figure 6.2 to Figure 6.7.

The energy infrastructure originates from the Hazelwood Power Station to the west of the Project Land and the Morwell Power Station to the north. These were supported by the large Hazelwood open-cut coal mine. Both of the power stations, open-cut mine and the Morwell briquette factory are now closed, with the scale and extent of buildings and the open-cut mine remaining to be defining elements within the landscape.

The electrical infrastructure including substations, transmission towers and powerlines are frequent and clearly evident within the Study Area.

The industrial sites within the Study Area consist of waste tip sites (PineGro Green waste and Morwell Transfer Station), processing of local forestry, engineering firms and landscape supplies. These are typically large compounds with large sheds and processing areas.

Key characteristics:

- Extended views of tall transmission towers and frequent powerlines;
- Substations containing a fenced area of concentrated electrical conduits and small buildings/sheds;
- Large power station buildings with tall stacks, large sheds and equipment;
- Large heavy industrial factories i.e. Morwell briquette works (closed) and Omni Specialities fertilizer; and

Large compounds including numerous large sheds for manufacture, construction and processing.

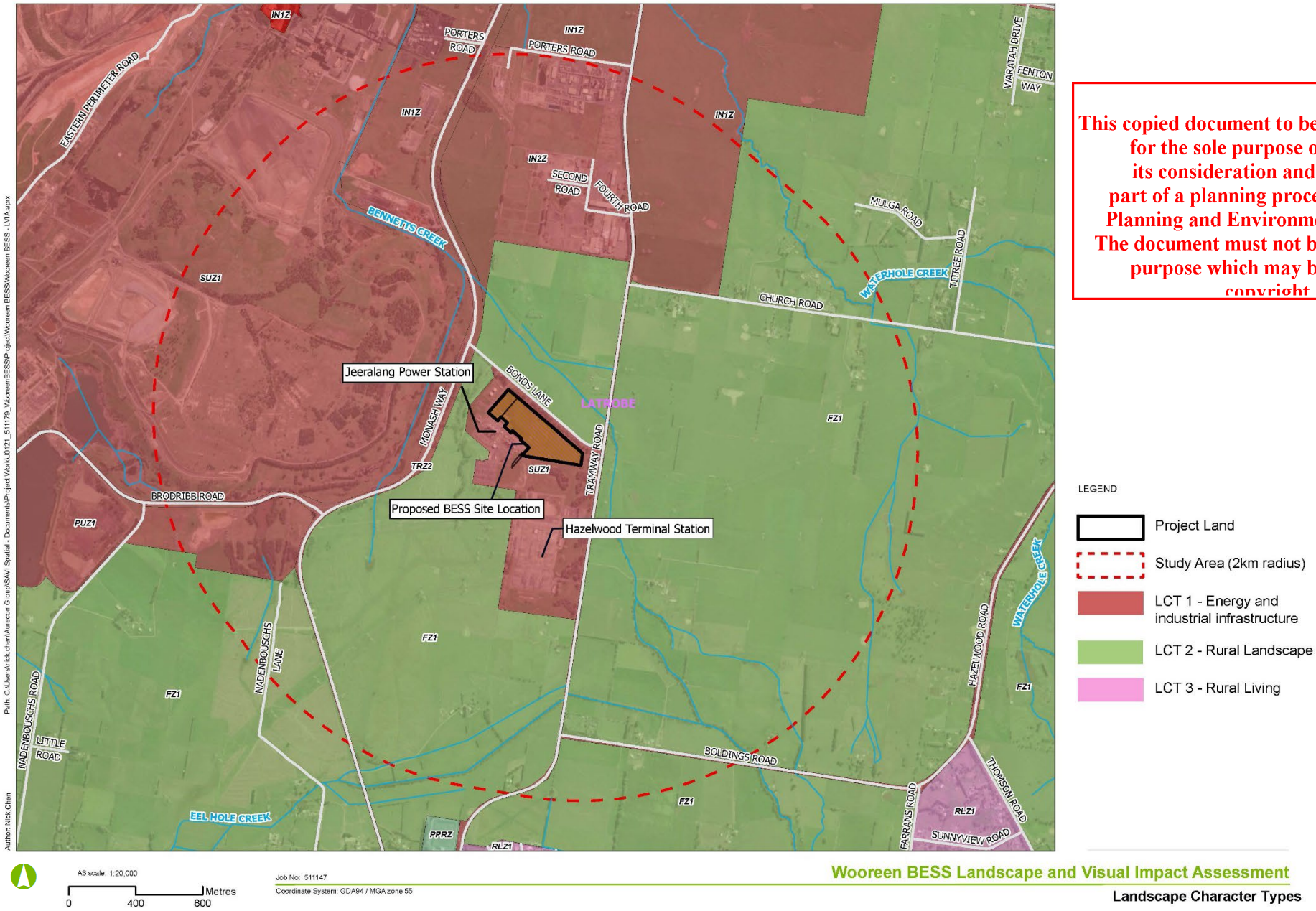


Figure 6.1 Landscape Character Types within Study Area

Figure 6.2 LCT 1: Morwell Terminal Station (MWTS)

Figure 6.3 LCT 1: Large transmission towers

Figure 6.4 Morwell Energy Brix Power Station

Figure 6.5 Omnia Specialties industrial site

Figure 6.6 Hazelwood open-cut mine
(image: Latrobe Valley Express, Dec-2017)

Figure 6.7 PineGro Green waste site

6.1.2 LCT 2: Rural landscape

LCT 2 is a rural landscape that surrounds the Study Area comprising an undulating topography and valley plains. There are large paddocks used for sheep and cattle grazing. Supporting farm infrastructure includes fencing, sheds and machinery (refer Figure 6.8). There are rural residential dwellings scattered throughout this landscape type.

To the west of the Project land is a small man-made hill. This is the Hazelwood mining overburden mound which has been shaped and planted (grasses and native trees) to blend in with the surrounding landscape.

The rural landscape is traversed by numerous waterways, including Bennetts Creek and Waterhole Creek to the north and Eel Hole Creek to the south of the Project Land. Bennetts Creek has been diverted around mining and power station operations, although the low flowing creek has been naturalised through ephemeral vegetation.

The rural landscape within the Study Area is influenced by powerlines and transmission towers which cross fields and hilltops.

Numerous arterial roads traverse the rural landscape including Monash Way, Tramway Road and Boldings Road which comprise of both LCT 1 and LCT 2.

Key characteristics:

- Scattered rural residential dwellings and ancillary farm buildings at low densities;
- Vegetation occurs throughout the area sporadically in agricultural paddocks, along riparian corridors and as windrows. Species are both native and exotic, with windrows mostly made up of dense planting of pine and macrocarpa species;
- The landscape often appears as a patchwork of different colours and textures, dependent upon the nature of the farming occurring within any given area and the time of year; and
- Small streams, creeks and wetlands traverse the landscape.

Figure 6.8 LCT 2: Rural landscape including hay-baling, stock fencing and large pastures

6.1.3 LCT 3: Rural living

LCT 3 is located approximately 2.8 km southeast of the Project Land and south of Hazelwood Road. This area, northeast of Churchill, forms the hilltop backdrop viewed from areas in the north-west. There are long distant views afforded across the lower valley of the rural landscape to the north from the road network occasionally disrupted by planted roadside corridor vegetation as seen in Figure 6.9 and Figure 6.10.

Rural residential dwellings are located within a rural environment on large blocks encircled within vegetation. The original landscape has been altered for farming and as such lack areas of remnant vegetation. Planted vegetation exists typically considered to be for the purpose of amenity and/or screening.

Key characteristics:

- Rising topography that forms a hilltop backdrop from the lower areas within the surrounding landscape;
- Rural residential dwellings and ancillary farm structures at low densities on land blocks no greater than two hectares;
- Altered landscape lacking remnant vegetation, with planted vegetation typically considered to be for the purpose of amenity and/or screening; and
- Road side vegetation typically lines the rural road network filtering long-distant views to the lower valley of the rural landscape.

Figure 6.9 LCT 3: House entry on Thomson Road looking northwest towards the Project Land (image: Google street view)

Figure 6.10 LCT 3: Hazelwood Road (image: Google street view)

6.2 Absorptive capability of the Landscape Character Type

The ability of the landscape types to absorb changes has been assessed and is outlined in Table 6.1.

Table 6.1 LCT absorptive capability

Landscape Type	Ability to absorb change	Comments
LCT 1: Energy and industrial infrastructure	High	This landscape has been heavily altered for farming and/or energy generation and lack any environmental or cultural values of significance. The scale and type of existing energy and industrial infrastructure has a large influence within the Study Area and provides a high capacity to absorb changes.
LCT 2: Rural landscape	Moderate	The rural landscape is modified by human activities. It contains farming infrastructure such as large sheds and farm fencing. This landscape typically sees high voltage powerlines traversing the undulating landscape and provides capacity to absorb further changes.
LCT 3: Rural Living	Very Low	Changes to views immediately adjacent to rural residential receptors are often more critically received. As such, it is assumed that the viewer is highly sensitive to changes in their immediate surroundings.

7 Visual Appraisal

7.1 Project Land appraisal

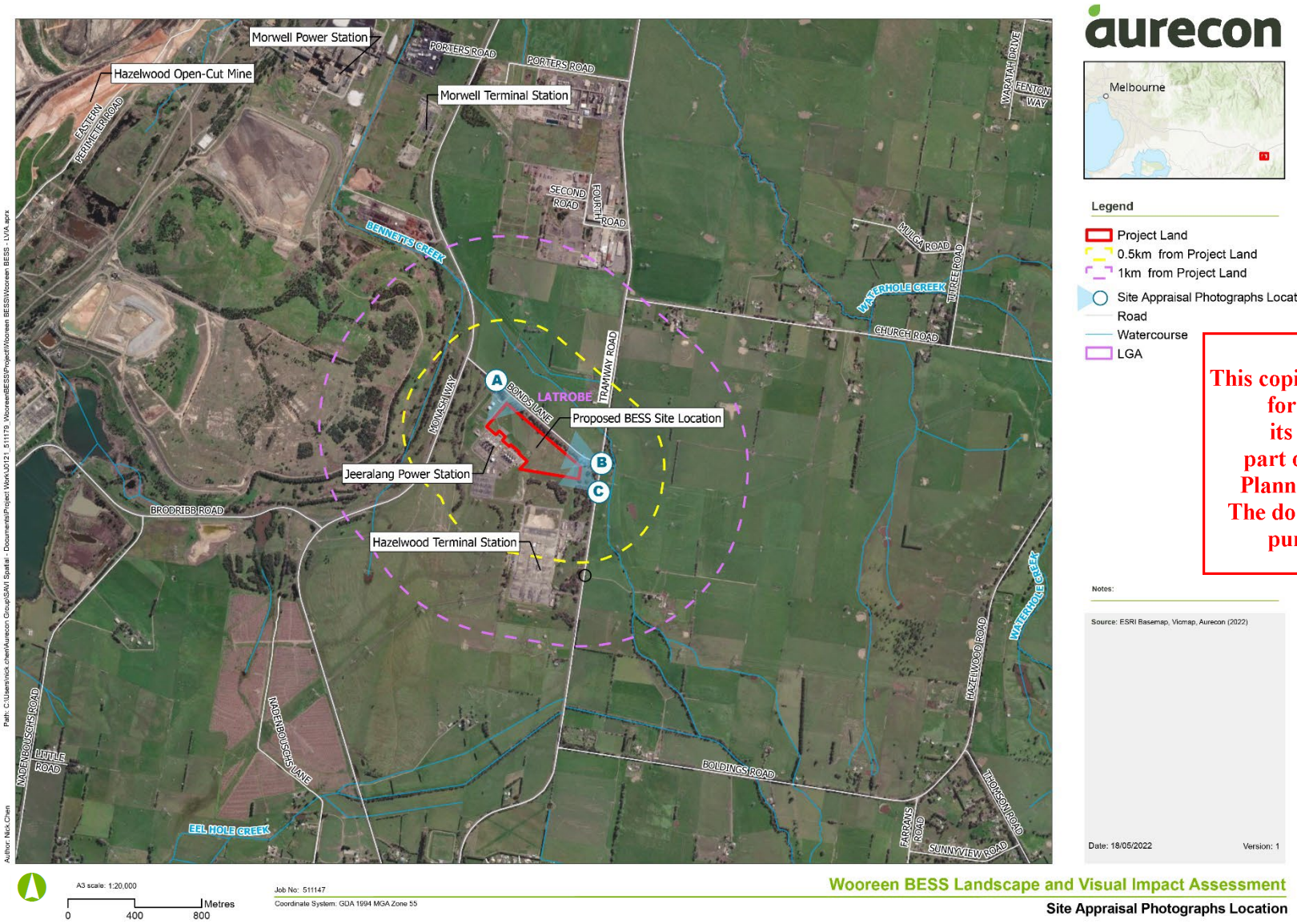
An appraisal of the landscape of the Project Land is set out below and is illustrated in Figure 7.3. The plan shows the existing vegetation, boundary features, buildings and roads on or in close proximity to the Project Land. A number of Site Appraisal Photographs (A to C inclusive) were taken and are shown on Figure 7.3 and are described below.

Site Appraisal Photograph A is taken from the north-western corner of the Project Land looking south-east (refer to Figure 7.1). Foreground views are of the planted vegetation corridor along the north-eastern boundary of the Project Land adjacent Bonds Lane and the entry infrastructure to the Jeeralang Power Station. In the right of the frame there are views of the vertical energy infrastructure of Jeeralang Power Station with its bulky mass inhibiting long distance views to the rural landscape beyond. In the left of the photograph, the high voltage towers are seen traversing the rural landscape. There are glimpses of the Project Land from this vantage point through the lower trunks of the trees. The rising hilltops of Hazelwood south and north are prominent in the background.

Figure 7.1 View from entrance to Jeeralang Power Station from Bonds Lane taken from the north-western corner of the Project Land looking south-east

Site Appraisal Photograph B is taken from the north-eastern corner of the Project Land looking west (refer to Figure 7.2) Foreground views are of the planted vegetation corridor along the north-eastern boundary of the Project Land which curtail views towards the bulk and mass of the Jeeralang Power Station from this vantage point. Glimpses of the Project Land are afforded in the left of the photograph. Due to the intervening vegetation and flat topography, there are no long-distance views to the rural landscape beyond.

Figure 7.2 View from Bonds Lane taken from the north-eastern corner of the Project Land looking west



aurecon

Legend

- Project Land
- 0.5km from Project Land
- 1km from Project Land
- Site Appraisal Photographs Locations
- Road
- Watercourse
- LGA

Notes:

Source: ESRI Basemap, Vicmap, Aurecon (2022)

Date: 18/05/2022 Version: 1

Wooreen BESS Landscape and Visual Impact Assessment

Site Appraisal Photographs Location

Figure 7.3 Project Land appraisal plan and Site Appraisal Photograph Locations

Site Appraisal Photograph C is taken from the eastern corner of the Project Land looking north-west (refer to Figure 7.4). Foreground views are of the groups of planted vegetation along the eastern boundary of the Project Land. In the centre of the photograph, there are views towards the Project Land. The bulk and mass of the Jeeralang Power Station is seen in the left of the frame inhibiting long distance views to the rural landscape beyond. The planted vegetation corridor along the north-eastern boundary of the Project Land is observed in the right of the photograph. The Hazelwood overburden mound forms the backdrop to views experienced from this vantage point.

Figure 7.4 View from Tramway Road taken from the eastern corner of the Project Land looking north-west

Based on the landscape appraisal of the Project Land it is evident that the low-lying topography combined with the perimeter planting along the north-eastern and eastern boundaries provide enclosure and containment to the Project Land. Beyond the boundaries of the Project Land, the Jeeralang Power Station to the south-west and planting groups to the north of the Hazelwood Terminal Station also control any views afforded to the Project Land from the rural landscape. The Hazelwood overburden mound forms the backdrop to views experienced from the east looking westward.

7.2 Project Land contextual visual appraisal

A series of Site Context Photographs have been undertaken from the area surrounding the Project Land to determine the approximate visual envelope of the Project Land based on consideration of factors such as topography, existing vegetation and built form. The locations of these Site Context Photographs are illustrated in Figure 7.6 and are described as **Site Context Photographs 1-5** below.

Site Context Photograph 1 as illustrated in Figure 7.5 is taken from Monash Way looking north-east towards the Project Land. The planted vegetation along the western boundary of Jeeralang Power Station filter views to the lower components of the energy infrastructure. The vertical components and high voltage powerlines are evident above the tree canopies and dominate the skyline. Any views afforded towards the Project Land would be inhibited and absorbed by the existing vegetation and energy infrastructure.

Figure 7.5 View from Monash Way looking north-east towards the Project Land (distance from Project Land approx. 1km)

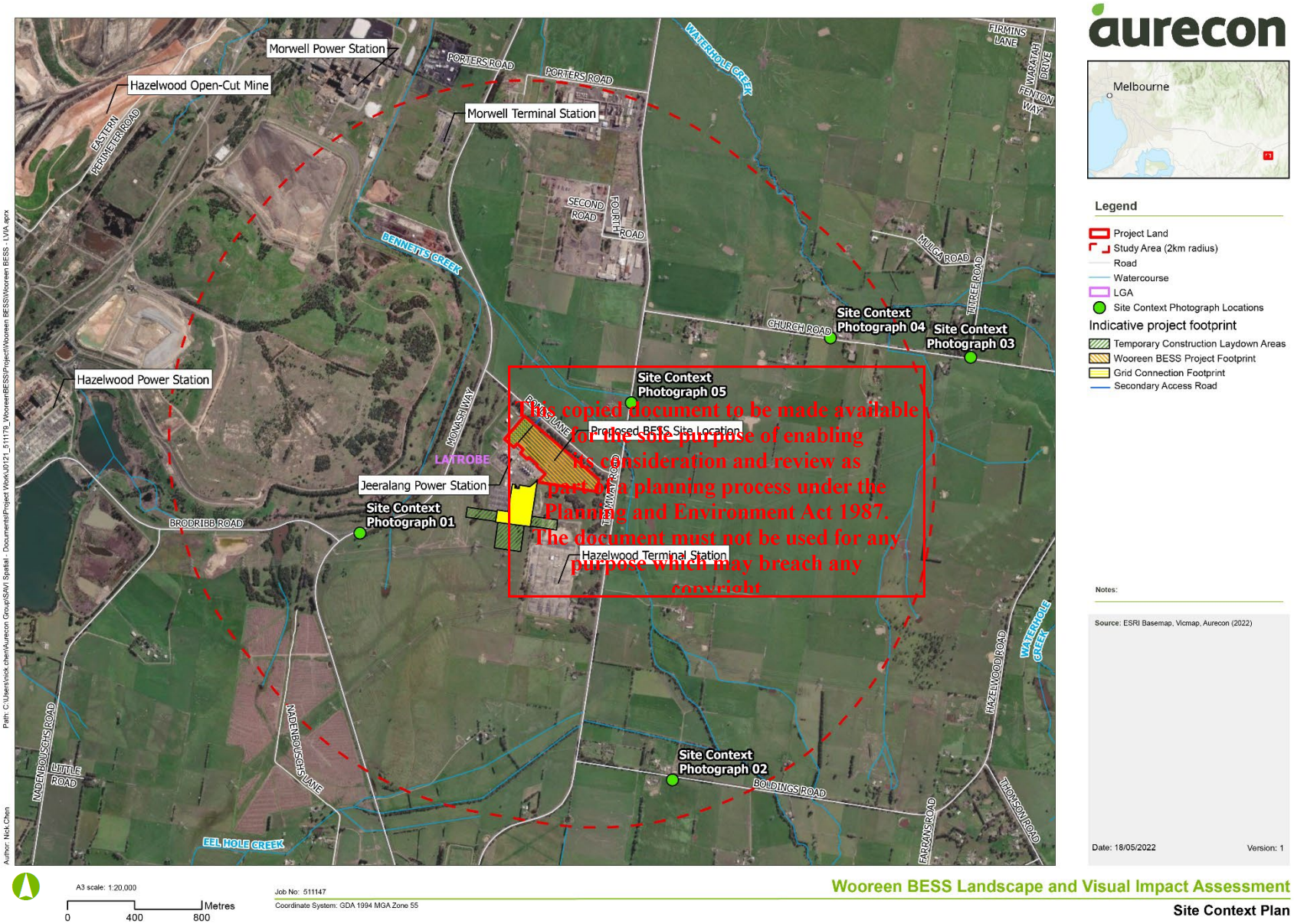


Figure 7.6 Project Land context plan and Site Context Photograph Locations

As illustrated in Figure 7.7 **Site Context Photograph 2** the existing intervening vegetation inhibit views towards the Project Land. In the middle of the photograph there are distant view towards the high voltage powerlines that traverse the landscape north-south to the east of Tramway Road.

Figure 7.7 View from Hazelwood Road looking north-west towards the Project Land (distance from Project Land approx. 1.7km)

To the north-east of the Project Land the topography descends into the small valley of Waterhole Creek preventing any long-distance views south-westwards. This is illustrated in **Site Context Photograph 3** (refer to Figure 7.8). The distance and intervening vegetation also prevent any views towards the Project Land from this vantage point.

Figure 7.8 View from Tree Road looking south-west towards the Project Land (distance from Project Land over 2km)

To the south-west, the undulating topography, distance and intervening vegetation curtail any visibility towards the Project Land. This is illustrated in reference to **Site Context Photograph 4** in Figure 7.9.

Figure 7.9 View looking south-west from Hazelwood Primary School towards the Project Land (distance from Project Land approx. 1.6km)

As illustrated with reference to **Site Context Photograph 5**, Figure 7.10, which is taken from Tramway Road looking south-west, there are glimpses towards the Project Land through the intervening vegetation along Bonds Lane.

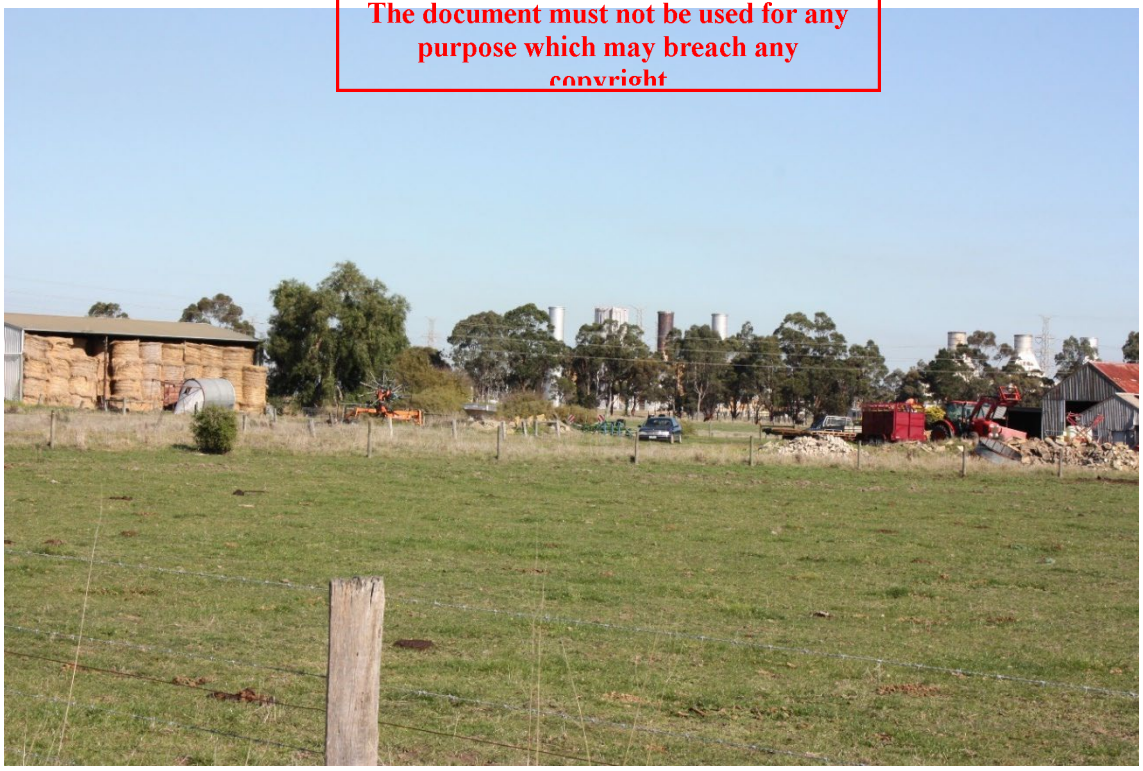


Figure 7.10 View looking south-west from Tramway Road towards the Project Land (distance from Project Land approx. 0.5km)

In summary, the relatively flat topography of the Project Land combined with localised undulating topography formed by the creek lines and intervening vegetation across the landscape, control any middle to

background views afforded towards the Project Land. Furthermore, energy and industrial infrastructure punctuate the skyline which either limit or truncate views towards the Project Land. As such, the visibility zone is limited to foreground views from within 5oo metres of the Project Land.

7.3 Visibility of the WESS

The following section outlines the impact assessment on the visual components at operation of the WESS and the residual impacts that remain following the implementation of mitigation measures.

7.3.1 Detailed assessment of representative viewpoints

A total of five representative viewpoints were identified for the WESS based on the design, viewing distance and aspect. The locations of the assessed viewpoints are shown in Figure 7.11.

There were no viewpoints within the Study Area that are designated or assessed as significant viewpoints.

The details on the individual viewpoints including photographs of existing conditions can be found in the subsequent section.

Figure 7.11 Viewpoint assessment locations

VIEWPOINT 01

Viewing location	From the residential driveway off Church Road, looking southwest towards the WESS. Refer to Figure 7.12		
Existing setting	Church Road is a sealed road providing access to Hazelwood North Primary School and residents in the area and connects directly to Tramway Rd. This view is representative of the residential dwellings within farmland. There are foreground views across agricultural land that has gently rising topography punctuated with energy infrastructure including powerlines and transmission towers. The gas turbines of the Jeeralang Power Station dominate the skyline. Large paddocks, used for crops and grazing contain farm infrastructure such as post and wire fencing, sheds and machinery. There are scattered groups of vegetation located along the local streets. Rural residential dwellings are disbursed across the landscape typically encircled within vegetation.		
Viewing context	Duration of view static (fixed view)	Viewing angle: perpendicular	
Visual Sensitivity Level	**LOW**		
Viewer sensitivity		**Landscape sensitivity**	
Land use	Residential	Landscape Type	LCT 2 Rural landscape
Viewing distance (m)	Middleground (approx. 1.15 km from closest project component)		
Viewer sensitivity level	**Moderate**	Absorptive ability	**Moderate**
Visual Modification Level	**NEGLIGIBLE**		
Viewpoint discussion	The upper section of the four proposed 220kV connection towers up to approximately 30m tall, are expected to be visible from this viewpoint above existing trees, however they are unlikely to be discernible from the Jeeralang Power Station and Hazelwood Terminal Station existing energy and electrical infrastructure. Visibility is likely to be negligible due to distance, intervening vegetation across the rural landscape and the planted vegetation corridor along the north-eastern boundary of the Project Land adjacent Bonds Lane.		
Operational Visual Impact	**NEGLIGIBLE** The negligible visual modification and low visual sensitivity, results in a negligible visual impact at operation for the resident on Church Road.		
Residual Visual Impact	**NEGLIGIBLE** No mitigation is proposed, and visual impacts remain negligible.		

Figure 7.12 Viewpoint 01: Existing view from Church Road, looking southwest towards the WESS (yellow line indicative of the WESS location)

VIEWPOINT 02

Viewing location	From the residential driveway off Tramway Road, looking northwest towards the WESS. Refer to Figure 7.13		
Existing setting	Tramway Road is a sealed road providing north-south access between Morwell and Churchill. This view is representative of the residential dwellings within farmland. There are foreground views across agricultural land that has gently rising topography punctuated with energy infrastructure including high voltage transmission towers. Large paddocks, used for crops and grazing contain farm infrastructure such as post and wire fencing, sheds and machinery. Rural residential dwellings are disbursed across the landscape typically encircled within vegetation. The wire mesh fencing of the Hazelwood Terminal Station is a dominate urban element within the landscape which affords glimpses of the energy infrastructure behind. There are scattered groups of vegetation located along the eastern boundary of Hazelwood Terminal Station which front Tramway Road.		
Viewing context	Duration of view static (fixed view)	Viewing angle: perpendicular	
Visual Sensitivity Level	**MODERATE**		
Viewer sensitivity		**Landscape sensitivity**	
Land use	Residential	Landscape Type	LCT 2 Rural landscape
Viewing distance (m)	Middleground (approx. 600 metres from closest project component)		
Viewer sensitivity level	**High**	Absorptive ability	**Moderate**
Visual Modification Level	**NEGLIGIBLE**		
Viewpoint discussion	The upper section of the four proposed 220kV connection towers up to approximately 30m tall, are expected to be visible from this viewpoint above existing trees, however they are unlikely to be discernible from the Hazelwood Terminal Station existing energy and electrical infrastructure. Visibility is likely to be negligible due to the angle, low-lying topography and intervening vegetation across the rural landscape including the planted vegetation groups along the eastern and northern boundaries of the Hazelwood Terminal Station.		
Operational Visual Impact	**NEGLIGIBLE** The negligible visual modification and low visual sensitivity, results in a negligible visual impact at operation for the resident on Tramway Road.		
Residual Visual Impact	**NEGLIGIBLE** No mitigation is proposed, and visual impacts remain negligible.		

Figure 7.13 Viewpoint 02: Existing view from Tramway Road, looking north-west towards the WESS (yellow line indicative of the WESS location)

VIEWPOINT 03

Viewing location	From the corner of Boldings and Hazelwood roads, looking northwest towards the WESS. Refer to Figure 7.14.		
Existing setting	Boldings and Hazelwood roads are sealed providing north-east/south-west connections between Traralgon and Churchill. This view is representative of an arterial road. From this elevated vantage point, there are wide, open views of farmland comprising of open grassed paddocks with farm infrastructure such as post and wire fencing, sheds and machinery. The gas turbines associated with Jeeralang Power Station and energy infrastructure of the Hazelwood Terminal Station are seen on the valley floor above the intervening vegetation. High voltage transmissions towers and overhead powerlines are seen traversing the undulating landscape. Windrows of native and exotic canopy trees are located along paddock boundaries and there are scattered groups of vegetation within the rural fields. Rural residential dwellings are disbursed across the landscape typically encircled within vegetation. The rising land affords distant views to the ranges of Moondarra State Park.		
Viewing context	Duration of view dynamic (moving view)	Viewing angle: perpendicular	

Visual Sensitivity Level	**VERY LOW**		
Viewer sensitivity		**Landscape sensitivity**	
Land use	Collector Road	Landscape Type	LCT 2 Rural landscape
Viewing distance (m)	Background (approx. 2700 metres from closest project component)		
Viewer sensitivity level	**Very low**	Absorptive ability	**Moderate**
Visual Modification Level	**NEGLIGIBLE**		
Viewpoint discussion	As demonstrated by Figure 7.14, the WESS would not be discernible from this viewpoint due to distance to the project proposed components and the intervening vegetation traversing the rural landscape. As such, there would be no resulting visual impact for the users of Boldings and Hazelwood roads.		
Operational Visual Impact	**NEGLIGIBLE** The negligible visual modification and very low visual sensitivity, results in a negligible visual impact at operation for the users of Boldings and Hazelwood roads.		
Residual Visual Impact	**NEGLIGIBLE** No mitigation is proposed, and visual impacts remain negligible.		

Figure 7.14 Viewpoint 03: From corner of Boldings and Hazelwood roads, looking northwest towards the WESS (yellow line indicative of the WESS location)

VIEWPOINT 04

Viewing location	From Hazelwood North Reserve, looking south-west towards the WESS. Refer to Figure 7.15.
Existing setting	This view is experienced by users of Hazelwood North Reserve and Hazelwood North Primary School, and representative of residential views fronting Church Road. Farmland is zoned either side of the road. There are foreground views across agricultural land that has gently rising topography traversed with amenity vegetation and windrows. Rural residential dwellings are disbursed across the landscape typically encircled within vegetation. There are distant views of the distinctive gas turbines associated with Jeeralang Power Station and energy infrastructure of the Hazelwood Terminal Station. There are long distant corridor glimpses amongst the intervening vegetation and undulating topography towards the rising ranges of Delburn.
Viewing context	Duration of view static (fixed view) — Viewing angle: perpendicular

Visual Sensitivity Level	**LOW**		
Viewer sensitivity		**Landscape sensitivity**	
Land use	Parks and reserve	Landscape Type	LCT 2 Rural landscape
Viewing distance (m)	Middleground (approx. 1.6 km from closest project component)		
Viewer sensitivity level	**Moderate**	Absorptive ability	**Moderate**

Visual Modification Level	**NEGLIGIBLE**
Viewpoint discussion	The upper section of the four proposed 220kV connection towers up to approximately 30m tall, are expected to be visible from this viewpoint, however they are unlikely to be discernible from the Jeeralang Power Station and Hazelwood Terminal Station existing energy and electrical infrastructure. Visibility is likely to be negligible due to the distance, viewing angle and low-lying topography.
Operational Visual Impact	**NEGLIGIBLE** The negligible visual modification and low visual sensitivity, results in a negligible visual impact at operation for the users of Hazelwood North Reserve.
Residual Visual Impact	**NEGLIGIBLE** No mitigation is proposed, and visual impacts remain negligible.

Figure 7.15 Viewpoint 04: Existing view from Hazelwood North Reserve, looking southwest towards the WESS (yellow line indicative of the WESS location)

VIEWPOINT 05

Viewing location	From Monash Way, looking southeast towards the Project and the Jeeralang Power Station. Refer to Figure 7.16.
Existing setting	Monash Way connects Morwell (north) to the townships of Churchill (south) and further connecting to the Strzelecki Highway. To either side of the road, the land is zoned industrial (IN1Z) at this viewpoint location. There are foreground views across agricultural land that is generally low-lying topography and traversed with amenity vegetation and windrows. Rural residential dwellings are disbursed across the landscape typically encircled within vegetation. High voltage transmissions towers and overhead powerlines are seen traversing the rural landscape. There are middleground views of the Jeeralang Power Station filtered by the planted vegetation corridor along the north-eastern boundary of the Project Land adjacent Bonds Lane. The rising hilltops of Hazelwood south and north are prominent in the background.
Viewing context	Duration of view: dynamic (moving view) Viewing angle: perpendicular

Visual Sensitivity Level	**VERY LOW**		
Viewer sensitivity		**Landscape sensitivity**	
Land use	Collector road	Landscape Type	LCT 1 Energy and industrial infrastructure
Viewing distance (m)	Middleground (approx. 1.6 km from closest project component)		
Viewer sensitivity level	**Low**	Absorptive ability	**High**
Visual Modification Level	**VERY LOW**		

Viewpoint discussion

The proposed 6m high noise wall for approximately 400m along Bonds Lane is expected to be visible from this viewpoint, located in front of the existing Jeeralang Power Station. It is noted that the planted vegetation corridor along the north-eastern boundary of the Project Land adjacent Bonds Lane would filter the bulk of the noise wall. Furthermore, the gas turbines of the Jeeralang Power Station are strong vertical elements within the landscape setting.

The four proposed 220kV connection towers up to approximately 30m tall, are likely to be visible however there are already many powerlines and transmission towers within the surrounding landscape setting and would be commensurate with the existing visual conditions.

Overall, there would be a minimal visual change due to the compositional contrast in form and shape values between the proposed noise wall fronting Bonds Lane and the verticality and pattern typically experienced in the landscape from the energy infrastructure. It is acknowledged that the view is transient and would be experienced for a short duration, resulting in a minor deterioration to the view for road users.

Operational Visual Impact **VERY LOW**

The very low level of visual sensitivity combined with the very low degree of modification, would result in a very low adverse visual impact at operation for Monash Way road users.

Residual Visual Impact **VERY LOW**

No mitigation is proposed, and visual impacts remain very low adverse visual impact for Monash Way road users.

Figure 7.16 Viewpoint 05: Existing view from Monash Way, opposite Morwell Terminal Station (yellow line indicative of the WESS location)

7.3.2 Summary of detailed assessment findings

The following section provides a summary of the detailed assessment of representative viewpoint findings at operation and the resulting residual impacts.

Table 7.1 Summary of visual impacts

Viewpoint no.	Description	Operational impacts	Residual impacts
Viewpoint 01 (VP1)	From residential driveway off Church Road, approximately. 1.15km northeast of the WESS. Viewpoint is representative of residential dwellings within farmland.	Negligible	Negligible
Viewpoint 02 (VP2)	From residential driveway off Tramway Rd approximately 600m southeast of the WESS. Viewpoint is representative of residential dwellings within farmland.	Negligible	Negligible
Viewpoint 03 (VP3)	From Boldings and Hazelwood roads, approximately 2.7km southeast of the WESS.	Negligible	Negligible
Viewpoint 04 (VP4)	From Hazelwood North Reserve, approximately 1.6km northeast from the WESS.	Negligible	Negligible
Viewpoint 05 (VP5)	From Monash Way, approximately 1.6km northwest from the WESS.	Very Low	Very Low

7.4 Photosimulations

Photosimulations were selected based on the findings from the visual assessment which comprised of an appraisal of the landscape of the Project Land, assessment from the area surrounding the Project Land to determine to determine the approximate visual envelope of the Project Land and the detailed viewpoint assessment.

Two photosimulations were prepared from photographs of the existing conditions. These were selected based on the visual appraisal which demonstrated that views from sensitive locations such as the nearby rural residents would be minimal due to intervening structures, vegetation and/or distance from the viewpoint. Furthermore, viewpoints that are either representative from other sensitive receptors such as open space reserves or educational facilities also illustrate that the WESS is not prominent in the surrounding landscape. As such, it was determined that views towards the WESS would be experienced from the surrounding road network within 500m of the Project Land.

As illustrated in Figures 7.17 to Figure 7.18 the proposed 6m high noise wall facing Bonds Lane located in front of the existing Jeeralang Power Station is expected to be partially visible from Bonds Lane. It is noted that the planted vegetation corridor along the north-eastern boundary of the Project Land adjacent Bonds Lane would filter the bulk of the noise walls. Furthermore, the gas turbines of the Jeeralang Power Station are strong vertical elements within the landscape setting.

The four proposed 220kV connection towers up to approximately 30m tall, are likely to be visible however there are already many powerlines and transmission towers within the surrounding landscape setting and would be commensurate with the existing visual conditions

Overall, there would be a minimal visual change from Bonds Lane due to the compositional contrast in form and shape values between the proposed noise wall and the verticality and pattern typically experienced in the landscape from the energy infrastructure. Furthermore, the existing planted vegetation corridors in the immediate areas surrounding the Project Land assist in filtering views to the WESS.

Figure 7.19 Existing view from entrance to Jeeralang Power Station from Bonds Lane taken from the north-western corner of the Project Land looking south-east

Figure 7.20 Indicative WESS view from entrance to Jeeralang Power Station from Bonds Lane taken from the north-western corner of the Project Land looking south-east – 6m high noise wall fronting Bonds Lane

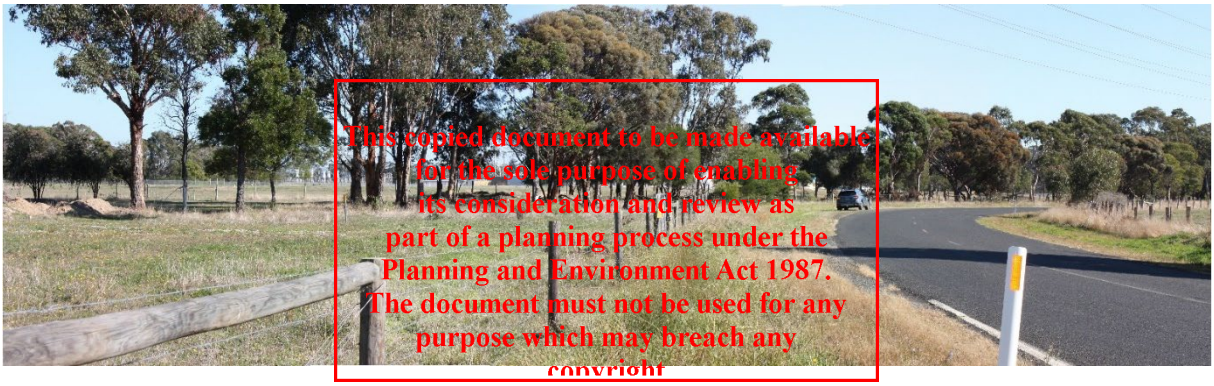


Figure 7.21 Existing view from Bonds Lane taken from the north-eastern corner of the Project Land looking west

Figure 7.22 Indicative WESS view from Bonds Lane taken from the north-eastern corner of the Project Land looking west – 6m high noise wall fronting Bonds Lane

7.5 Lighting impacts

The sensitivity of the local landscape to the introduction of more lighting has been considered. Sensitivity depends on visibility, remoteness and scenic quality with the degree of enclosure afforded by the key factors, landform and vegetation, along with patterns of land use and settlements. One environmental lighting zone has been identified within the visual catchment of the Study Area - Environmental Zone E2 Rural: Low

district brightness area. This zone is typically representative of sparsely inhabited rural areas, village or relatively dark outer suburban locations.

The main potential receptors of light include the rural residential properties, roads and industrial areas in the vicinity of the WESS which are currently affected by existing light sources. Existing sources of light adjoining or in the immediate area surrounding the WESS include:

- Jeeralang Power Station;
- Hazelwood Terminal Station;
- Two collectors roads Monash Way and Tramway Road; and
- Two rural residential properties – one south-east off Tramway Road and one north-east off Church Road.

Lighting from the WESS including the entry and access circulation to buildings such as control and switch rooms has the potential to result in a negative change to the night-time setting of nearby rural residents, albeit at a very low level.

The proposed new lighting treatments would not result in a significant negative impact to the setting due to the presence of existing lighting from the surrounding energy infrastructure.

Overall, the Project Land already experiences lighting impacts from the road corridor and adjoining lighting sources such as energy infrastructure, street lighting and general sky glow from the urban area of Morwell in the north-west. Consequently, the operational lighting impacts for the WESS is not expected to generate significant levels of lighting above that is currently experienced within the rural landscape. Therefore, the lighting impacts for the WESS are low. Accordingly, the lighting assessment demonstrates that the Project Land is not sensitive to the introduction of new lighting.

8 Mitigation

The purpose of mitigation is to avoid, reduce or where possible remedy or offset any significant adverse effects on the environment arising from the proposed development. Measures to reduce potential visual impacts as a result of the WESS during construction and operation.

8.1 Construction phase mitigation

At the time of this report, construction elements have not been designed, therefore the below is a high-level approach based on construction access and construction compounds.

8.1.1 Built form

- Ancillary facilities are to be developed with consideration to visual impacts.
- Prioritise storage areas and associated works are to be located in cleared or otherwise disturbed areas away from the Monash Way interface.
- Where feasible and reasonable, the elements within construction sites would be located to minimise visual impact, for example materials and machinery would not be visible above temporary screens.
- Site lighting is to be designed to minimise glare issues and light spillage into adjacent areas and generally consistent with the requirements of Australian Standard 4282-1997 Control of the obtrusive effects of outdoor lighting.
- Fencing quality should be commensurate with existing transparent security fencing surrounding the MWTS.

8.1.2 Vegetation and landscape

- Existing trees adjacent to the works will be retained and protected where possible to screen construction support sites, minimising clearing where possible.
- Where possible, trees will be trimmed rather than removed.
- Where practical, areas disturbed by construction and not required for operation of the project are to be restored to existing condition.

8.2 Operational phase mitigation

The principal consideration in mitigating potential landscape and visual impacts by the WESS is through site selection. The proposed site was selected as providing the most suitable location for WESS given its rural locality, separation from residential localities and proximity to the existing Jeeralang Power Station and Hazelwood Terminal Station. It is also noteworthy that the Project Land is in close proximity to other significant energy and industrial infrastructure including the Morwell Energy Brix Power Station, Hazelwood Power Station and the Omnia Specialities site.

8.2.1 Built form

At the time of this report, the built elements have not been designed, therefore the below is a high-level approach to designing the built form.

- Architectural materials - cladding, materials and colour used to mitigate appearance of bulky structures. Appropriate design or neutral colours to be adopted for structures visible beneath the horizon, to blend with existing background vegetation.

- Inspection and maintenance of security lighting direction to ensure it is directed to the worksite and away from neighbouring land uses.
- If signage is required, it should be placed in an appropriate location. Where possible, group any new signage with existing signage to limit visual clutter.

9 Conclusion

The Proponent is proposing to install a Battery Energy Storage System in Hazelwood North, to help maintain reliable and affordable energy supply for Victoria.

The Project Land is located approximately four kilometres southeast of the township of Morwell, in the Latrobe Valley area of Gippsland. The Project Land spans across two sites on Bonds Lane, Hazelwood North, adjacent to the existing Jeeralang Power Station

The Project Land lies predominantly within the Special Use Zone Schedule 1 - Brown Coal (SUZ1), with a small section within Farming Zone (FZ).

The Project Land gently rises south-easterly from approximately 80m AHD to 90m AHD. The landscape character type of the Project Land is LCT 1 – Energy and industrial infrastructure and is influenced by the adjacent energy infrastructure such as Jeeralang Power Station and Hazelwood Terminal Station. The character of the Project Land is further influenced to a considerable extent by the surrounding urban uses such as high voltage towers and the surrounding collector roads.

The Project Land has been heavily altered for farming and/or energy generation, and as such lacks extensive areas of native vegetation or significant ecological values. Extensive areas of planted vegetation exist adjacent the Project Land, all of which was considered to be for the purpose of amenity and/or screening

The area surrounding the Project Land has a variety of land uses including rural living, farming zones, industrial sites and land used for power generation. There are no designated views or sites of environmental significance within the Study Area up to two kilometres from the Project Land.

A search of the Victorian Aboriginal Heritage Register (VAHR) revealed that there are no Aboriginal places or areas of cultural heritage sensitivity within the Project Land.

There is one Victorian Heritage Register (VHR) listed heritage place, Morwell Power Station and Briquette Factory (H2377) situated approximately 1.8 km north-west of the Project Land and will not be impacted by the WESS.

There are a number of waterways and landforms within the Study Area that are highly modified as the result of diversions around and reclamation of the Morwell open-cut coal mine.

The landscape character type within the Study Area is comprised predominately of energy and industrial and rural farmland. There is a small pocket of rural living within the south-easterly section of the Study Area. Rural residential homesteads are dispersed across the rural landscape but are typically encircled by vegetation filtering or inhibiting views towards the WESS.

Based on the landscape appraisal of the Project Land it is evident that the low-lying topography combined with the perimeter planting along the north-eastern and eastern boundaries provide enclosure and containment to the Project Land. Beyond the boundaries of the Project Land, the Jeeralang Power Station to the south-west and planting groups to the north of the Hazelwood Terminal Station also control any views afforded to the Project Land from the rural landscape.

Based on the contextual visual appraisal, the relatively flat topography of the Project Land combined with localised undulating topography formed by the creek lines and intervening vegetation across the landscape, control any middle to background views afforded towards the Project Land from the surrounding area. Furthermore, energy and industrial infrastructure punctuate the skyline which either limit or truncate views towards the Project Land. As such, the visibility zone is limited to foreground views from within 5oo metres of the Project Land.

This is further reiterated from the detailed assessment of the WESS from five representative viewpoints (VP01 to VP05). This assessment concluded that the four proposed 220kV connection towers, are likely to be visible at least partially from all assessed viewpoints, however the visual modification is assessed as negligible. These proposed components do not intrude in regard to the size, scale and geographical extent to

the those within the Jeeralang Power Station which comprises of larger and bulkier structures than those proposed. Furthermore, electrical infrastructure including substations, transmission towers and powerlines are frequent and clearly evident within the Study Area.

The proposed 6m high noise wall facing Bonds Lane located in front of the existing Jeeralang Power Station is expected to be partially visible from Monash Way (VP05). It is noted that the planted vegetation corridor along the north-eastern boundary of the Project Land adjacent Bonds Lane would filter the bulk of the noise walls. Furthermore, the gas turbines of the Jeeralang Power Station are strong vertical elements within the landscape setting.

There has been no landscape mitigation design proposed for the indicative concept plan. It is recommended that the existing planted vegetation corridors and groups within the immediate areas surrounding the Project Land are retained to assist in minimising adverse visual impacts to the WESS when viewed from the surrounding landscape. This includes the following:

- North-eastern planted vegetation corridor adjacent Bonds Lane to soften and filter views from the collector roads Monash Way and Tramway Road (within EnergyAustralia land ownership);
- Eastern planted vegetation groups adjacent Tramway Road to soften and filter views fromTramway Road (within EnergyAustralia land ownership);
- Southern planted vegetation groups adjacent to the Project Land to soften and filter views fromTramway Road (within AusNet land ownership); and
- Western planted vegetation corridors and groups to soften and filter views from Monash Way (within Department of Treasury and Finance land ownership).

The operational lighting impacts for the WESS is not expected to generate significant levels of lighting above that is currently experienced within the rural landscape. Therefore, the lighting impacts for the WESS are low. Accordingly, the lighting assessment demonstrates that the Project Land is not sensitive to the introduction of new lighting.

Overall, there would be a minimal visual change from Monash Way, Bonds Lane and Tramway Road (within 500m of the Project Land). This is due to the compositional contrast in form and shape values between the proposed noise wall fronting Bonds Lane and the verticality and pattern typically experienced in the landscape from the energy infrastructure. Furthermore, the existing planted vegetation corridors in the immediate areas surrounding the Project Land either filter or inhibit views to the WESS. It is acknowledged that these views would be transient and experienced for a short duration, resulting in a minor deterioration to the view for the road users.

Appendix A

Visual Prominence Rationale

VISUAL PROMINENCE RATIONALE

The visual prominence of a development can be determined by understanding the extent to which an object is part of a viewer's static field of view.

The measurement of the field of view is based upon the parameters of human vision outlined below. These provide a basis for assessing and interpreting the visual prominence of a development by comparing the extent to which the development will intrude into the central field of vision (both horizontally and vertically).

These horizontal and vertical fields of view are also interlinked to the viewing distance from the development. The methodology is based on the reduction of the visibility of a development in the distance as the field of view reduces (i.e. the increase in distance between a given viewpoint and the development).

Horizontal line of sight

It is generally accepted that the central field of vision for the human eye covers a horizontal angle of approximately 50 degrees to 60 degrees. Within this angle, both eyes observe an object simultaneously creating a degree of overlap, which is the central field of view (refer to Figure A.1). Within the central field of vision, the viewed image is sharp, colours are separately defined and depth perception occurs.

The visual prominence of a development will vary according to the proportion a development occupies the central field of vision.

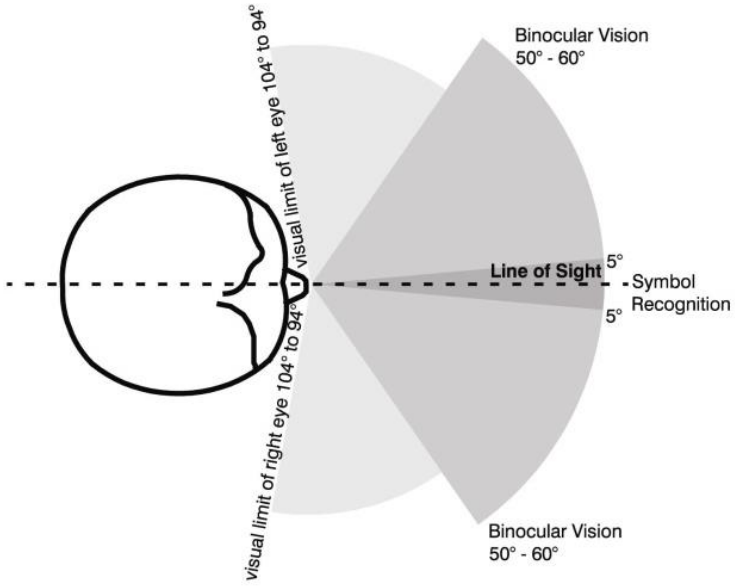


Figure A.1 Horizontal line of sight

Table A.1 outlines the potential visual prominence of a development, dependant upon on how much of the horizontal central field of vision that it occupies.

Degrees of Field of View occupied	Potential visual prominence – horizontal field of view
Less than 5º	**Insignificant - Low visual prominence** The development would not be highly visible in the view, unless it contrasts strongly with the background.
5º – 30º	**Potentially Noticeable – Moderate visual prominence** The development may be noticeable. The degree that it intrudes on the view would be dependent on how well it integrates with the landscape setting.
Greater than 30º	**Potentially Dominant - High visual prominence** The development would be highly noticeable.

Table A.1 Potential visual prominence based on degrees of horizontal field of view occupied

Vertical line of sight

As for the horizontal line of sight, there is also a vertical central field of view. If we assume that the horizon is 0º then the eye clearly defines colour, field of view and has image sharpness for an angle of approximately 25º upwards and 30º downwards. However, in reality, the typical line of sight for a standing person at ground level is approximately 10º below the horizon line (Refer to Figure A.2).

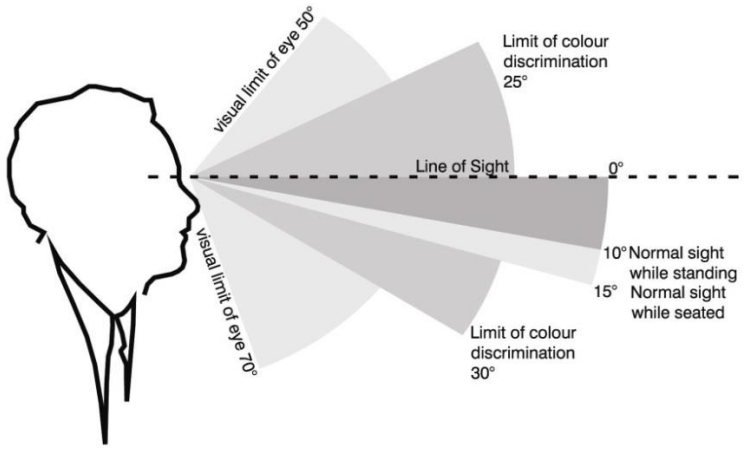


Figure A.2 Vertical line of sight

Objects that occupy a small proportion of the vertical field of view (less than 5^0) are visible but not dominant, particularly when they occur within landscapes that have been modified by human activity.

Table A.2 demonstrates the potential visual prominence of a development, dependant upon on how much of the vertical central field of vision that it occupies.

Degrees of Field of View occupied	Potential visual prominence – vertical field of view
Less than 0.5º	**Insignificant - Low visual prominence** A small thin line in the landscape and is no longer an easily recognisable element.
0.5º – 2.5º	**Potentially Noticeable - Moderate visual prominence** The development may be noticeable. The degree that it intrudes on the view would increase as distance reduces and be dependent on how well it integrates with the landscape setting.
Greater than 2.5º	**Potentially Dominant - High visual prominence** The development would be highly noticeable, although the degree of visual intrusion would depend on the landscape setting and the width / thickness of the object.

Table A.2 Potential visual prominence based on degrees of vertical field of view occupied

Visual prominence in relation to distance and field of view

These horizontal and vertical fields of view are also interlinked to the viewing distance from the development. The viewing distances, foreground, middleground and background, (refer to Table A.3) have been established based on previous field studies undertaken by Aurecon. The distances also relate to the distances for the land use types in the viewer sensitivity assessment methodology.

Distance from a viewer	Potential visual prominence
> 2.0km (background)	**Insignificant** The visibility of the development would progressively diminish over greater distances of 2km with no visibility beyond 5km due to atmospheric conditions.
Between 0.5km & 2.0km (middleground)	**Potentially Noticeable** The development would be noticeable, reducing with distance. The degree that it intrudes on the view would be dependent on topography and the vegetation within the landscape setting and how well it integrates with the surrounding land-uses.
< 0.5km (foreground)	**Potentially Dominant** The development would be highly noticeable, although the degree of visual intrusion would depend on the landscape setting (where not screened by vegetation or buildings) and the width / thickness of the object.

Table A.3 Potential visual prominence based on distance from a viewer

Figure A.3 illustratively demonstrates how the viewshed of a horizontal object is determined by its height and not so much by its width based on the viewing distance from a development. As a viewer moves further away from a horizontal object the width may still be apparent, however the vertical dimension reduces to insignificance.

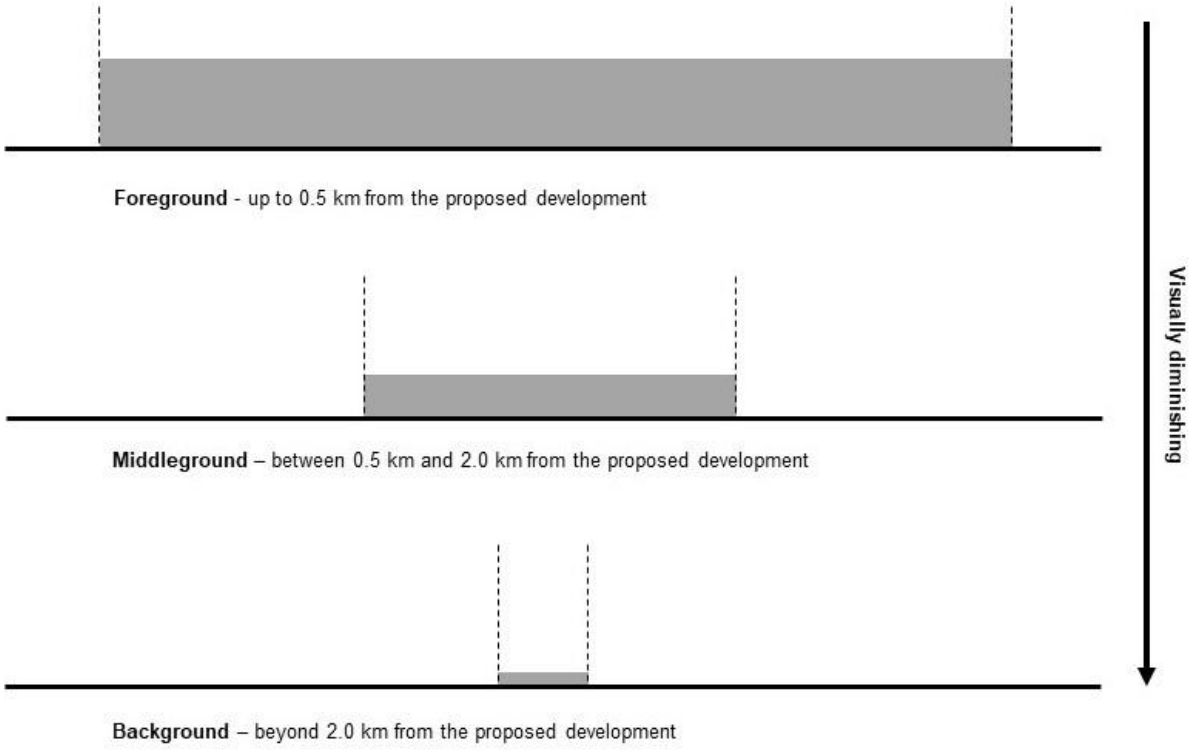


Figure A.3 The reduction in visibility of the horizontal line of sight based on increase in distance from a viewpoint

The same approach can be applied to the vertical field of view. As a viewer moves further away from a vertical object the height may still be apparent, however the vertical dimension reduces to insignificance (refer to Figure A.4).

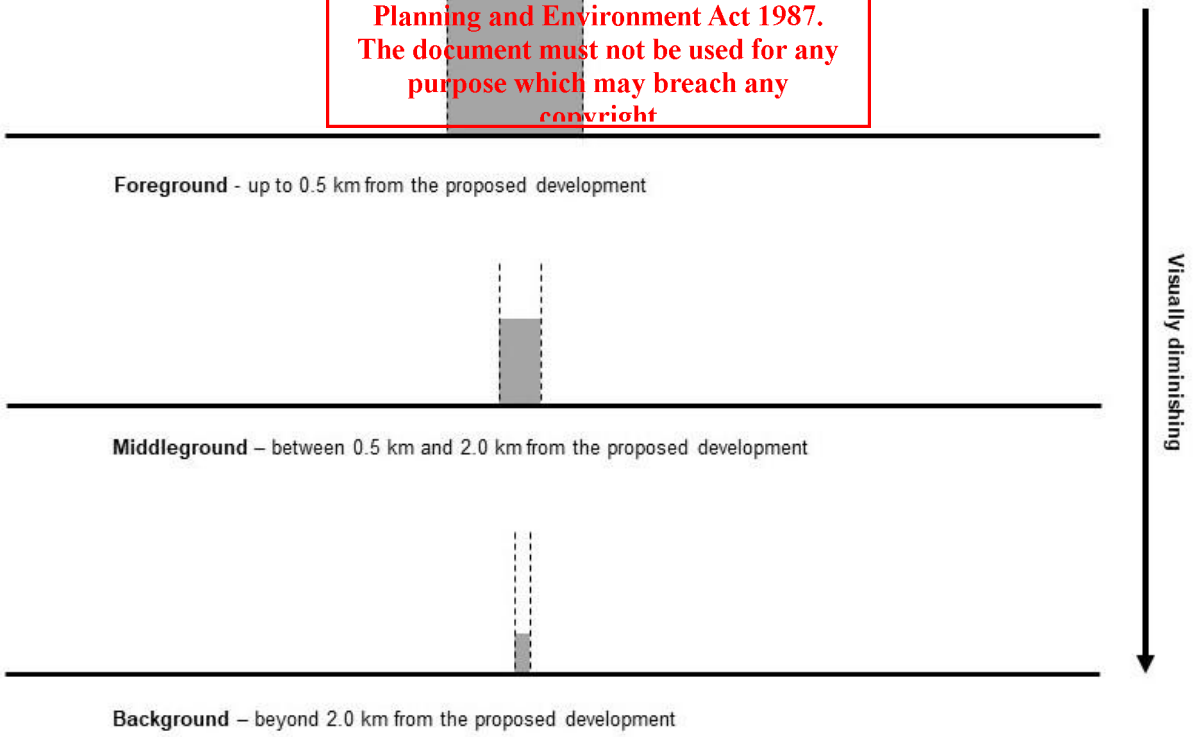


Figure A.4 The reduction in visibility of the vertical line of sight based on increase in distance from a viewpoint

Appendix B

Guidance Notes for the reduction of Obtrusive Light

Guidance Note 01/20

Guidance notes for the reduction of obtrusive light

ADVERTISED PLAN

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This guidance note has been revised to reflect the changes in international guidance regarding obtrusive light as detailed in CIE 150:2017 *Guide on the limitation of the effects of obtrusive light from outdoor lighting installations*.[1] It also considers industry comment regarding the assessment and definition of obtrusive lighting.

Good lighting practice is the provision of the right light, at the right time, in the right place, controlled by the right system.

Humanity's invention of artificial light and its application in the external environment has done much to safeguard and enhance our night-time environment but, if not properly controlled, *obtrusive light* (sometimes referred to as light pollution) can present serious physiological and ecological problems.

Obtrusive light – whether it keeps you awake through a bedroom window, impedes your view of the night sky or adversely affects the performance of an adjacent lighting installation – is a form of pollution, which may also be a nuisance in law and which can be substantially mitigated without detriment to the lighting requirements of the task.

Sky glow, the brightening of the night sky, *glare* the uncomfortable brightness of a light source when viewed against a darker background, *light spill* the spilling of light beyond the boundary of the area being lit and *light intrusion* ("nuisance")[2] are all forms of obtrusive light which may cause nuisance to others, or adversely affect fauna and flora as well as waste money and energy.

Considerations to be made

Think before you light. Is it necessary? What effect could it have on others? Has it the potential to cause a nuisance? How can you mitigate and manage any potential adverse effects from your lighting installation?

There are published standards and guidance for most lighting tasks, adherence to which will help mitigate obtrusive lighting aspects. Organisations from which full details of these standards can be obtained are given later in this Guidance Note.

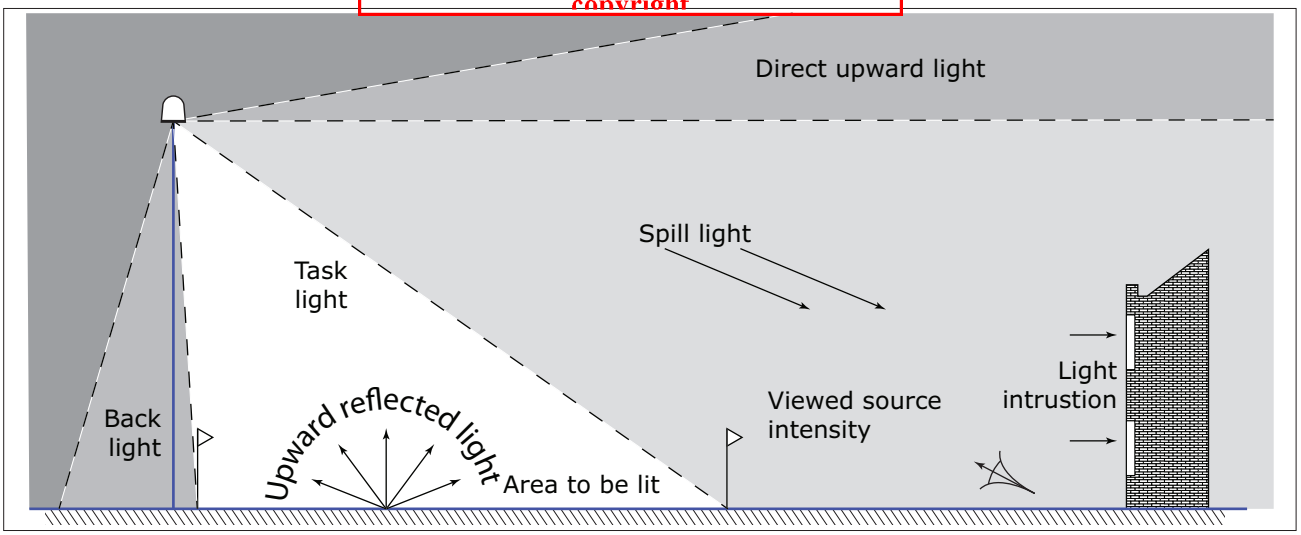


Figure 1: Types of intrusive light

1 The copyright of the data detailed within this guide belongs to CIE, email ciecb@cie.co.at
This document should be used in conjunction with CIE 150:2017 and CIE 126:1997 and not as a replacement for the procedures contained therein.
These documents can be obtained from https://www.techstreet.com/cie/pages/home and members of a National Committee of the CIE can purchase them with a discount of 66.7%.

2 The term light trespass is sometimes used, but trespass is to physically encroach on land and light can't do that, so the term nuisance should always be used.

For the purpose of this Guidance Note the following two Commission Internationale De L'Eclairage (CIE) documents are specifically referenced; they provide guidance to the mitigation of obtrusive light from exterior lighting installations:

- CIE 150:2017 Guide on the limitation of the effects of obtrusive light from outdoor lighting installations;
- CIE 126-1997 Guidelines for minimizing sky glow

When considering any lighting installation these two documents should be referenced.

Whilst this Guidance Note specifically considers the effects from external lighting installations, the considerations within it can be relevant when considering modern office blocks and shop fronts where the main external facing structure is transparent and light from within the buildings could become a source of illumination to the exterior environment.

"Good Design Equals Good Lighting"

It cannot be stressed sufficiently that employing a competent lighting designer with proven experience in the lighting application being considered will provide a suitable lighting installation where all obtrusive lighting aspects are mitigated[3].

Any lighting scheme consists of three basic elements: a light source, a luminaire (incorporating the optical control system) and a method of installation/mounting.

Light sources (lamps/LEDs)

Remember that the light source output in lumens is not the same as the wattage and that it is the former that is important in combating the problems of obtrusive light.

3 Competency can be determined through membership of a professional lighting body supported by the appropriate qualifications and experience in the application of lighting required.

Most night-time visual tasks are only dependent on light radiated within the visual spectrum. It is therefore not necessary for light sources to emit either ultra-violet or infra-red radiation unless specifically required to do so. The majority of light sources used in external lighting do not contain these wavelengths or where they are present their spectral power is very low.

Research indicates that light from the blue end of the spectrum could have important adverse effects on fauna and flora. The lighting designer should consider the blue light spectral power of the light source and try to balance the needs of the task to be lit with any impact on fauna and flora within the environment.

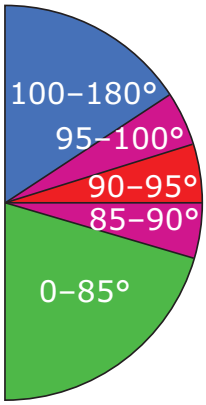
Luminaires

The choice of luminaire with the right optical distribution at the right mounting height is critical to minimising light spill and obtrusive light effects while providing the right lighting performance on the task area.

Sky glow is the general diffuse sheen that is visible in the direction of large cities, airports, and industrial complexes. It occurs from both natural and artificial light sources and does not depend exclusively on the lighting design. It also depends on the atmospheric conditions (humidity, aerosols, clouds, haze, atmospheric pollution, etc). Light propagating into the atmosphere either directly from upward directed or incompletely shielded sources, or after reflection from the ground or other surfaces, is partially scattered back towards observers on the ground; the impact being shown in Table 1.

It is therefore important to consider the luminaire, its light distribution, how it is installed, and how it is set up.

For most general sports and area lighting installations the use of luminaires with asymmetric optics designed so that the front glazing is kept at or near parallel to



Indicative diagram

Table 1: The effect on the ability to view the night sky at various angles

Angle of light emitted (degrees)	Sky glow effect	Glare effect
100 – 180	Local	Little
95 – 100	Significant	Some
90 – 95	High	High
85 – 90	Significant	High
0 – 85	Minimal	Some

the surface being lit should, if correctly aimed, ensure minimum obtrusive light.

Appendices 1 and 2 in this Guidance Note give more details of how to choose luminaires, and if necessary modify them through the use of louvres and shields.

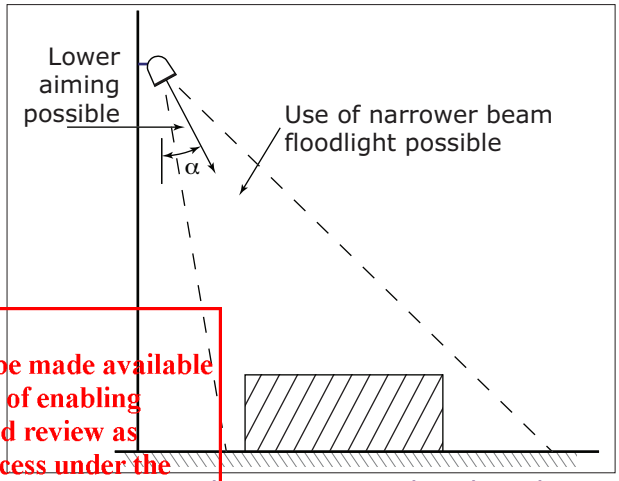


Figure 2a: Higher mounting height – less spill light and glare

Installation

In most cases it will be beneficial to use as high a mounting height as possible, giving due regard to the daytime appearance of the installation.

It should be noted that a lower mounting height is perhaps not better as can be seen from Figures 2a and 2b from CIE 150. A lower mounting height can create a higher level of light spill and require additional lighting points.

Keep glare to a minimum by ensuring that the main beam angle of all luminaires directed towards any potential observer is no greater than 70°. Higher mounting

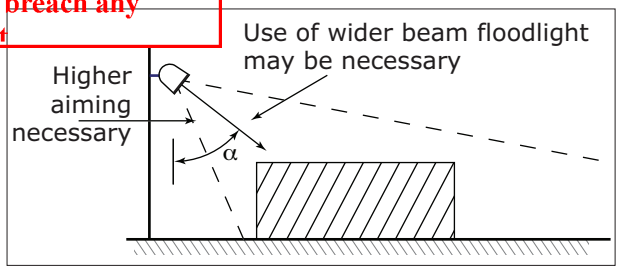


Figure 2b: Lower mounting height – more spill light and glare

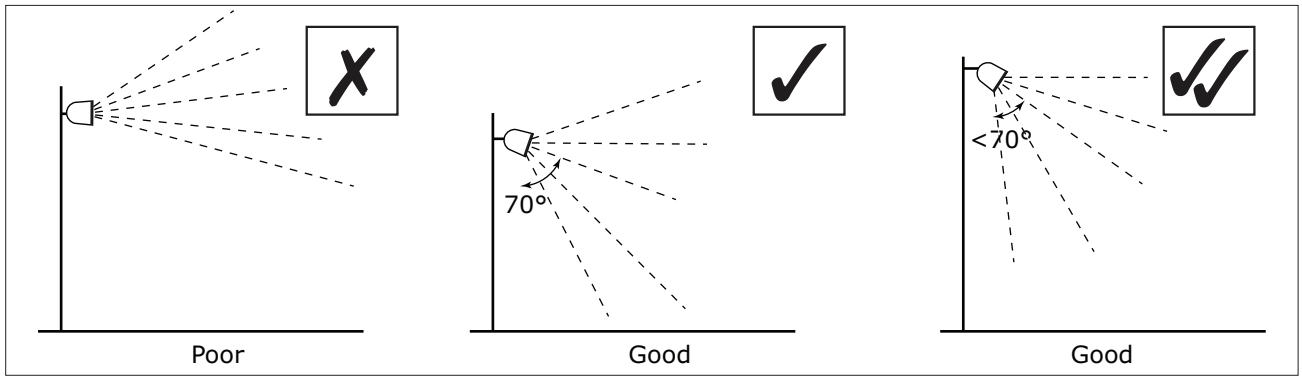


Figure 3 Luminaire aiming angles

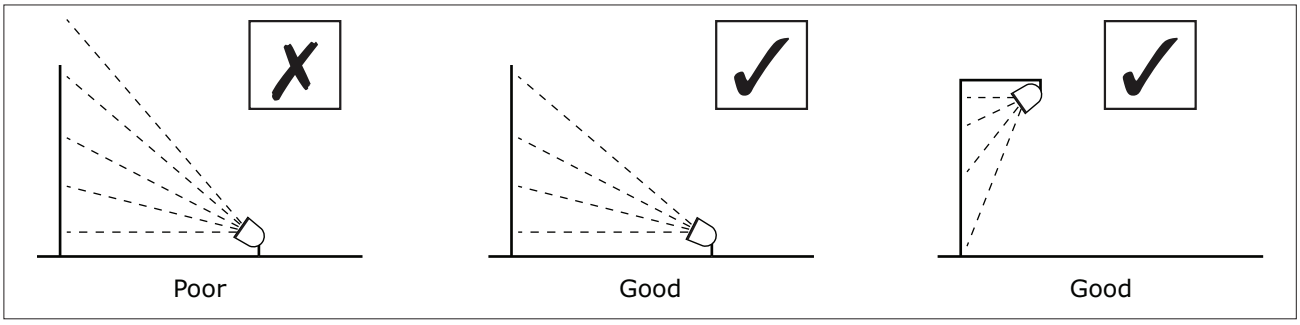


Figure 4 Façade illumination

heights allow lower main beam angles, which can assist in reducing glare.

In areas with low ambient light levels, glare can be very obtrusive, and extra care should be taken when positioning and aiming lighting equipment. With regard to domestic security lighting, the ILP produces an information leaflet GN09:2018 *Domestic exterior lighting: getting it right!* which is freely available from its website.

When lighting vertical structures such as advertising signs, direct light downwards wherever possible. If there is no alternative to up-lighting, as with much decorative lighting of buildings, then the use of luminaires with the correct optical distribution, coupled where required with shields, baffles and louvres, will help minimise spill light around and over the structure.

For road and amenity lighting installations, light near to and above the horizontal should normally be minimised to reduce glare and sky glow (Note the Upward Lighting Ratios (ULR's) advised in Tables 5 and 6). In rural areas the use of full horizontal cut off luminaires installed at 0° uplift will, in addition to reducing sky glow, help to minimise visual intrusion within the open landscape. However, in some urban locations, luminaires fitted with a more decorative bowl and good optical control of light should be acceptable and may be more appropriate.

Clean Neighbourhoods and Environment Act 2005 (CNEA)

The Clean Neighbourhoods and Environment Act 2005 (CNEA) gives local authorities and the Environment Agency additional powers to deal with a wide range of issues by classifying artificial light emitted from defined premises as a statutory nuisance.

The CNEA 2005 amended paragraph 79(1)(fb) of the Environmental Protection Act 1990 to extend the statutory nuisance regime to include light nuisance stating the following:

'artificial light emitted from premises so as to be prejudicial to health or a nuisance'.

Guidance produced on Sections 101 to 103 of the CNEA 2005 by DEFRA (DEFRA, April 2006) extends the duty on local authorities to ensure their areas are checked periodically for existing and potential sources of statutory nuisances including nuisances arising from artificial lighting. Local authorities must take reasonable steps to investigate complaints of such nuisances from artificial light. Once satisfied that a statutory nuisance exists or may occur or recur, local authorities must issue an abatement notice (in accordance with section 80(2) of the Environmental Protection Act 1990), requiring that the nuisance cease or be abated within a set timescale.

National Planning Policy Framework (NPPF)

The NPPF was introduced as a more concise and useable planning document to aid developers and designers in the design and construction of developments within the UK.

The National Planning Policy Framework 2019 makes little reference to lighting with regard to the control of obtrusive light with section being the only reference, which states:
c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

With regard to the planning aspect, many local planning authorities (LPAs) have already produced, or are producing, policies that within the planning system will become part of their local development framework. For new developments there is an opportunity for LPAs to impose planning conditions related to external lighting, including curfew hours.

National planning policy

The national on-line planning guidance resource looks at when lighting pollution concerns should be considered.

The guidance provides a high-level overview for planners, with links to appropriate documents looking at the subject through seven discussion points:

- What light pollution considerations does planning need to address?
- What factors can be considered when assessing whether a development proposal might have implications for light pollution?
- What factors are relevant when considering where light shines?
- What factors are relevant when considering when light shines?
- What factors are relevant when considering how much the light shines?
- What factors are relevant when considering possible ecological impacts of lighting?
- What other information is available that could inform approaches to lighting and help reduce light pollution?

It is to be hoped that whilst the guide does not specifically require it planners will consider the application of artificial light and consult with lighting designers. The planners can then be advised on the planning conditions that might be applicable for each project and review any submissions to determine if the planning conditions have been met.

The Scottish Executive has published a design methodology document (March 2007) entitled "*Controlling Light Pollution and Reducing Lighting Energy Consumption*" to further assist in mitigating obtrusive light elements at the design stage.

Environmental zones

It is recommended that local planning authorities specify the environmental zones given in Table 2 for exterior lighting control within their development plans.

Design guidance

The following limitations based upon CIE150 may be supplemented or replaced by an LPA's own planning guidance for exterior lighting installations. As lighting design is not as simple as it may seem, you are advised to consult and/or work with a competent professional lighting designer when considering any exterior lighting.

Table 2: Environmental zones

Zone	Surrounding	Lighting environment	Examples
E0	Protected	Dark (SQM 20.5+)	Astronomical Observable dark skies, UNESCO starlight reserves, IDA dark sky places
E1	Natural	Dark (SQM 20 to 20.5)	Relatively uninhabited rural areas, National Parks, Areas of Outstanding Natural Beauty, IDA buffer zones etc.
E2	Rural	Low district brightness (SQM ~15 to 20)	Sparsely inhabited rural areas, village or relatively dark outer suburban locations
E3	Suburban	Medium district brightness	Well inhabited rural and urban settlements, small town centres of suburban locations
E4	Urban	High district brightness	Town/city centres with high levels of night-time activity

Notes:

1. Where an area to be lit lies on the boundary of two zones the obtrusive light limitation values used should be those applicable to the most rigorous zone.
2. Rural zones under protected designations should use a higher standard of policy.
3. Zone E0 must always be surrounded by an E1 Zone.
4. Zoning should be agreed with the local planning authority and due to local requirements a more stringent zone classification may be applied to protect special/specific areas.
5. SQM (Sky Quality Measurements) referenced by the International Dark-Sky Association (IDA), the criteria for E0 being revised in mid 2019 but not retrospective.
6. Astronomical observable dark skies will offer clearer views of the Milky Way and of other objects such as the Andromeda galaxy and the Orion Nebula.
7. Although values of SQM 20 to 20.5 may not offer clear views of astronomical dark sky objects such as the Milky Way, these skies will have their own relative intrinsic value in the UK.

Table 3 (CIE 150 table 2): Maximum values of vertical illuminance on properties.

Light technical parameter	Application conditions	Environmental zone				
		E0	E1	E2	E3	E4
Illuminance in the vertical plane (E_v)	Pre-curfew	n/a	2 lx	5 lx	10 lx	25 lx
	Post-curfew	n/a	<0.1 lx*	1 lx	2 lx	5 lx

Note:

* If the installation is for public (road) lighting then this may be up to 1 lx.

Recommended maximum values of light parameters for the control of obtrusive light

Limitation of illumination on surrounding properties

Light intrusion/nuisance

Limits apply to nearby dwellings/premises or potential dwellings/premises and specifically windows; the values are the summation of all lighting installations.

Spill light

Table 3 can also be considered for the management of spill light; however, designers must consider the task performance requirements of any adjacent lit areas and ensure that any spill light does not adversely affect these performance parameters as this could affect their safe use. This may result in a need to minimise spill and intrusive lighting values to less that might be expected for the environmental zone within which the installation lies.

Limitation of bright luminaires in the field of view.

The limits for the luminous intensity of bright luminaires are dependent on the viewing distance *d*, (between the observer and the bright luminaire(s)) and the projected area A_p, of the bright part of the luminaire in the direction of the observer.

Table 4 shows the maximum values for the luminous intensity of luminaires in designated directions where views of bright surfaces of luminaires are likely to be a nuisance to occupants of premises or from positions where such views are likely to be maintained, that is, not momentary or short-term.

Considerations to aid the application of Table 4 and the assessment process.

a) The assessment of A_p for observers can prove difficult and will vary for all observer positions and distances. To aid this assessment values of A_p corresponding to the geometric mean diameter of each luminaire group have been extracted from CIE 150 Annex C and included within Table 4. These areas can be considered for an assessment of likely A_p in the observer direction to calculate a maximum luminous intensity value.
b) The above information is applicable for the consideration of a single luminaire but where two or more luminaires are located in close proximity to each other that to the observer they appear as a single light source then the assessment shall be undertaken based upon the combined bright surfaces of luminaires (A_p) in the direction of the observer or, from positions where such views are likely to be maintained.
c) In installations that involve mast lighting the luminaires will often be viewed against the night sky. The contrast between the background sky and the bright surface areas of the luminaires can be considerable. In such installations the curfew levels set for each environmental zone shall be applied with the exception that such installations within an E4 zone will be designed to suit the curfew requirements of an E3 zone.

Limitation of the effects on transport systems

Limits apply where users of road networks are subject to a reduction in the ability to see essential information. CIE 150 2017; Table 5 gives values that are for relevant positions and for viewing directions in the path of travel.

This assessment does not just apply to road lighting installations but to any installation where luminaires positioning falls under the above definition.

Limitation of sky glow

See Tables 6 and 7

Table 4 (CIE 150 table 3 (amended)): Limits for the luminous intensity of bright luminaires[4].

Light technical parameter	Application conditions	Luminaire group (projected area A_P in m^2)					
		$0<A_P \leq 0.002$	$0.002<A_P \leq 0.01$	$0.01<A_P \leq 0.03$	$0.03<A_P \leq 0.13$	$0.13<A_P \leq 0.50$	$A_P>0.5$
Maximum luminous intensity emitted by luminaire (I in cd)	E0						
	Pre-curfew	0	0	0	0	0	0
	Post-curfew	0	0	0	0	0	0
	E1						
	Pre-curfew	0.29 *d*	0.63 *d*	1.3 *d*	2.5 *d*	5.1 *d*	2,500
	Post-curfew	0	0	0	0	0	0
	E2						
	Pre-curfew	0.57 *d*	1.3 *d*	2.5 *d*	5.0 *d*	10 *d*	7,500
	Post-curfew	0.29 *d*	0.63 *d*	1.3 *d*	2.5 *d*	5.1 *d*	500
	E3						
	Pre-curfew	0.86 *d*	1.9 *d*	3.8 *d*	7.5 *d*	15 *d*	10.000
	Post-curfew	0.29 *d*	0.63 *d*	1.3 *d*	2.5 *d*	5.1 *d*	1,000
	E4						
	Pre-curfew	1.4 *d*	3.1 *d*	6.3 *d*	13 *d*	26 *d*	25,000
	Post-curfew	0.29 *d*	0.63 *d*	1.3 *d*	2.5 *d*	5.1 *d*	2,500
Aid to gauging A_p		2 to 5cm	5 to 10cm	10 to 20cm	20 to 40cm	40 to 80cm	>80cm
Geometric mean of diameter (cm)		3.2	7.1	14.1	26.3	56.6	>80
Corresponding A_p representative area (m^2)		0.0008	0.004	0.016	0.063	0.251	>0.5

Notes:

1. d is the distance between the observer and the glare source in metres;
2. A luminous intensity of 0 cd can only be realised by a luminaire with a complete cut-off in the designated directions;
3. A_p is the apparent surface of the light source seen from the observer position
4. For further information refer to Annex C of CIE 150
5. Upper limits for each zone shall be taken as those with column $A_p>0.5$

Limitations of the effect of over-lit building façades and signs

Table 8 provides recommendations regarding luminance values that provide visibility in order that a balanced urban lighting master plan can be considered and such lighting does not cause negative impacts such as a continuous increase in the lighting levels (ratcheting) between buildings and within areas and light pollution.

Illuminated advertising signage should be assessed as advised in the ILP's Professional Lighting Guide *The brightness of illuminated advertisements*, (PLG 05)

4 Amended based upon the approach taken by NSVV Nederlandse Stichting Voor Verlichtingskunde (Dutch: Dutch Foundation for Illumination; The Netherlands) and to consider CIE 150 Annex C Table C.2

Table 5 (CIE 150 table 4): Maximum values of threshold increment and viewing direction in the path of travel.

Light technical parameter	Road classification*			
	No road lighting	M6/M5	M4/M3	M2/M1
Veiling luminance† (L_V)	0.037 cd/m^2	0.23 cd/m^2	0.40 cd/m^2	0.84 cd/m^2
Threshold increment	15% based on adaption luminance of 0.1 cd/m^2	15% based on adaption luminance of 1.0 cd/m^2	15% based on adaption luminance of 2.0 cd/m^2	15% based on adaption luminance of 5 cd/m^2

Notes:

* Road classifications as given in CIE 115:2010

† The veiling luminance values specified in this table are based upon on a permissible TI value of 15%

Definitions:

TI The measure of disability glare (the reduction in visibility caused by intense light sources in the field of view) expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present. Note: Higher values of TI correspond to greater disability glare.

L_V The luminance that would need to be superimposed on a scene in object space to reduce the scene's contrast by an amount equal to the added retinal illuminance from scattered light on the scene's retinal image. It is most commonly used to describe the contrast-reducing effect of a glare source in the field of view.

Table 6 (CIE 150 table 5): Maximum values of upward light ratio (ULR) of luminaires.

Light technical parameter	Environmental zones				
	E0	E1	E2	E3	E4
Upward light ratio (ULR)/%	0	0	2.5	5	15

Note:

This does not take into account the effect of light reflected upwards from ground that also contributes to sky glow. This is the traditional method to limit sky glow and is suitable to compare different single luminaires.

For illuminated advertising signs the aim should be to achieve the limits advised in PLG05.

Table 7 (CIE 150 table 6): Maximum values of upward flux ratio of installation (of four or more luminaires).

Light technical parameter	Type of installation	Environmental zones				
		E0	E1	E2	E3	E4
Upward flux ratio (UFR)/%	Road	n/a	2	5	8	12
	Amenity	n/a	n/a	6	12	35
	Sports	n/a	n/a	2	6	15

Notes:

Table 7 allows the effect of both direct and reflected upward components of a whole installation to be taken into account. The factor being the upward flux ratio (UFR) and CIE 150 suggests that table 7 is used for all installations consisting of four or more luminaires.

Clauses 6.4.2 and 6.4.3 of CIE 150:2017 describe the calculation methods for both ULP and UFR.

Light emitted just above the horizontal in a zone between 90o and 110o is extra critical for sky glow in large open areas around observatories. An additional measure in these areas limits the luminous intensities ($I_{90} - I_{110}$) as follows:

- between 90° and 100° < 0.5 cd/1000lm;
- between 100° and 110° 0 cd.

Table 8 (CIE 150 table 7): Maximum permitted values of average surface luminance (cd/m^2).

Light technical parameter	Application conditions	Environmental zones				
		E0	E1	E2	E3	E4
Building façade luminance (L_b)	Taken as the product of the design average illuminance and reflectance divided by π	< 0.1	< 0.1	5	10	25
Sign luminance (L_s)	Taken as the product of the design average illuminance and reflectance divided by π, or for self-luminous signs, its average luminance.	< 0.1	50	400	800	1.000

Note:
The values apply to both pre- and post-curfew, except that in zones 0 and 1 the values shall be zero post curfew. The values for signs do not apply to signs for traffic control purposes.

Relevant publications and standards

British Standards

- BS 5489-1:2013 *Code of practice for the design of road lighting – Part 1 Lighting of roads and public amenity areas*;
- BS EN 13201-2:2015 *Road lighting. Part 2: Performance requirements*;
- BS EN 13201-3:2015 *Road lighting. Part 3: Calculation of performance*;
- BS EN 13201-4:2015 *Road lighting. Part 4: Methods of measuring lighting performance*;
- BS EN 12193:2018 *Light and lighting. Sports lighting*;
- BS EN 12464-2:2014 *Lighting of work places. Outdoor work places*;
- PD CEN TR 13201-1:2014 *Road lighting. Guidelines on selection of lighting classes*.

CIE publications

- CIE 001 *Guidelines for minimizing urban sky glow near astronomical observatories*;
- CIE 094-1993 *Guide for floodlighting*;
- CIE 112-1994 *Glare evaluation system for use within outdoor sport and area lighting*;
- CIE 115:2010 *Lighting of roads for motor and pedestrian traffic*;
- CIE 126:1997 *Guidelines for minimizing sky glow*;
- CIE 129:1998 *Guide for lighting exterior work areas*;
- CIE 136:2000 *Guide to the lighting of urban areas*;
- CIE 150:2017 *Guide on the limitation of the effects of obtrusive light from outdoor lighting installations*;
- CIE 169:2005 *Practical design guidelines for the lighting of sport events for colour*.

ILP publications

- PLG04 *Guidance on undertaking environmental lighting impact assessments*;
- PLG05 *The brightness of illuminated advertisements*;
- PLG06 *Guidance on installation and maintenance of seasonal decorations and lighting column attachments*
- GN09 *Domestic exterior lighting: getting it right!*

SLL/CIBSE Publications

- LG01 *The industrial environment* (2018);
- LG04 *Sports lighting*;
- LG06/16 *The exterior environment*;
- LGLOL *Guide to limiting obtrusive light*.

NB: These notes are intended as guidance only and the application of the values given in the various tables should be given due consideration along with all other factors in the lighting design. Lighting is a complex subject with both objective and subjective criteria to be considered. The notes are therefore no substitute for professionally assessed and designed lighting, where the various and maybe conflicting visual requirements need to be balanced.

Acknowledgements

Allan Howard – WSP (Chair)

Peter Raynham – UCL

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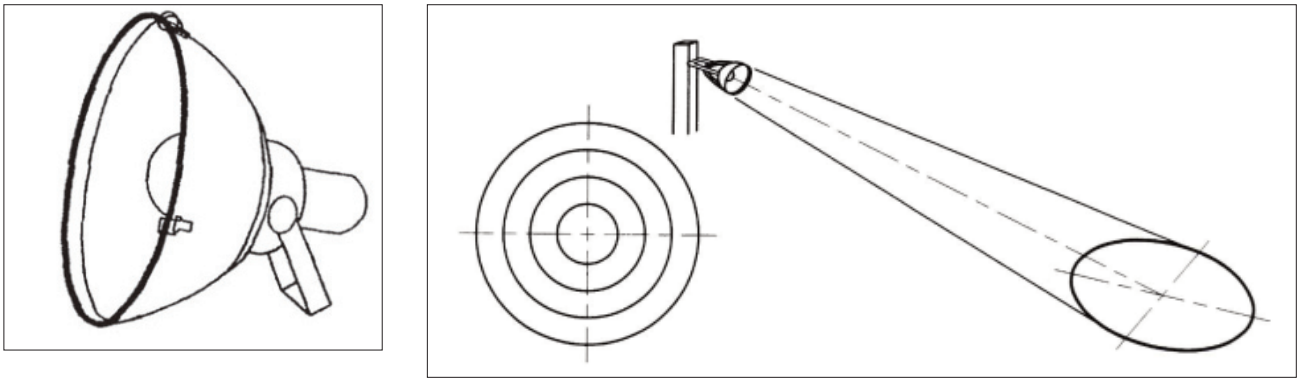
Appendix 2 images – acdc

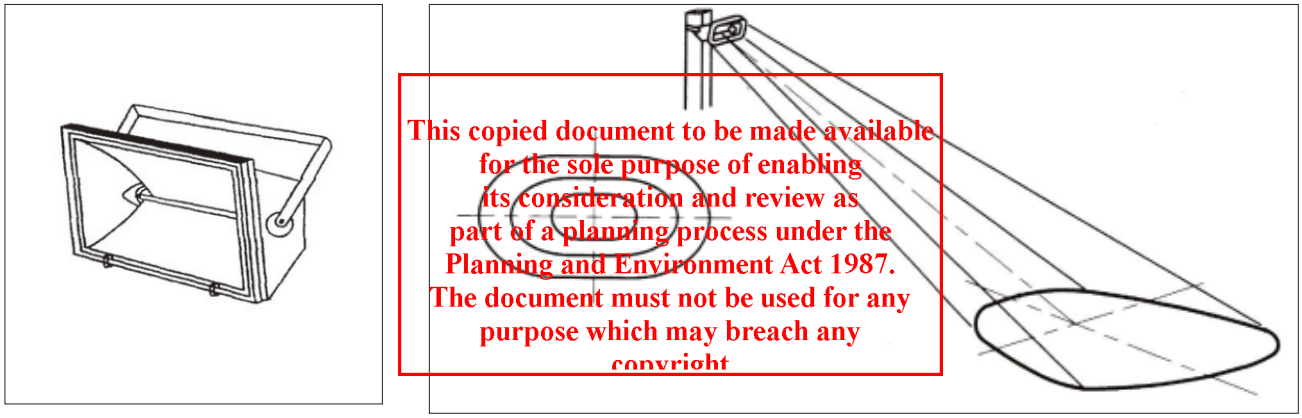
Appendix 1

Outdoor luminaire classification system

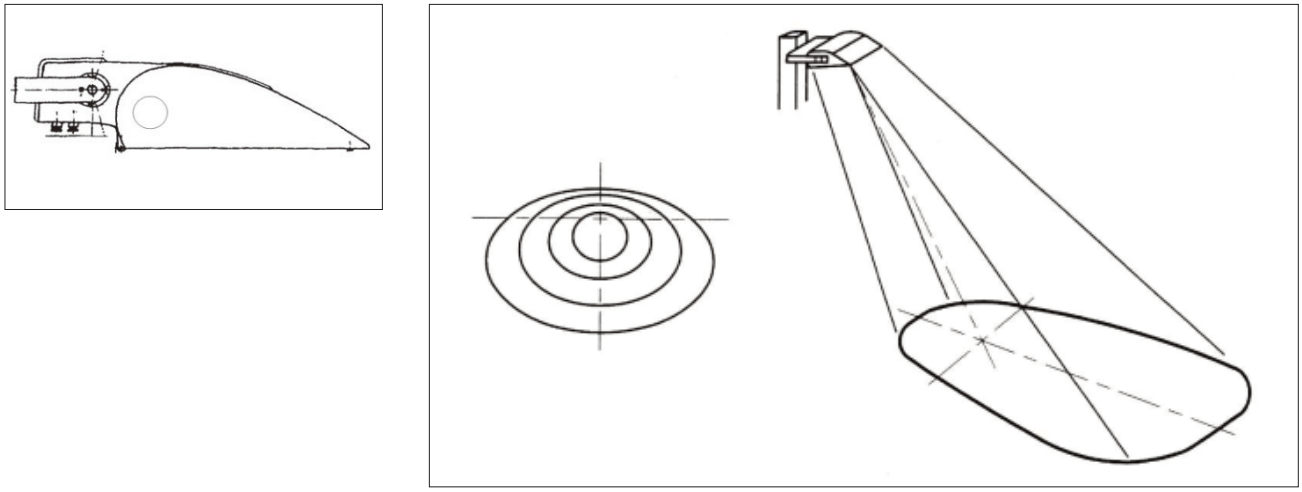
Based upon CIE 150:2017 and for the purpose of this and associated documents the following figures illustrate the luminaire classification (CIE 150:2017)



Type A: Floodlight/projector producing a symmetrical beam



Type B: Floodlight/projector producing a fan-shaped beam



Type C: Floodlight/projector producing a double asymmetric distribution in the vertical plane

Appendix 2

Illustrations of luminaire accessories for limiting obtrusive light

Luminaire with cowl, hood and shield

With louvre

With cowl

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