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SUNTOP SOLAR FARM

VISUAL IMPACT ASSESSMENT

Prepared for Pitt & Sherry - May 2018

CAMBIUM GROUP

PROPOSED SUNTOP SOLAR PHOTOVOLTAIC (PV) FARM
VISUAL IMPACT ASSESSMENT

DATE: 7 May 2018
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02	13 March 2018	Updated Draft for review: revised footprint, use of tracking panels, revised substation location	A. Dodds	S. Brodbeck
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04	7 May 2018	Panel numbers	A. Dodds	S. Brodbeck

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1 Introduction

1.1 Purpose of this report

This report has been prepared to assess visual impacts associated with a proposed photovoltaic (PV) solar farm at Suntop, NSW (the 'Proposal'). The report has been prepared for the Proponent, Photon Energy, and addresses the Secretary's Environmental Assessment Requirements (SEARs) issued by the Department of Planning and Environment (DPE) regarding 'visual' issues potentially associated with the Proposal.

The relevant SEARs state:

> *Visual – including an assessment of the likely visual impacts of the development (including any glare, reflectivity and night lighting) on surrounding residences, scenic or significant vistas, air traffic and road corridors in the public domain, including a draft landscaping plan for on-site perimeter planting, with evidence it has been developed in consultation with affected landowners.*

The requirements of the SEARs, and the relevant sections of this report where these requirements are met are identified in **TABLE 1-1.**

TABLE 1-1: SEARS VISUAL REQUIREMENTS

Visual Requirement	Where addressed in this report
…an assessment of the likely visual impacts of the development…	Whole of report.
…(including any glare, reflectivity and night lighting)…	Key visual concerns of solar farms such as glare and reflectivity are considered in **SECTION 5.0.** Night lighting is discussed at **SECTION 4.4.**
…surrounding residences, scenic or significant vistas, air traffic and road corridors in the public domain…	**SECTION 6.0** - likely effects to landscape character. **SECTION 7.0** - likely affects to surrounding key viewpoints, including public viewpoints from Suntop Road and from surrounding rural residences.
…a draft landscaping plan for on-site perimeter planting, with evidence it has been developed in consultation with affected landowners.	**SECTION 9.3** – A Concept Landscape Plan has been prepared for on-site perimeter planting.

1.2 Brief project description

Photon Energy propose to construct and operate a PV solar farm generating up to 200 megawatt (MW) with the use of tracking panels, on a property at 909 Suntop Road, Suntop. Suntop is a rural area, approximately 10 kilometres (km) south-west of Wellington in the Dubbo Regional Council Local Government Area (LGA). The solar farm (the 'Site') would occupy 472 hectares (ha) of the 517ha rural property, approximately 91%.

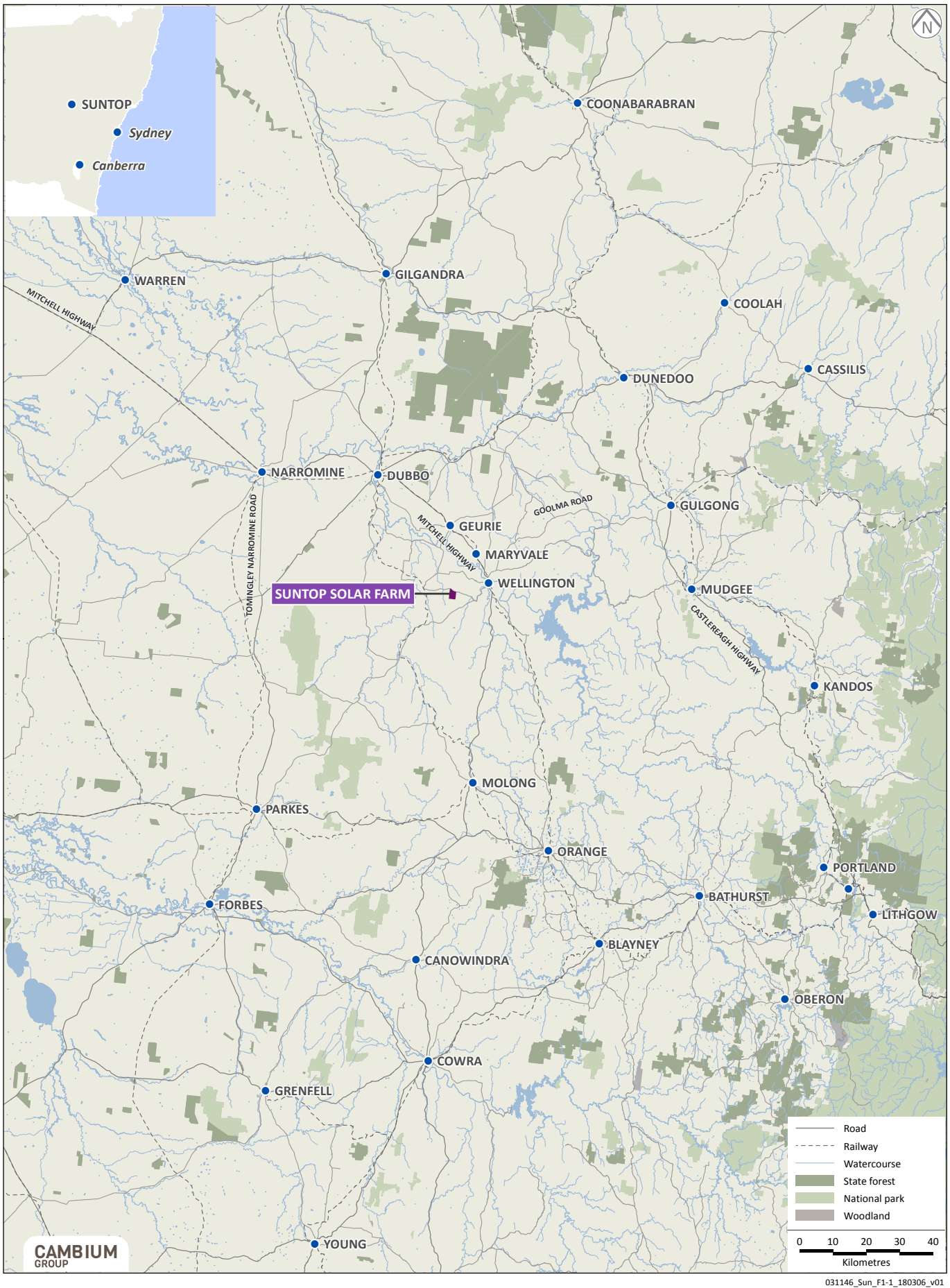
The location of the proposed Site is shown in **FIGURE 1-1**. A description of the Site is provided in **SECTION 3.0** and a detailed description of the Proposal and its components is provided in **SECTION 4.0.**

1.3 Report format

The key tasks of the assessment process are set-out in the report's format:

- Outline the methodology for the assessment **(SECTION 2.0)**
- Establish baseline conditions and describe the site context **(SECTION 3.0)**
- Describe the main visual changes associated with the Proposal **(SECTION 4.0)**
- Discuss key visual concerns of solar farms **(SECTION 5.0)**
- Assess the likely effects to landscape character (**SECTION 6.0**)
- Assess the likely affects to surrounding key viewpoints **(SECTION 7.0)**
- Present photomontages from key viewpoints (**SECTION 8.0**)
- Present mitigation measures including a concept landscape plan **(SECTION 9.0)**
- Discuss cumulative impacts (**SECTION 10.0**)
- Conclusion (**SECTION 11.0**).

FIGURE 1-1
Site location
SUNTOP SOLAR FARM - VISUAL IMPACT ASSESSMENT



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2 Assessment methodology

This section of the report defines the methodology for the assessment. The assessment methodology has been based on the relevant state government guideline (i.e. the Draft Large Scale Solar Energy Guideline), professional experience with other large-scale infrastructure projects, and visual assessment guidelines used by government authorities in Australia and internationally.

2.1 Methodology Framework

The *Draft Large Scale Solar Energy Guideline* (New South Wales (NSW) Department of Planning (DPE), 2017) provides the community, industry, applicants and regulators with guidance on the planning framework for the assessment and approval of large scale solar energy development proposals under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), which are classified as 'State significant development' (SSD).

The Guideline identifies the key planning and strategic considerations relevant to solar energy SSD in NSW. It aims to assist in the site selection and design of proposals and it will be used by the DPE to assist in the assessment of relevant development applications. It is intended as a general guideline only.

Under the Guideline, visual impact considerations are most relevant in the section on 'site selection', where it states that:

> *'sites with characteristics that may assist in minimising localised impacts such as:*
>
> - *land that does not contain native vegetation or has previously been cleared and utilised for industrial - type purposes (brown - field sites) in rural settings,*
> - *unobtrusive sites with flat, low - lying topography, and*
> - *sites with potential to be screened, such as those that can be readily vegetated along boundaries, to reduce visual impacts'.*

Additionally, under the heading of 'Site Constraints' (where this heading is further defined as meaning that 'while the following types of land or sites are not precluded from large-scale solar energy development, they do indicate areas of constraint that should be identified as part of the constraints mapping'), the following relevant component is identified:

> *'sites with high visibility, such as those on prominent or high ground positions, or sites which are located in a valley with residences with elevated views looking toward the site' (NB: a footnote further defines this to mean: 'high visibility or prominence is of particular concern if the solar infrastructure at the site would be juxtaposed against significant scenic, historic or cultural landscape'.)*

Under 'Key Assessment Issues' the Guideline refers to the consideration of visual impacts as follows:

Visual impacts: the acceptability of impacts on landscape character and values, the amenity of landholders and communities, and the adequacy of the measures which are proposed to avoid, reduce or otherwise manage these impacts.

The visual impact of solar energy development will depend on the scale and type infrastructure, the prominence and topography of the site relative to the surrounding environment, and any proposed measures to screen or otherwise reduce visibility of the site. Solar thermal projects may have greater offsite visibility due to the presence of tower infrastructure. Greater off - site visibility of the site will increase the chances of impacts such as glint, glare, reductions in visual amenity, and detraction from the surrounding landscape character including natural, scenic, historic or cultural landscapes. There may also be road safety impacts from glint and glare.

The most relevant parts of the Guidelines relating to visual impacts have been addressed as part of this report. The findings are presented in the conclusion at **TABLE 11-1.**

2.2 Applied Methodology

The applied methodology used in this report has been based on professional experience with other large-scale infrastructure projects, and visual assessment guidelines used by government authorities in Australia and internationally, including:

- '*Environmental Impact Assessment Guidance Note – Guidelines for Landscape Character and Visual Impact Assessment'*, 2013, NSW Roads and Maritime Services
- '*Visual Landscape Planning in Western Australia'*, 2007, Western Australian Planning Commission
- the United Kingdom's widely used '*Guidelines for Landscape and Visual Impact Assessment,*' 2013, the Landscape Institute and Institute of Environmental Management and Assessment.
- '*Best Management Practices for Reducing Visual Impacts of Renewable Energy Facilities on BLM-Administered Lands'*, 2013, United States Department of the Interior.

The below guideline on reviewing visual assessments has also informed the methodology:

- '*Guide to Evaluating Visual Impact Assessments for Renewable Energy Projects'*, 2014, Sullivan and Meyer, for United States Department of the Interior.

The methodology has been tailored to address the particular visual impacts of establishing this type and scale of infrastructure in this location.

2.3 Potential visibility

An initial step in the assessment was to identify potentially-sensitive viewing locations such as residences, and publicly accessible areas such as towns and local roads. These locations were initially determined by establishing the potential geographic extent of the viewing area using desktop analysis of aerial photography and elevation.

2.4 Site assessment

A site inspection was held 22 November 2017. The Proposal was considered in the context of the Site setting. Landscape character within the locality is described at **SECTION 3.0.**

The potentially sensitive viewing locations previously identified by desktop analysis were verified[1] during the site inspection. Viewpoints were modified or confirmed based on site findings (such as the screening effects of vegetation).

Access to four of the close private properties was possible during the site inspection. For the remainder of properties, visibility was assessed from the closest public access to each viewpoint and desktop analysis. The assessment viewpoints are identified in **SECTION 7.0.**

The initial site investigation findings are shown at **APPENDIX A.**

Due to the large number of potential viewers, and the relatively similar visual experience from some locations, some viewpoints were grouped. Groups (or clusters of viewpoints) were determined based on:

- 1. distance from the Proposal;
- 2. elevation comparative to the Proposal; and
- 3. proportion of the Site potentially seen.

Viewpoints were then selected for photomontage images. Where possible, the locations selected have the 'worst case' (most prominent) view of the Proposal. However, viewpoints have also been selected that are representative of the variety of locations with views of the Proposal.

2.5 Assessment criteria

Two main types of visual impacts are assessed in this report:

1. Effect on the landscape character – the overall impact of a project on an area's character and sense of place.
2. Effect on key viewpoints – the day to day visual effects of a project on people's views.

The level of impact to landscape character and viewpoints is based on the combination of two criteria – 'sensitivity' and 'magnitude of change', defined by Roads and Maritime (2013) as:

[1] Desktop analysis does not take into account site features such as vegetation and built elements which may obstruct views.

- Sensitivity - The sensitivity of a landscape character zone or view and its capacity to absorb change. In the case of visual impact this also relates to the type of viewer and number of viewers.
- Magnitude - The measurement of the scale, form and character of a development proposal when compared to the existing condition. In the case of visual assessment this also relates to how far the proposal is from the viewer.

For the purposes of this assessment, the specific criteria used to determine sensitivity and magnitude of change (both for landscape character and visual impact to viewpoints) are listed in **TABLE 2-1** and **TABLE 2-2.** These criteria have been defined for this Proposal and take into account the particular characteristics of the solar farm Proposal, such as its low height.

2.5.1 Sensitivity criteria

Understanding the characteristics of those who would likely view the Proposal is important because it is the human response to visible changes in a landscape that determines whether the changes represent an improvement in scenic attractiveness (a positive visual impact) or a decrease in scenic attractiveness (a negative visual impact)[2].

Public vs Private viewpoints

Visual perceptions of renewable energy equipment dominate public acceptability but differ between visitors and residents*.

When assessing private viewpoints, such as residences, the closer the proximity and clearer the potential view, generally the greater sensitivity to change, and therefore the higher potential for visual impact. However, although a high impact may be experienced by an individual residence, or group of residences, the overall level of impact needs to take into account the number of residents affected, plus how significant that impact may be in terms of the wider community.

* Apostol, D. 2017. *The Renewable Energy Landscape.* Routledge, 20160819. (Apostol 108)

The following sensitivity criteria have been considered in this assessment[3]:

- The type of viewer that sees from a particular viewpoint (private or public, stationary or moving and their engagement in the view) (Refer also side bar "public vs private viewpoints")
- Viewer distance from the Proposal (clarity is reduced as distance increases)[4]
- Numbers of people viewing from the viewpoint
- Expected duration of views
- Particular sensitivities of the viewers

These criteria have been used as a guide to determine high, moderate, low or negligible sensitivity ranking, as shown in **TABLE 2-1**.

[2] Sullivan, R. and M Meyer. 2014. p22

[3] Adapted from:

- Apostol, D. 2017. *The Renewable Energy Landscape*; Sullivan, R. and M Meyer. 2014. p43; and
- United States Department of the Interior. 2013. Best Management Practices for Reducing Visual Impacts of Renewable Energy Facilities on BLM-Administered Lands.

[4] Regions with sunnier skies and dryer air will, on average, experience higher levels of visual contrast and longer visibility distances for renewable energy facilities than will regions with less sunny skies and higher humidity levels. United States Department of the Interior. 2013

TABLE 2-1: SENSITIVITY RANKING CRITERIA

Sensitivity	Criteria (general guide only, some or all may apply)
High	▪ Landscape or cultural heritage of high to very high conservation value ▪ Landscape with characteristics that are highly sensitive and highly affected by large-scale development ▪ Public views with a high to very high number of users and/or in close proximity ▪ Private views in close proximity (generally less than 1km) with mostly unimpeded views
Moderate	▪ Landscape or cultural heritage of moderate conservation value ▪ Landscape with characteristics moderately affected by large-scale development ▪ Public views with a moderate to high number of viewers and/or viewers are in close or moderate proximity (generally less than 2.5km away) ▪ Private views in moderate proximity (generally 1-2.5km) with some views, or a further distance (2.5-5km) with mostly unimpeded views
Low	▪ Some landscape or cultural heritage conservation value but of lower visual value ▪ Landscape characteristics not greatly affected by large-scale development ▪ Public views for a small number of users and/or viewers more distant (generally over 2.5km away) ▪ Private views in more distant proximity (generally 5km+) with some unimpeded views
Negligible	▪ Landscape has no or very little cultural heritage, conservation or visual value ▪ Characteristics relatively unaffected by large-scale development ▪ Very few people can view ▪ Viewers are a long distance from site (generally over 5km with no obvious views) ▪ Private views generally not affected.

2.5.2 Magnitude of change criteria

The following magnitude criteria have been considered when determining magnitude of change:

- The characteristics of the proposal (its size, scale relative to other objects in view)

- Visual prominence (how dominant, or the focal point of the view is the proposal)
- Viewer position in relation to the proposal (elevation and angle of viewpoint, relationship to sun angle)
- Extent (proportion of the proposal that would be seen)
- Compatibility with surrounding landscape (the contrasts of the proposal in scale and character (either existing or planned) and effect on scenic quality
- Whether the change would be temporary or permanent

These criteria have been used as a guide to determine high, moderate, low or negligible magnitude taking into account the general visual features (scale, bulk and height) of the proposal, as shown in **TABLE 2-2.**

TABLE 2-2: MAGNITUDE OF CHANGE RANKING CRITERIA

Magnitude	Criteria (general guide only, some or all may apply)
High	▪ Significant scale (bulk and height) and extent of area affected ▪ Permanent and irreversible change ▪ The site has a high visual prominence (is a key feature of the view) ▪ The viewer position in relation to the proposal is substantially elevated and from a northern, eastern or western location ▪ The viewer sees a large proportion of the facility (typically more than half (50%)) ▪ The proposal forms a significant and immediately apparent part of the scene, and one that significantly contrasts in scale and character (either existing or planned) and is severely detrimental to the quality of the scene.
Moderate	▪ Moderate scale (bulk and height) and extent of area affected ▪ The site is visually prominent (a recognisable feature of the view) ▪ The viewer position in relation to the proposal is elevated ▪ The viewer sees a moderate proportion of the facility (typically a quarter to a half (25-50%)) ▪ Temporary, or if permanent, effects which may reduce over time ▪ The proposal becomes a noticeably dominant feature of the scene, and one that contrasts in scale and character (either existing or planned), possibly reducing the quality of the scene.
Low	▪ Small in scale (bulk and height) and extent of area affected

Magnitude	Criteria (general guide only, some or all may apply)
	▪ Temporary, or if permanent, visual effects able to be reduced substantially over time ▪ The site is less visually prominent ▪ The viewer position is usually to the south of the facility ▪ The viewer sees a small portion of the facility (typically less than a quarter (25%) and/or from a further distance) ▪ The proposal forms a visible and recognisable new element within the overall scene, yet one that is relatively compatible with the surrounding character (either existing or planned) and would not generally reduce the quality of the scene.
Negligible	▪ The proposal constitutes only a minor component of the wider view, which might be missed by the casual observer or receptor. Awareness of the proposal would not have a marked effect on the overall quality of the scene.

2.5.3 Level of Impact

By combining sensitivity and magnitude of change, an approximate level of impact to either landscape character or visual impact to viewpoints is ascertained, as shown in **TABLE 2-3** (as adapted from Roads and Maritime, 2013). The range of overall impact level (to both the landscape character and visual impact to surrounding viewpoints) can be either beneficial or adverse, with six possible rankings: high, moderate-high, moderate, moderate-low, low, and negligible.

TABLE 2-3: LEVEL OF IMPACT

Matrix of relationship between sensitivity and magnitude					
		Magnitude			
		HIGH	**MODERATE**	**LOW**	**NEGLIGIBLE**
Sensitivity	**HIGH**	High	Moderate - high	Moderate	Negligible
	MODERATE	Moderate - High	Moderate	Moderate - Low	Negligible
	LOW	Moderate	Moderate - Low	Low	Negligible
	NEGLIGIBLE	Negligible	Negligible	Negligible	Negligible

3 Site context and description

This section of the report describes the Site and its surroundings. It identifies any important visual resource areas (including sensitive scenic, historic, or cultural resources) and other sensitive viewpoints (residential areas, roads, etc.) that could have views of the Proposal.

3.1 Site context

Suntop is a rural area approximately 10km south-west of Wellington, the nearest town. The area is part of the NSW Central West wheat-sheep belt[5], and is typical of the undulating, agricultural, broadacre farming areas within the mid-western region. An image of the Suntop area is shown on **FIGURE 3-1** to illustrate landscape character.

FIGURE 3-1: TYPICAL LANDSCAPE CHARACTER OF SUNTOP

[5] Australian broadacre zones and regions. http://apps.daff.gov.au/agsurf/regions.html#122. Accessed 30 November 2017

Geographically separating Suntop and Wellington, and providing the backdrop for Suntop, is the Mount Arthur Reserve, a 2,123ha Crown Reserve set aside for Public Recreation and Environmental Protection. **FIGURE 3-3** shows the general locality of Mount Arthur Reserve. The Reserve lies within the northern most section of the Catombal Range and takes in three main peaks - Mounts Arthur, Wellesley and Duke - rising to 563m above sea-level. The Reserve is recognised on the Register of the National Estate for its natural values. A large portion of the Reserve has been protected in various forms since 1913.

West of the Reserve, land in the Suntop area has been developed for agricultural purposes and is primarily used for crops (wheat and canola) and grazing (sheep and cattle). Large paddocks of improved pastures, crops, rural residences, large farm sheds, stores of grain and stock feed, trucks and harvesters are common throughout the area.

Land in the vicinity is undulating. There are numerous small creeks and the nearest river is the Macquarie River at Wellington. The area can experience extremes in temperature. In 2017, the hottest temperature recorded was 45 degrees and the coldest was -4.5 degrees[6]. During harvesting, dust plumes are common.

Suntop is home to approximately 70 residents. Two local roads - Suntop Road and Renshaw McGirr Way - provide connection to the main NSW road and rail network (refer to **FIGURE 3-3**).

The dominant background colours common to the area are the colours of the crops (seasonally changing from bright greens to pale, muted yellows), grazing pastures (light, bright greens to light browns and yellows), scattered tall vegetation (dark grey-green), soil (red-brown), surrounding vegetated ridges (soft deep blue) and occasional patches of exposed rocks (greys).

There are no local sources of large-scale artificial lights such as would be associated with an industrial premises or commercial facility operating at night. Farm sheds and associated farming infrastructure are made of sheet metal, concrete or timber. Some surfaces, particular roofs, are highly reflective. Power lines and tall transmission lines cross the paddocks and run along the local road. They generally appear as dark vertical lines via their steel or timber pole construction.

3.2 The Site

The Site (at 909 Suntop Road, Suntop) borders Suntop Road along its northern boundary. Existing 132KV transmission lines traverse the property. There is an existing homestead along the western property boundary, agricultural sheds, fences, water tanks, silos and farm equipment located at the property.

The nearest neighbour is located near the intersection of Suntop Road and the electricity transmission lines. Land use within and immediately around the Site is agricultural. The existing features of the Site are shown on **FIGURE 3-2**.

[6] Meat and Livestock Australia. Weather.mia.com.au.climate-history.nsw/suntop. Accessed 29 November 2017

FIGURE 3-2

Existing site features

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3.2.1 Heritage

There were no heritage places or items identified at the Site or within 1km of the Site.

3.2.2 Vegetation

The Site is mostly cleared of trees, however, there are mature native trees along the western boundary and a few remnant trees are scattered within the paddocks over exotic ground cover (pasture grasses). Several rows of trees have been planted along paddock boundaries within the Site. Some shrubs and trees also occur within the lower lying areas of the property.

A detailed Biodiversity Assessment has been prepared as part of the EIS which provides further details on existing vegetation and biodiversity.

3.2.3 Landform

The Site is undulating. There are two ridges within the property, both 420m above sea level (ASL), shown on **FIGURE 3-2**. The lowest point on the property is approximately 370m ASL. A tributary of Barney's Creek passes east to west through the middle of the Site and there are several small dams.

The site has been classified as groundwater vulnerable under Wellington Local Environmental Plan (LEP) 2012.

3.3 Planning and regulatory requirements

3.3.1 Land zoning

The Proposal occurs within the Dubbo Regional Council LGA. The LGA has two LEPs, including the Wellington LEP 2012 which commenced operation on 23 November 2012. Under Wellington LEP, the Site is zoned Primary Production (RU1 zone).

Electricity generating works are not permitted within the RU1 zone under the LEP. However, clause 34(7) of the Infrastructure State Environmental Planning Policy (ISEPP) provides that developments for the purpose of 'solar energy systems' may be carried out with consent on any land, except as prescribed by subclause 34(8). As such, electricity generating works such as the proposed Suntop Solar Farm are permissible with consent.

3.3.2 Scenic provisions

There are no specific documents relating to scenic protection within the western plains region, however, one of the aims of the Wellington LEP 2012 is:

> *to facilitate and encourage sustainable growth and development that…protects and enhances environmentally sensitive areas, ecological systems, areas of a high scenic, recreational or conservation value, and areas that have potential to contribute to improved environmental and scenic outcomes*[7]

[7] Clause 1.2(2)(c)(iii), Wellington LEP 2012

3.3.3 Future development

Plans for further PV solar installations in the Wellington area are being considered by the Proponent of the Suntop solar farm (Photon Energy). Similar facilities involving PV solar panels and a substation are proposed at Mumbil and Maryvale. The proposed locations of all three PV solar farms are shown on **FIGURE 3-3**.

The proposed Mumbil solar farm is located on the eastern side of the Mount Arthur Reserve, south of Wellington, and south-east of Suntop. It is approximately 21.5km from the proposed Suntop solar farm in a straight line, or 33km on road.

The proposed Maryvale solar farm is located on the eastern side of the Mount Arthur Reserve, north of Wellington, and north-east of Suntop. It is approximately 14.5km from the proposed Suntop solar farm in a straight line, or 21km on road.

It is not possible to see all three sites from a single viewpoint (except possibly from the air). Neither the Mumbil nor the Maryvale site are visible from the proposed Suntop solar farm Site.

The cumulative impact of the potential development is further considered at **SECTION 10.0.**

FIGURE 3-3

Proposed solar farms in the Wellington area

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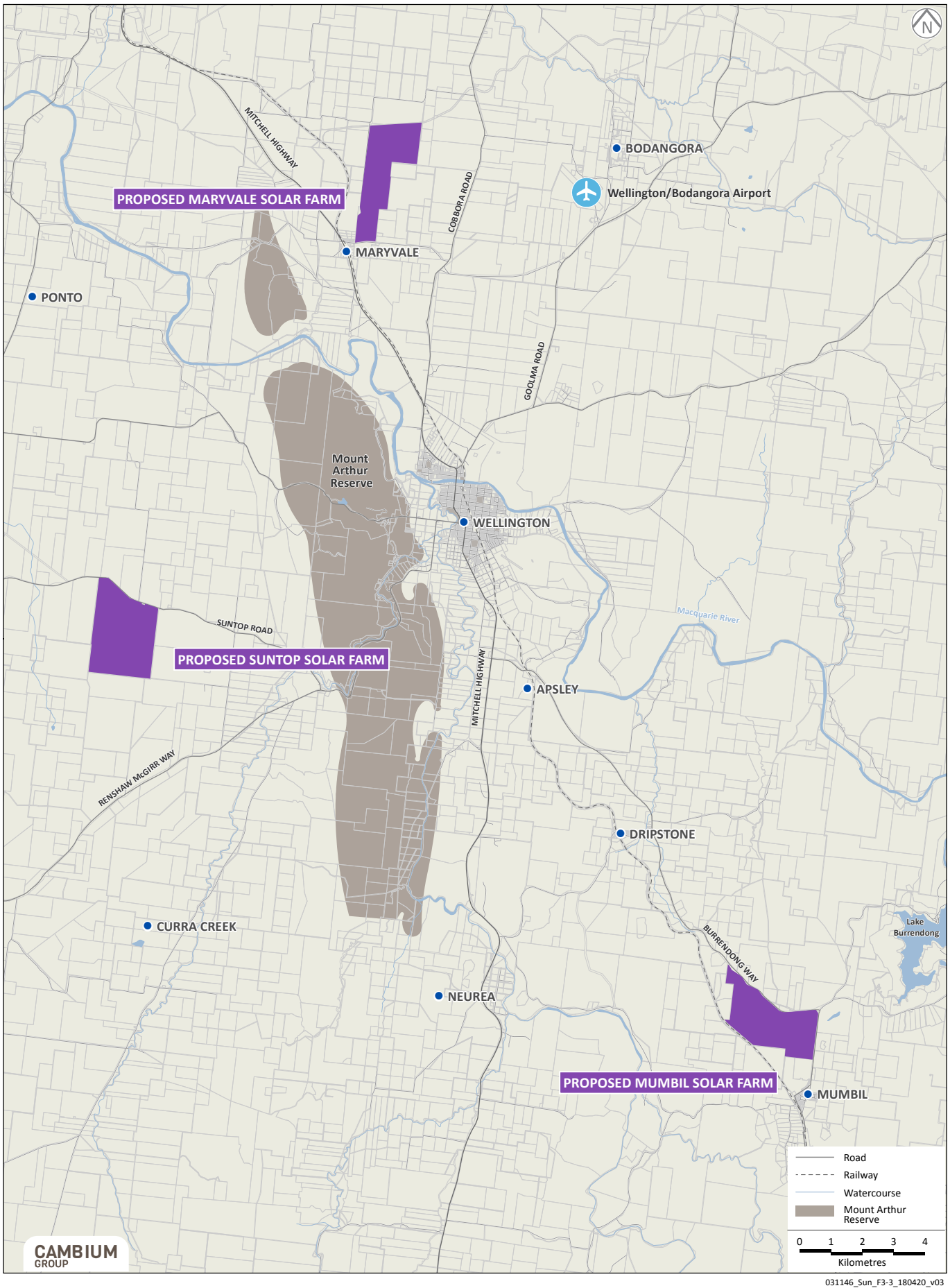

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4 Description of the Proposal

This section of the report presents information about the Proposal, describes the visual characteristics of the solar farm and sources of potential visual change associated with the Proposal.

4.1 The Proposal

The Proposal would occupy 472 ha of the rural property at 909 Suntop Road. This is equivalent to approximately 91% of the property, with the remaining land continuing to be used for agricultural purposes. The Site is proposed to be leased by the Proponent for 30 years.

The Proposal would consist of PV solar panels installed on a single axis tracker system across the Site. The single axis tracker system would allow the PV panels to tilt from +60◦ angle east in the morning, to -60◦ angle west in the afternoon, to follow the sun throughout the day.

A substation would be installed in the vicinity of the existing TransGrid electricity transmission lines to connect to the existing transmission lines and transmit power generated by the solar farm to the local energy grid. Ancillary infrastructure, such as roads and buildings, would also be required to support the operation of the solar farm.

The development footprint would avoid existing surface water bodies on the site where possible. A buffer of 40m would be provided between infrastructure and any waterway and a 10m buffer would be provided from the Site boundaries. The footprint would also avoid the majority of vegetation present.

In summary, the Proposal comprises the following elements:

- 472ha of PV solar panels (2m x 1m) mounted on steel posts to achieve a maximum panel height of approximately 4m
- A 132kv substation (30m x 80m) on a concrete slab, including two transformers and associated 132kv switchgear
- Inverters and inverter stations (containers comprising wiring/cabling which collect and convey the energy produced by the PV panels)
- Underground cabling and other electrical infrastructure (eg security systems)
- A maintenance compound and buildings
- A 1.8m high wire link security fence with 24/7 surveillance cameras, installed around the perimeter of the Site
- Landscaping and environmental works
- A main access road off Suntop Road for all access and egress for the Site, including the substation.

The key elements of the Proposal, including the approximate footprint of the PV solar panels, are shown on **FIGURE 4-1**.

FIGURE 4-1

Proposed site layout

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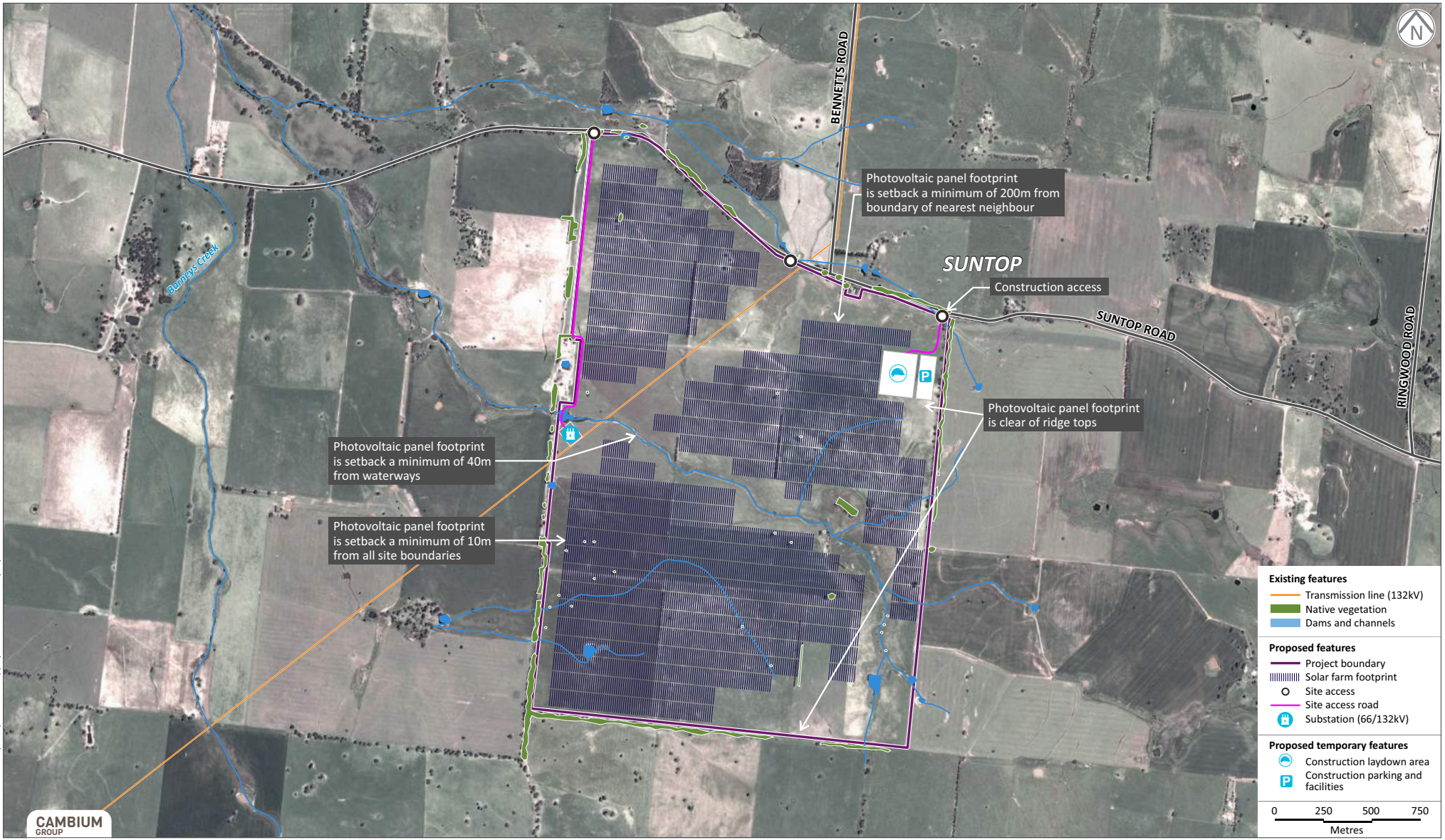

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4.2 Main components relevant to visual impact assessment

The main components of the Proposal are discussed below. Potential visual issues that may be associated with solar farms are discussed at **SECTION 5.0.**

PV panels

An estimated 550,000 PV panels would be installed. Each PV panel would be approximately 2 metres (m) x 1m in area, constructed of dark-coloured material covered with an anti-reflective coating. Each panel is comprised of 72 high efficiency monocrystalline cells with glass and aluminium frames.

The PV panels would be arranged in groups (arrays) which would run north/south, mounted on steel posts in rows approximately 11m apart. An example of the type of panels to be installed at Suntop is shown at **FIGURE 4-2**.

FIGURE 4-2: EXAMPLE OF TRACKER SOLAR (PV) PANELS (provided by Pitt & Sherry)

The mounting structure would provide a maximum panel height of approximately 4m at full tilt which occurs twice during the day - in the morning when facing east (9am), and in the afternoon when facing west (3pm). During the day, the panels would slowly tilt and in the middle of the day lie flat facing up, resulting in a panel height of approximately 2.3m at midday.

The steel posts of the mounting structure would extend between 1.6 to 4m below ground depending on geological conditions. The ground surface under the panels would essentially remain unchanged and covered with pasture grasses. An example of the type of mounting structure to be installed at Suntop is shown at **FIGURE 4-3.**

FIGURE 4-3: EXAMPLE OF GROUND-MOUNTING ARRANGEMENT (provided by Pitt & Sherry)

Inverters

Energy generated by the PV panels would be transferred from the arrays via cables to inverters. Approximately 10,000 PV panels would connect to each inverter. Two to three inverters would be housed within a single container ("inverter station") located at the end of rows of PV panels. There would be approximately 60 inverter stations across the Site.

The inverter stations would convert the energy from direct current (DC) to alternating current (AC). An image of the type of PV solar inverter station to be installed at Suntop is provided at **FIGURE 4-4.**

FIGURE 4-4: EXAMPLE OF PV SOLAR INVERTER & INVERTER STATION (provided by Pitt & Sherry)

The inverter stations to be installed across the site would follow one of the following options:

- 40 x 4.92 MW Ingeteam CON40 inverters (Dimensions: 12.2m long x 2.4m wide x 2.9m high) – housed in a 40' container.
- 59 x 3.20 MW Ingeteam CON20 inverters (Dimensions: 6.1m long x 2.4m wide x 2.6m high) – housed in a 20' container.

The inverter stations would be delivered fully containerised and be installed on concrete foundations, slightly elevated above the ground.

Colour treating the inverters, inverter stations, and ancillary structures proposed at the Site is one of the numerous mitigation measures proposed. A dark grey is proposed for the structures (although final colour choice would be determined during detailed design). A dark colour would have a receding effect, decreasing the visibility and contrast of the structures. Mitigation measures are discussed in detail at **SECTION 9.0.**

Substation

Energy would be conveyed from the inverter stations to the substation via underground electrical cabling. The substation is proposed to be located within the Site along the western boundary, over 1.5km from Suntop Road. An access road would be formed from Suntop Road close to the western boundary to provide access to the substation.

The substation would be operated by TransGrid. TransGrid's general arrangement for the substation is illustrated in **FIGURE 4-5.** The key features of the substation include:

- entry gate
- 3m high security fencing around the substation,
- 33kV switchgear building and auxiliary services building, and
- two transformers which would increase the voltage of the energy received from the inverter stations to a level that could be transmitted from the Site via the TransGrid powerlines.

An example of a similar substation is shown at **FIGURE 4-6.**

The substation would be constructed on a concrete pad, approximately 60m x 80m, with gravel placed around the equipment and fence to restrict vegetation growth and provide a safe working environment in accordance with Australian Standards.

A 10m asset protection zone (APZ) would be maintained around the substation in accordance with TransGrid design and safety standards.

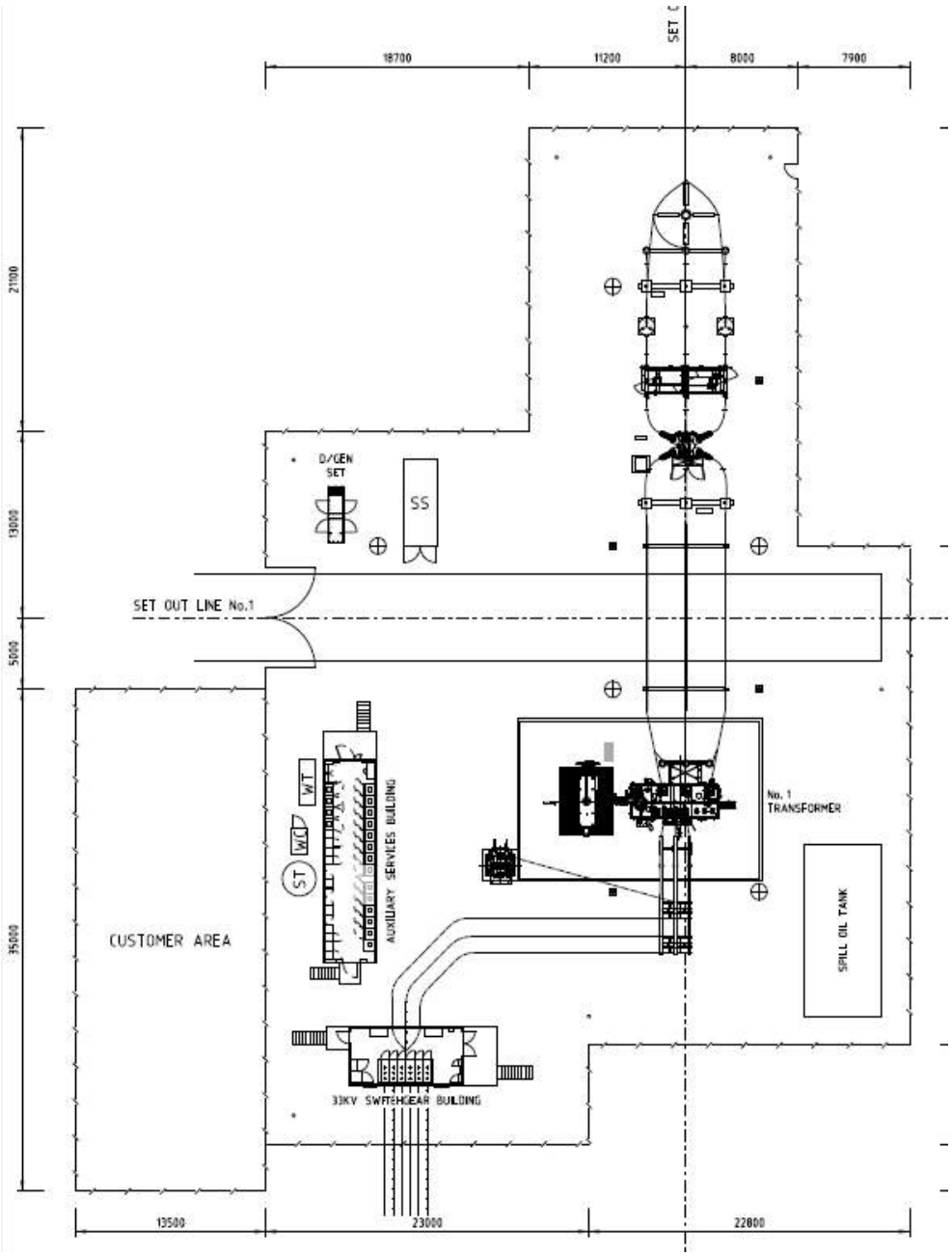


FIGURE 4-5: GENERAL ARRANGEMENT OF SUBSTATION (plan supplied by TransGrid)

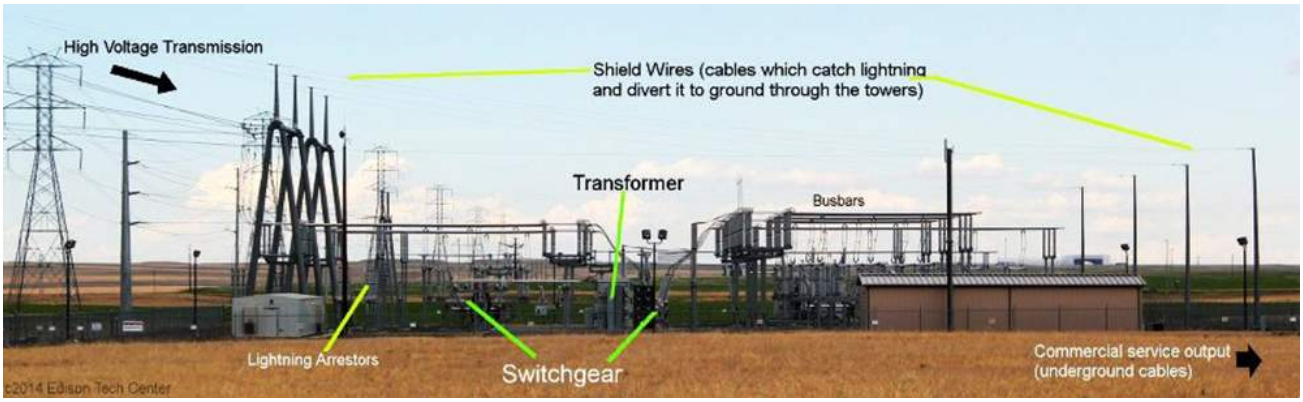


FIGURE 4-6: EXAMPLE OF A SIMILAR SUBSTATION TO THAT PROPOSED (supplied by Pitt & Sherry)

TransGrid infrastructure works

A short section of new overhead transmission lines (20m height, 132kV single-circuit, wood poles) would be installed to enter and exit the substation to connect to the existing 132 kV transmission line. This connection is subject to TransGrid detailed design however it is assumed that timber poles (similar to surrounding infrastructure) would be installed to carry powerlines from the substation to the 132kV transmission line.

Further works to connect to the existing TransGrid Wellington Substation would be undertaken by TransGrid and would occur wholly within the existing transmission line easement. TransGrid have advised their works would not result in any change to existing land use and has limited potential for environmental impacts due to the existing disturbed nature of the easement and temporary nature of the works.

Site access

Access to the Site would be from Suntop Road, a local, sealed road managed by Dubbo Regional Council. The main entrance to the solar farm would be located at the existing Site entrance, along the western boundary of the property. The main entrance road would also provide access to the proposed TransGrid substation.

Additional access roads are required across the Site for operations and would be formed between panel installations, wide enough for maintenance vehicles to move through. These internal roads would not be constructed or delineated due to the low frequency of proposed access.

A creek crossing would be constructed to gain access to the southern part of the Site.

A temporary site access would be formed off Suntop Road at the north-east corner of the Site for use during construction.

Parking and storage

A small parking area may be provided for worker's utility vehicles to park during periodic Site maintenance.

Two 40' shipping containers for storage of maintenance equipment would be located near the eastern boundary (within the compound area used during construction).

Emergency firefighting water would be stored in a tank (approximately 50,000 litres (L) in size - likely to be 4-5m in diameter and approximately 2-3m high), which may be located near the Site entrance (although the final location is yet to be determined).

Colour treating the storage containers and water storage tank (same as the inverters and other ancillary structures) is proposed in this report to reduce their visibility.

Site fencing

The perimeter of the Site would be bounded by security fencing (at least 1.8m high) with lockable access gates from the main access off Suntop Road and with 24/7 surveillance cameras. An example of the Site security fencing is shown at **FIGURE 4-7.**

The substation would have its own, additional security fencing – 3m high palisade security fencing installed around the perimeter of the substation – and additional security gate.

FIGURE 4-7: EXAMPLE OF A SIMILAR SECURITY FENCING TO THAT PROPOSED (supplied by Pitt & Sherry)

Planting

The Proposal for the solar farm includes tree planting around the boundary of the Site to screen and filter direct views into the Site. A Concept Landscape Plan is provided at **FIGURE 9-1.** Planting is one of numerous mitigation measures proposed for the solar farm. Mitigation measures are discussed in detail at **SECTION 9.**

Residence

The existing residence and built structures on the western side of the property are subject to a subdivision and would not form part of the Site.

4.3 Construction

The construction phase of the Proposal is expected to take twelve months. Up to 250 people would be required on Site during the peak construction period. It is anticipated that the solar farm would be constructed in 1ha stages – with up to 10 stages in construction at any one time.

No construction works are proposed to occur at night. Standard construction hours would be adopted.

Site establishment

A temporary construction compound would be installed along the eastern boundary of the Site. The location of the construction compound is shown on **FIGURE 4-1**. Access to the construction compound would be via a temporary access road off Suntop Road.

During construction, the traffic volume is expected to be up to 40 heavy vehicles (mostly B-double trucks), and 50 light commercial vehicles per day.

Initial site establishment works would include:

- Formation of a stabilised, tmporary construction access
- Materials laydown area
- construction offices (one 12m x 3m site office, four 12 x 3m break rooms)
- parking area (for approximately 80 vehicles)
- staff amenities
- CCTV (Security purposes)
- Fencing.

Preparation of the construction laydown area would include limited site grading, lining the ground surface and placing a gravel cap over the lining. Gravel and lining would be removed when the construction phase is complete.

Vegetation clearance

Vegetation to be retained would be protected. A buffer of 40m is proposed between infrastructure and any waterway and the majority of existing vegetation on Site would be avoided.

Minor vegetation clearing is proposed. Vegetation clearance would be targeted to grasses, shrubs and isolated trees located at proposed trenching areas, and where steel post installation is proposed.

Earthworks

Minor earthworks would be required to prepare the ground for footings and concrete slabs to install the inverters, transmission kiosk and substation. The earthworks would temporarily expose the red soils of the Site. A range of plant may be used including scrapers, bulldozers, excavators, rollers, trucks, backhoe and loaders.

Trenching (up to 1.2m deep) would be required over the Site to lay the interconnecting cabling. The trenches would be backfilled.

Pile driving (approximately 1.6m to 4m deep) would be required to install the supporting structures for the solar panels.

Minor, localised earthworks may be required beneath the PV panels to achieve more consistent gradients. However, broadscale, levelling/benching across the Site is not required to install the PV panel mounting structures.

Delivery

Most of the infrastructure for the solar farm would be pre- fabricated off-site, delivered and then assembled on-site. Trucks would transport the modular equipment to Site via Suntop Road. Suntop Road, Renshaw McGirr Way, and the Mitchell Highway (21km west of the Site) would be the major transport routes for haulage and Site vehicles during construction.

A truck parking area would be provided at a suitable location either within Wellington or on the outskirts of the town. In the event a suitable location cannot be found, a suitable site at Dubbo would be investigated.

Installation

Plant required to install the components of the solar farm would likely include excavators, cable trenching equipment, elevated work platform, backhoes, bulldozers, scrapers, rollers, pile drivers, trucks, fork-lifts and cranes.

The PV mounting structures would be driven or screwed into ground using a pile driver or similar. Additional support structures would be attached to the steel mounting structures and the PV panels would then be crane-mounted onto the support structures.

New powerlines would be installed (if required) and the substation would be connected to the existing transmission line to convey the energy.

The main Site access road along the western boundary of the Site would be upgraded.

The inverters, inverter stations and other ancillary buildings would be installed (including the two shipping containers to be used for storage of maintenance equipment).

Proposed planting would be undertaken.

4.4 Operation

The Proposal would operate 24 hours a day, 7 days a week, however, this would not involve the presence of staff on-site or active operations. Night operations are not required for the solar farm or for the substation, and ordinarily, there would be no night lighting at the site. Any lights installed would only be illuminated in an extraordinary event (such as an emergency).

The Site would have remote 24/7 on-line monitoring and 24hr site security response would be available should a security event occur.

Irregular maintenance activities will be undertaken during standard working hours (except in an emergency) and are expected to include:

- Panel cleaning
- Repairs, cleaning or replacement of infrastructure, as required
- Mowing or stock management activities to control vegetation.

4.5 Decommissioning and rehabilitation

The Proposal is intended to be operational for approximately 30 years. At the end of this period, the solar farm would either be decommissioned or updated for continued use. If the Site is decommissioned, all structures (with the exception of the substation) would be removed and the Site would be rehabilitated and returned to agricultural use.

5 Potential visual concerns

A review (by others) of studies of social-cultural attitudes and renewable energy acceptance, based on surveys from 13 countries, concluded that "the singularly most important concern about renewable energy is visual intrusion"[8].

This section of the report briefly discusses, and seeks to address, some of the potential visual concerns the community may have related to PV solar farms. The impact assessment presented in **SECTIONS 6.0 and 7.0** takes account of concerns where relevant.

5.1 Scale

Large scale solar facilities can occupy very large land areas, have regular, strong geometry, and can be visible for long distances. One study found that large PV solar facilities are not uncommonly visible at a distance of 16km[9], yet it is notable that, when viewed from long distances, the facilities may not be recognisable as solar facilities.

FIGURE 5-1 provides a visual comparison of the height of PV panels compared to other familiar elements, illustrating the overall low profile of the Proposal.

Although large, such solar facilities have visual advantages in that they are generally low to the ground, have low visual contrast, and can appear as shadows from a distance [10]. Depending on the project layout and contrast, in some cases they may appear to be natural features, while in other cases, they may lack sufficient visual detail to be identified positively as solar facilities[11].

5.2 Glint and glare

Glint is generally defined as a momentary flash of light. Glare is a longer and for some time continuous source of light reflection.

In desert areas, glare has been observed from parabolic trough facilities and solar array facilities[12]. The Proposal does not use these technologies. These types of solar facilities concentrate thermal solar power by using mirrors to reflect the sun to one point, concentrating the sunlight. The PV solar modules proposed to be installed at Suntop are non-reflective and do not use concentrating mirrors.

The *NSW Department of Industry Resources & Energy: Solar Farms in NSW Fact Sheet* (June 2016) states:

[8] Apostol, Dean (2017) *The Renewable Energy Landscape*. Routledge. (Apostle 121)

[9] Sullivan, R. et.al. (2012). *Visual impacts of utility-scale solar energy facilities on southwestern desert landscapes.*

[10] Sullivan et al. (2012). *p14*

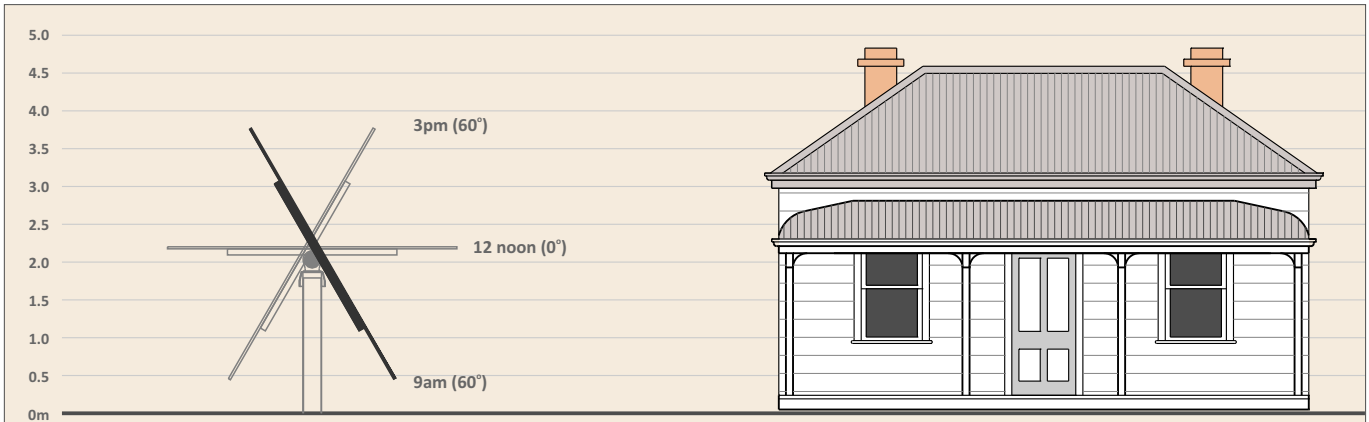
[11] Apostol, Dean. (2017) (Apostle 21)

[12] Sullivan et al. (2012). *p16*

FIGURE 5-1

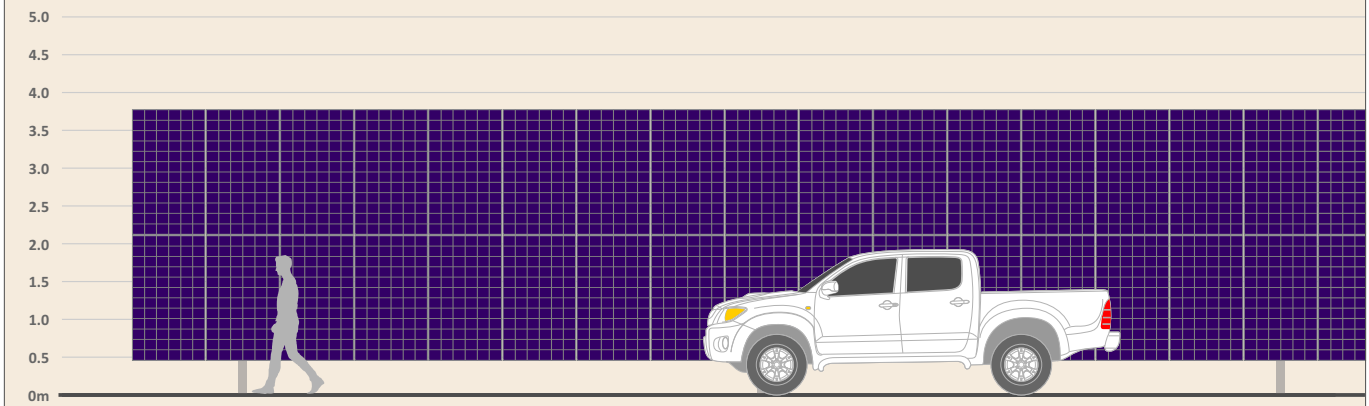
Photovoltaic solar panel height comparison (Tracking)

SUNTOP - VISUAL IMPACT ASSESSMENT

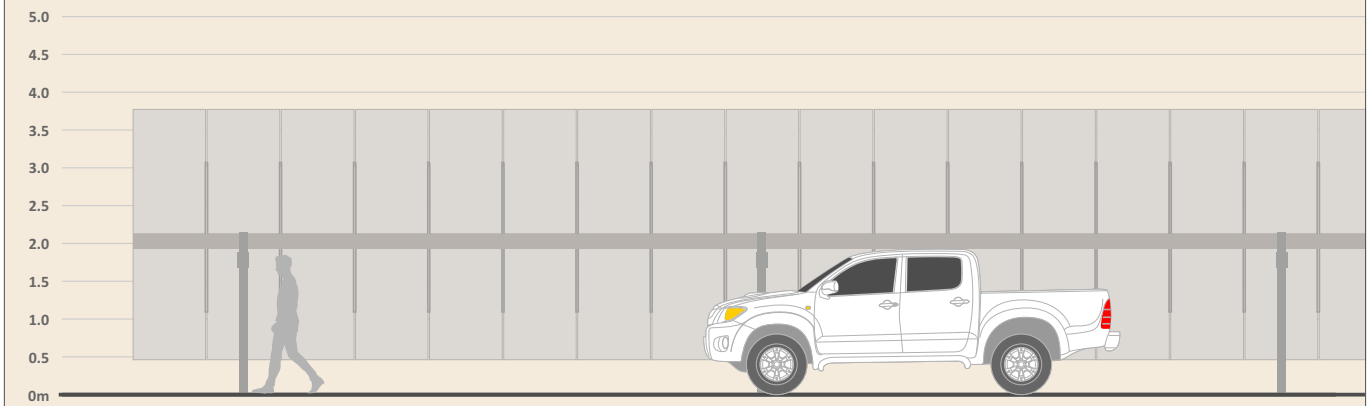


NORTH/SOUTH ELEVATION

FARM HOUSE



EAST ELEVATION (9am - 60°)



WEST ELEVATION (9am - 60°)

INDICATIVE ARRANGEMENT

CAMBIUM GROUP

Solar farms are not considered to be reflective. Photovoltaic panels are designed to reflect as little light as possible (generally around 2% of the light received) to maximise their efficiency, absorb sunlight and convert it to electricity. Minimising the light reflected from solar panels is a goal of panel design, manufacture and installation. The glare from panels is significantly less than that from bodies of water.

A comprehensive study of potential for glint and glare was undertaken for the proposed Sapphire Solar Farm near Glen Innes, NSW (Pager Power, November 2017). The proposed solar farm would comprise PV solar 'tracking panels'.

The study reviewed a substantial amount of available literature and found that:

- *Glint and glare effects can only ever occur when the weather is clear and sunny*
- *The reflections produced are of intensity similar to or less than those produced from still water and significantly less than reflections from glass and steel*
- *In the scenario where a solar reflection is possible towards a road user or resident in a surrounding dwelling, the individual will also be looking in the general direction of the Sun. This means the Sun and solar reflection will be visible simultaneously. The Sun is a significantly brighter source of light.*
- *Lastly, at any one location, only a particular area of solar panels will produce a solar reflection towards it.*

The study concluded:

- *'the overall expected impact upon road users with respect to safety is classified as Low (at worst) where the reflecting solar panels are visible*[13]
- And that for residents, *'The solar reflections would last for up to 20 minutes per day for up to 6 months from windows with a clear view of the reflecting solar panels... In all cases, a clear view of the reflecting solar panels at the particular time of day when a solar reflection was geometrically possible would be required. In addition, the weather would also have to be clear and sunny…the resulting impact significance is Low to Moderate. If screening removes the solar panels from view, No Impact will be possible.*
- *If mitigation were to be requested, the most appropriate form would be the installation of screening in the form of vegetation.*

Therefore, based on available information, and in-line with the *NSW Department of Industry Solar Farm Fact Sheet*, glint and glare are unlikely to be an issue for surrounding residents or road users.

[13] Pager Power, 2017, p3

5.3 Light refraction

A 'mirage' effect — glittering or shimmering — may be observed at PV facilities. The effect is similar to the shimmering seen over a bitumen road on a hot day which can make the road surface appear as though it is wet, rippling or reflective (refer to **FIGURE 5-2).**

FIGURE 5-2: 'MIRAGE EFFECT' ON ROAD ON A HOT DAY

The effect occurs because the surface of the road is hotter than the air around it. In the case of PV panels, heat from the panel surface warms the air above it, distorting (refracting) light waves. The air wobbles and makes the colour above the surface appear brighter and bluer[14].

The 'mirage' effect is not bright enough to cause discomfort. It is likely to be only observed during certain times of day and from certain viewing positions. **FIGURE 5-3** shows the effect (although difficult to see) from an elevated position (45m higher), north-east of, and 2.75km from, Royalla Solar Farm, the Australian Capital Territory (ACT). Another image of the Royalla Solar Farm is provided at **FIGURE 5-5.**

It is to be noted that the Royalla Solar Farm is not a directly comparable visual example as it is comprised of fixed-angle panels.

[14] Adapted from:
- The Naked Scientists, 01/06/2008, https://www.thenakedscientists.com/forum/index.php?topic=14849.0
- Physics, 26 May 2011, https://physics.stackexchange.com/questions/10464/why-does-the-road-look-like-its-wet-on-hot-days

FIGURE 5-3: PHOTOGRAPH OF ROYALLA SOLAR FARM NEAR CANBERRA (2.75km from solar farm)

5.4 Geometric pattern and viewer position

Viewer position in relation to the layout of PV modules also affects the appearance of the solar farm. An image showing viewer position in relation to the rows (arrays) of PV modules is shown at **FIGURE 5-4.** Viewer position determines which side of the PV modules is in view, and therefore which angle of surface is seen with respect to the viewer.

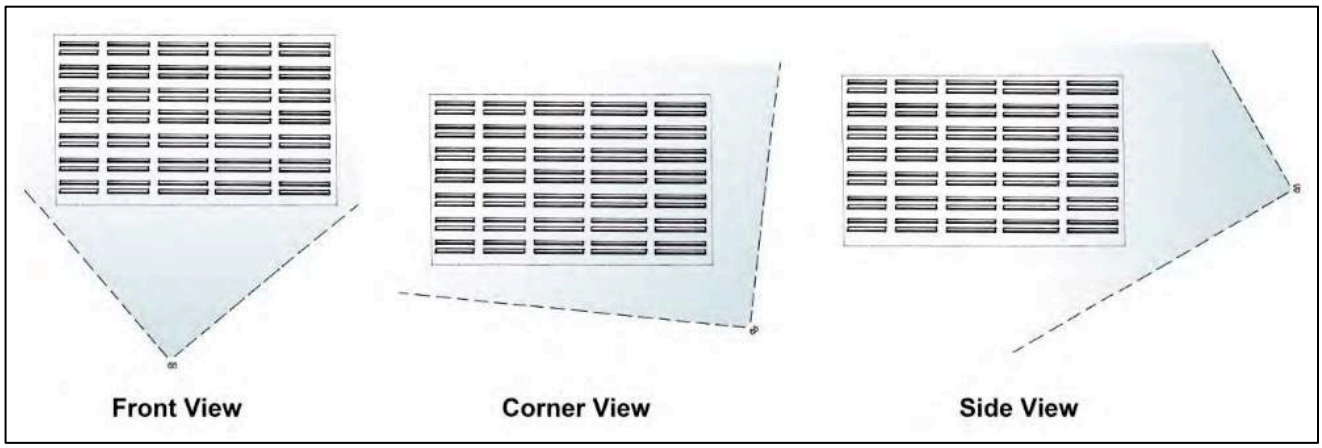


FIGURE 5-4: VIEWER POSITION IN RELATION TO PV PANELS (Argonne National Laboratory[15])

From some viewer positions it may be possible to see down the long rows (arrays) of the PV solar modules. If travelling past rows perpendicular to a road, the rapid change in viewer position would result in abrupt changes in angle and pattern of the panels. The colour of the panels would appear to change rapidly from black (when viewing the rear of the panels) to various shades from blue to white (when viewing the face of the panels). The visual change – the lightening or darkening appearance of the panels as the vehicle passes the facility[16] - would only be seen if looking directly down the rows when travelling past at speed and would be momentary[17].

Colour change in relation to viewer position is shown in the image at **FIGURE 5-5** (taken 200m from the nearest panels at Royalla Solar Farm, ACT). When viewing the face of the panels, the panels appear lighter in colour – with shades of blue to white. Looking at the rear of the panels, the panels appear black as they cast shadow.

However, as previously noted, the Royalla Solar Farm is not a directly comparable visual example as it is comprised of fixed-angle panels permanently facing the same direction. The proposed solar farm at Suntop would comprise tracking panels which slowly move throughout the day, changing their angle and direction.

[15] In Sullivan, R. and Meyer, M. 2014.

[16] Sullivan, R (2012) p22

[17] Sullivan, R et.al. (2012) p22

FIGURE 5-5: ROYALLA SOLAR FARM SHOWING COLOUR CHANGE WITH SIDE VIEW

5.5 Aviation

Aviation warning lights are required for towers and other tall structures which may be a hazard to aircraft. Normally these would be red flashing lights. As the proposed solar panels are low-profile, aviation warning lights are not required.

The solar panels also do not need to be painted white (such as would be required for wind turbines) as an aide to aerial navigation safety. There would be no colour contrast from the solar panels as a result of aviation safety requirements.

There is no movement (visible to the naked eye) that would be associated with the solar farm infrastructure. Therefore, motion would not be an obstruction to aviation.

The Proposal would not include solar towers or other structures that would contrast with dark night skies. The Proposal would not include mirrors or lenses or other reflective surfaces.

It is understood that the Civil Aviation Safety Authority (CASA) has generally advised that large scale solar farms, such as that proposed, are very unlikely to be a hazard to aircraft operations unless they are very close to and aligned to an airports approach or take off paths. The Proposal does not fall into that category.

5.6 Movement

Fixed solar panels are permanently oriented toward one aspect (north). Tracking PV solar panels, however, slowly follow the daily transverse of the sun in a 180 degree turn from the north-east in the morning, to the north-west by the afternoon. There is a wider range of potential viewpoints which may face moving panels during the day, however, their exposure to the face of the panels would be shorter in duration.

Although solar panels may change their orientation during the day, the movement is usually very slow and not apparent in short-duration views[18].

5.7 Skylining

Skylining occurs when structures are placed on ridgelines, summits, or other locations where they would be silhouetted against the sky. The eye is naturally drawn to prominent landscape features and high points[19]. Examples of skylining can be seen with power poles, telecommunications towers and wind turbines that are installed on ridges in rural landscapes.

PV solar panels are low-profile. Therefore, skylining is unlikely to be an issue unless the panels are located on prominent, exposed, high points, which drawn the attention of the viewer.

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[18] Sullivan, R. and M Meyer. 2014. p50

[19] United States Department of the Interior. 2013. *Best Management Practices for Reducing Visual Impacts of Renewable Energy Facilities on BLM-Administered Lands*. BMP 6.2.12

5.8 Ancillary structures

PV solar farms require a high number of inverters and ancillary structures to be installed across the Site. Multiple inverter stations (at 2.9m high x 2.4m wide x 12.2m long) are installed at the end of PV solar panel rows to convert the energy produced by the panels. The colour of such ancillary PV solar farm structures may contrast against the background landscape of the solar fam and could have the effect of drawing attention to the multiple structures laid out in a grid pattern across the farm.

The colour of ancillary structures is therefore important. Inverters and other facility components that are colour-treated two to three shades darker than the background landscape colour, better match the surroundings and decrease their visibility and contrast. White is generally the most conspicuous colour. Lighter colours should be avoided.

An example of white coloured inverters and other solar farm buildings is shown at **FIGURE 5-6,** Royalla Solar Farm, near Canberra, ACT. An example of a colour-treated inverter is shown **FIGURE 5-7,** at Williamsdale Solar Farm, near Canberra**.** These images show that the use of darker, more-recessive colours can lower visual contrast and potential visual impact.

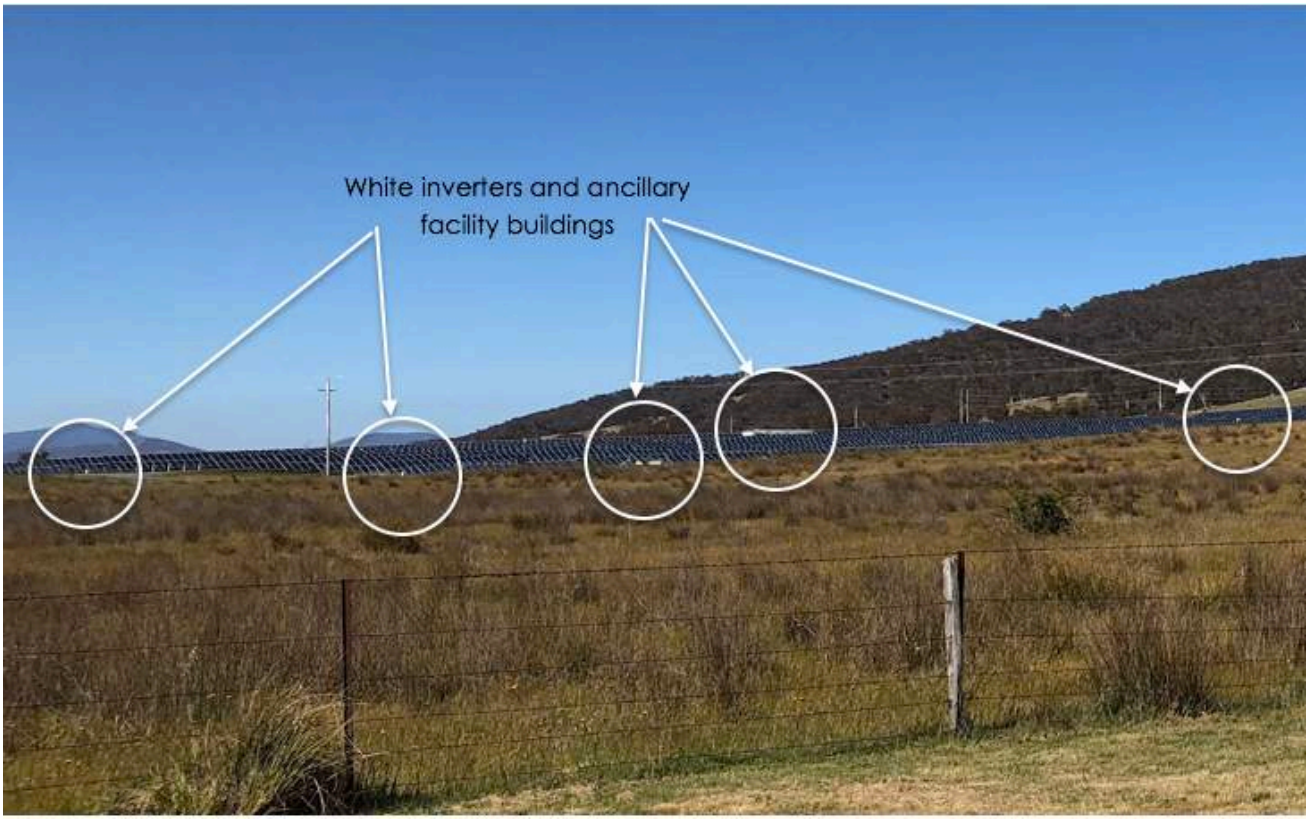

FIGURE 5-6: ROYALLA SOLAR FARM SHOWING WHITE ANCILLARY STRUCTURES

FIGURE 5-7: WILLIAMSDALE SOLAR FARM SHOWING COLOUR-TREATED INVERTERS

6 Impact to landscape character

The landscape character of the vicinity has been described at **SECTION 3.0.** This section of the report describes the changes in visual quality and character of the landscape caused by the Proposal. As noted in **SECTION 2.0,** the assessment of impact is based on the combination of two criteria: sensitivity and magnitude of change.

6.1 Sensitivity

The existing rural setting of Suntop is typical of the mid-western region. The landscape occasionally includes industrial-type elements, such as silos and sheds, and the land surface is often divided into grids and rows via fences, trees, and cropping patterns. However, the installation of a large-scale PV solar farm within the rural setting of Suntop would introduce a new, significantly large (although low-profile), human-made element into the agricultural landscape.

The colour contrast of the solar panels may be more evident in warmer months during wheat growing and harvesting. The dark colour of, and shadows cast by, the solar panels would contrast against the light, bright colour of the crops. The local landscape of broadacre paddocks, however, also creates a variety of patterns and background colours depending upon the crop or use of the land. Linear shadows are also cast by existing rows of trees within and around the Site.

Existing Site infrastructure (such as the sheds and silos) is taller than the proposed infrastructure, although, the Proposal would cover a larger land area.

Using the criteria listed in **TABLE 2-2,** the overall landscape character is rated as having **moderate** sensitivity:

- The landscape does not have particular high scenic significance; however, it is an attractive working, rural landscape, typical of the mid-western NSW agricultural area
- The patterning of the area is broadscale, with large agricultural farming lots
- There is a small local population, with the only access road to the Site, Suntop Road, not a main, through road.

6.2 Magnitude of change

Construction

The construction footprint would affect a large area – over 470ha. During construction, residents and visitors driving along Suntop Road would likely see machinery and equipment on the slopes of the Site installing the PV panels and inverters. However, construction of the substation would not be seen.

A key construction impact would be the number of trucks accessing the site to deliver equipment, and daily arrival and departure of construction worker's vehicles. Suntop Road would be affected by the number and frequency of transport movements. The construction compound and construction carpark (proposed to be located along the eastern boundary) would be seen from Suntop Road.

Using the criteria listed in **TABLE 2.2**, the magnitude of change to landscape character during construction is rated as **moderate**. There would be:

- Large extent of area affected
- Construction would be the dominant feature of the scene, but principally, only visible from the immediate area of Suntop Road
- The local road would be disrupted by frequent truck movements.

Operation

Once construction is completed, PV solar panels and inverters would be visible from Suntop Road and from several private properties. The substation, located over 1.5km from Suntop Road and at a lower elevation, would not be seen by Suntop Road users. There is one private property likely to have views of the substation (the impact to individual residents is assessed in **SECTION 7.0**).

The extent of land covered by the panels would be large – occupying the area of approximately 10 paddocks of common size in the vicinity. However, the undulating nature of the Site would restrict the extent of panels and inverters seen. In addition, due to the low profile of the panels and shadows created by the panel rows, the solar farm is unlikely to be particularly prominent, especially when viewed at a distance.

Colour-treating the inverters, as well as other structures on the Site as proposed in the mitigation measures (refer **SECTION 9.0**), would reduce their visibility. Proposed planting at perimeter locations of the PV solar farm (as proposed in the mitigation measures (refer **SECTION 9.0**), would restrict close views of the panels and inverters (in approximately 5 years from construction, allowing time for plants to grow sufficiently). From a distance, the PV solar farm would appear as dark shadow.

Using the criteria listed in **TABLE 2.2**, the magnitude of change to landscape character during operation is rated as **moderate**:

- The Site is not visually prominent
- The scale and colour of the PV solar farm would contrast the surrounding rural landscape, however, given the low-profile of the proposed Site structures and proposed dark colours, the PV solar farm would not be visually prominent
- The Proposal would be recognisable at close proximity until the proposed planting has time to grow sufficiently, however, given its low profile and proposed dark colouring, even in the interim period, the PV solar farm would not become the dominant feature of the scene

- The substation, located 1.5km from Suntop Road and at a lower elevation, would not be seen by travellers of Suntop Road

6.3 Level of impact to landscape character

Construction

The moderate sensitivity ranking, combined with the moderate magnitude of change during construction, leads to an overall moderate level of impact.

Operation

The moderate sensitivity ranking, combined with the moderate magnitude of change post-construction, leads to an overall moderate level of impact.

7 Impact to viewpoints

This section of the report assesses the potential effects of the changes on the viewer experience.

7.1 Identification of viewpoints

Fifty-seven potential viewing points were initially investigated during the site inspection (22 November 2017)[20]. Identification (ID) numbers were allocated to identify each viewpoint. Site verification determined that 27 viewpoints of the 57 viewpoints initially investigated could potentially see some sections of the proposed solar farm.

7.1.1 Private viewpoints

The majority of the identified viewpoints were from private residences. Access to four of the closest private properties[21] was possible during the site inspection. For the remainder of properties, visibility was determined from the closest public access to each viewpoint and desktop analysis of aerial and topographic mapping.

Generally, residences with potential viewpoints located within 2km of the Proposal site were assessed as individual viewpoints. However, due to the large number of potential private viewers, and the relatively similar visual experience from some locations, viewpoints beyond 2km were grouped based on their common experience of:

- distance from the Proposal;
- extent of the Proposal likely to be seen; and
- viewer position in relation to the proposed panels.

7.1.2 Public viewpoints

The closest recreational and scenic resource in the area – Mount Arthur Reserve – does not provide public viewing points. ID20, however, is located in an elevated position within the Reserve.

The only ground-level public locations with views of the Proposal site are from Suntop Road and Bennetts Road (refer **FIGURE 3-2**). Bennetts Road is an unsealed road providing local access to several properties. Suntop Road is the main public vehicular thoroughfare through Suntop. Suntop Road has been assessed as single viewpoint (VP Suntop Road), as the visual experience from the road is linear.

[20] A map of the viewpoints investigated is provided at **APPENDIX A, FIGURE A-1**.

[21] ID numbers 1, 7, 10 and 27, Appendix A, Figure A-2.

7.1.3 Aerial viewpoint

There could also be views of the Proposal from aircraft accessing the local Wellington Airport, which is situated approximately 20km to the north-east of the Site. Wellington Airport does not support commercial flights and is primarily used for private light aircraft. Some airborne viewers may find a solar (PV) farm interesting to look at - others may feel it reduces the quality of the landscape character.

There are other large-scale industrial-type facilities in the area that would be seen from the air (such as Wellington Correctional Centre and intensive poultry farm sheds – both located north east of Wellington), however, none are of the scale of the proposed solar farm. Regardless, from an airplane, the proposed solar farm is most likely to appear dark in colour, similar to shadowing and vegetation, and would likely have a similar dark appearance as that of the Mount Arthur Range.

7.2 Assessment of viewpoints

Each viewpoint, or viewpoint group, identified for assessment is shown in **TABLE 7-1**[22]. The table presents:

- the key factors affecting each viewpoint's visibility, and
- identifies the projected impact rating of each viewpoint at the time of construction.

The potential to further reduce impact through the implementation of mitigation measures has also been assessed for each viewpoint (or group). The proposed mitigation measures include planting around the boundary of the Site to screen and filter direct views (as per the Concept Landscape Plan provided at **FIGURE 9-1**). In most cases, trees and shrubs take several years to grow to a height that could successfully screen through views. Therefore, the assessment findings at **TABLE 7-1** identifies the projected rating five years following construction – whereby visual impact is reduced to an extent through screen planting.

A map showing the location of each viewpoint and its initial rating is provided at **FIGURE 7-1.**

[22] The original ID numbers used in the site investigation (22 November 2017) have been retained for consistency, therefore, the VP numbers are not consecutive.

TABLE 7-1: ASSESSED VIEWPOINTS AND PREDICTED VISUAL IMPACT LEVELS

Viewpoint (VP)	Analysis	Distance to nearest view of panels (approx.)	Approx. extent of Site potentially seen	Viewer position in relation to panels	Sensitivity (criteria in TABLE 2-1)	Magnitude of change (criteria in TABLE 2-2)	Impact level (criteria in TABLE 2-3)	Could impact be reduced with mitigation?	Impact level with mitigation measures implemented (5yrs following construction)
VP1 - Lot 53 DP 753238, approximately 490m from the Site boundary	The residence at VP1 is on an elevated ridge However, direct views from the house are not possible The Site is seen from the paddock east of the residence From the viewpoint east of the residence, a moderately large proportion of the PV solar farm could be seen Could potentially see the substation During the late afternoon, the front of the tracking panels would be seen as the panels tilt to face the west Throughout the morning, a rear view of the panels would be seen The closest row of the panels would be half a kilometre away	550m	Less than half (40%)	West	High	Moderate	Moderate-high	Extent of panels and inverters likely to be seen could reduce via screen planting near the boundary between the Site and VP1 property. Planting along the boundary could also reduce views of the substation	Moderate. Due to proximity and elevation of VP1, views of the PV panels (particularly the rows closest to VP1) and substation would reduce through planting, however, panels over some parts of the Site would remain visible above the height of screen planting
VP2 – 898 Suntop Road, Suntop (Lot 97 DP 753238),	The viewpoint is a private home; however, existing vegetation within the property and along Suntop	850m	Less than a quarter of site (20%)	North-west	High	Low	Moderate	Planting near the Site's northern and western	Moderate-low

approximately 780m from the Site boundary	Road obstructs much of the view A moderate proportion of the solar farm would be seen, although obstructed by existing vegetation, reducing the view substantially During the late afternoon, a view of the face of the tracking panels may be possible, although the view is at an angle, not directly front-on to the panels Is unlikely to see the substation							boundary would reduce views into the Site	
VP3 - 796 Suntop Road, Suntop (Lot 2 DP 983890), approximately 160m from the Site boundary	Is in close proximity to proposed panels and inverters (350m to nearest panels) Is opposite the Site entry (which would also be a second entry during construction) A relatively small proportion of the Site would be seen Is generally at same elevation as Suntop Road Existing trees along Suntop Road may substantially reduce views to the Site from the residence. However, access to the house was not possible during the Site inspection to confirm this, therefore, a worst case has been assumed	350m	Less than a quarter of Site (15%)	North	High	Moderate	Moderate-high	Views into the Site would reduce via screen planting along the northern 'Suntop Road' boundary	Moderate-low

	The viewpoint would potentially look down the long rows of PV panels. The viewer would not face the panels directly. Rather the viewer would see a side view of the panels (refer **FIGURE 5-4** and **FIGURE 5-5**), and see the angle of the panels change throughout the day as they tilt on their axis from east to west. Colour changes from viewing the long rows of panels at different angles would be likely Is unlikely to see the substation								
VP4 – 14 Bennetts Road, Suntop (Lot 92 DP 753238), approximately 270m from the Site boundary	The viewpoint is in close proximity to the Site boundary (270m); however, the nearest panels would be approximately 400m away A relatively small proportion of the Site would be seen Existing trees within VP4 property and along Suntop Road potentially reduce views to the Site from the residence The viewpoint would potentially look down the long rows of PV panels. The viewer would have a side view and see the panels on an angle as they tilt on their axis from east to west during the day. Colour	400m	Less than a quarter of Site (15%)	North	High	Moderate	Moderate - high	Views would reduce via proposed screen planting along the northern 'Suntop Road' boundary, and planting within VP6 property	Moderate-low

	changes from viewing the rows of panels at different angles would be likely The substation is unlikely to be seen								
VP5 – Lot 51 DP 1082497, approximately 380m east of the Site boundary	The closest panels to the viewpoint would be half a kilometre away A relatively small proportion of the Site would be seen Trees between the property and the solar farm would likely limit views The private home would potentially view the face of the panels in the morning, although the view is at an angle, not directly facing the panels Later in the day a rear view of the panels would be seen The substation is unlikely to be seen	500m	Less than a quarter of Site (4%)	North-east	High	Low	Moderate	Views into the Site would potentially reduce via screen planting along the northern 'Suntop Road' boundary	Moderate-low
VP6 – Lot 90 DP 657805, immediately north of the Site	Located immediately north of (adjoining) the Site, on the southern side of Suntop Road This is the closest residence to the proposed panels and inverters The property is lower in elevation than the surrounding solar farm Site The property faces north, and views are directed	200m	Less than a quarter of Site (15%)	North	High	High	High	Planting is proposed within the VP6 property. Planting includes shrubs and trees to create a dense screen along the three sides of the property	Moderate. Ultimately, if dense enough, the planting could completely screen views of the solar farm from this property. However, the visual change is still assessed

	northward, away from the proposed solar farm A relatively small proportion of the solar farm would be seen, however, views of the panels would be possible from three sides of the property From the yard of the property, in the morning, when looking west, the viewer would face the front of the panels. In the afternoon, when looking east, the viewer would again face the front of the panels At all times of the day when looking south, the viewer could potentially look upon the long rows of PV panels. The viewer would see the panels at a side angle (refer **FIGURE 5-4** and **FIGURE 5-5)**, as they tilt on their axis from east to west during the day. Colour changes from viewing the long rows of panels at different angles is likely The substation would not be seen VP6 would also be in close proximity to the proposed construction compound and would be the closest residence to the construction area.							bordering the Site. Screen planting is expected to substantially reduce views into the Site	as moderate due to the permanent magnitude of change. The setting of VP6 would have changed from a residence adjacent an open paddock, to a residence surrounded by dense native vegetation

	Although the interruption and visual disturbance resulting from construction and construction traffic accessing the compound would be temporary, the works would be a visually obvious and unavoidable change to the scenery and directly observable from VP6								
VP7 – 582 Suntop Road, (Lot 50 DP 753238), approximately 950m north of the Site	This viewpoint is over a kilometre from the nearest panels and inverters It is a private residence in an elevated positon, however direct views to the Site from the house are not possible A moderate proportion of the Site potentially seen The solar farm site would be seen from the paddock west of the residence The viewer would have a side view of the tracking panels. However, at this distance, colour changes from looking down the rows of panels may not be noticeable The substation would not be seen	1050m	Approximately a quarter of the Site (25%)	North	Moderate	Moderate	Moderate	Planting along Suntop Road would not be seen from this viewpoint due the its elevation above the Site	Moderate
VP Group A – ID13, ID15 and ID16	This group of viewpoints is within 2.5km of the Site boundary(approximately) Small to moderate	2.35km	Up to half of Site (up to 50%)	North to west	Low	Low	Low	Proposed planting unlikely to reduce views from these	Low

	proportion of the Site potentially visible ID13 and ID15 would have a distant view of the face of the panels during the late afternoon. For the remainder of the day, the rear of the panels would be seen. For ID16, a side view of panels may be possible. However, from all three viewer positions, the extent of panels seen would be minimal and unlikely to be prominent in the view Substation unlikely to be seen							viewpoints	
VP Group B – ID28, ID32 and ID38	More distant from Site boundary (2.5 to 5km) Located west of the Site Large extent of Site potentially visible although Site unlikely to be prominent in the view During the late afternoon, the face of panels would orient toward the viewer. For the remainder of the day, a rear view of the panels would be most likely Existing vegetation likely to reduce potential viewing area Potential views of the panels would have minimal visibility	4km to nearest view of panels	Over half of Site (up to 75%)	West	Low	Low	Low	Proposed planting along the vicinity of the western boundary of the Site may reduce views into the Site	Negligible

	Views of the substation unlikely								
VP Group C – ID20, ID30, ID31, ID34, ID35, ID55, ID56	More distant from the Site boundary (5km or more), located north-east to north-west of the Site, with only small proportion of the Site potentially seen During the early afternoon (early morning for ID20), a view of the face of the tracking panels may be possible, although the view is at an angle, not directly facing the panels Substation would not be seen Due to distance from Site and the siting of PV panels to avoid higher ridges on the site, potential views of the panels would have minimal visibility. Solar farm unlikely to be prominent in the view	6km to nearest view of panels	Over half of the Site (up to 75%)	North-east to north west	Low	Negligible	Negligible		Negligible
VP Group D – ID40 and ID41	Over 5km from the Site Located west of the Site During the late afternoon, the viewer would face the front of the panels Substation unlikely to be seen A moderate proportion of the Site possibly seen Views likely to be obscured by trees Solar farm unlikely to be	7.25km to nearest view of panels	Up to a half of the Site (50%)	West	Low	Low	Low	Screen planting along the western Site boundary may reduce view	Negligible

	prominent in the view Due to distance from Site and the siting of PV panels to avoid higher ridges on the Site, potential views of the panels would be limited								
VP Group E - ID26, ID42, ID50, ID52	Distant from the Site (over 5km) Located south of the Site Would see side angle of panels although tilt of panels is unlikely to be discernible Moderate proportion of the Site seen with side or rear view of the panels seen Substation would not be seen Solar farm unlikely to be prominent in the view Due to distance from Site and the proposed PV panels avoiding higher ridges on the Site, potential views of the panels would be very limited	6km to nearest view of panels	Up to a half of the Site (up to 50%)	South-east to south-west	Low	Negligible	Negligible		Negligible
VP Suntop Road (linear viewpoint)	Travellers using Suntop Road pass immediately to the north of the Site The road is in close proximity to the Site, however, the distance to the proposed panels and inverters ranges from 75m to 200m or more as the viewer travels along the road	75m to the nearest view of panels	15%	North	Moderate	Moderate	Moderate	Views into the Site likely to reduce via screen planting along the northern 'Suntop Road' boundary	Moderate-low

	The PV modules would be in rows perpendicular to the road. Therefore, when travelling past the solar farm, the viewer is likely to see the colour of the panels change rapidly from black to various shades from blue to white, lightening in appearance as the viewer position changes. This visual change would only be seen if looking directly down the rows when travelling past at speed, and would be momentary Views are temporary Substation would not be seen A relatively small proportion of the Site seen								

FIGURE 7-1

Predicted visual impact levels for identified viewpoints

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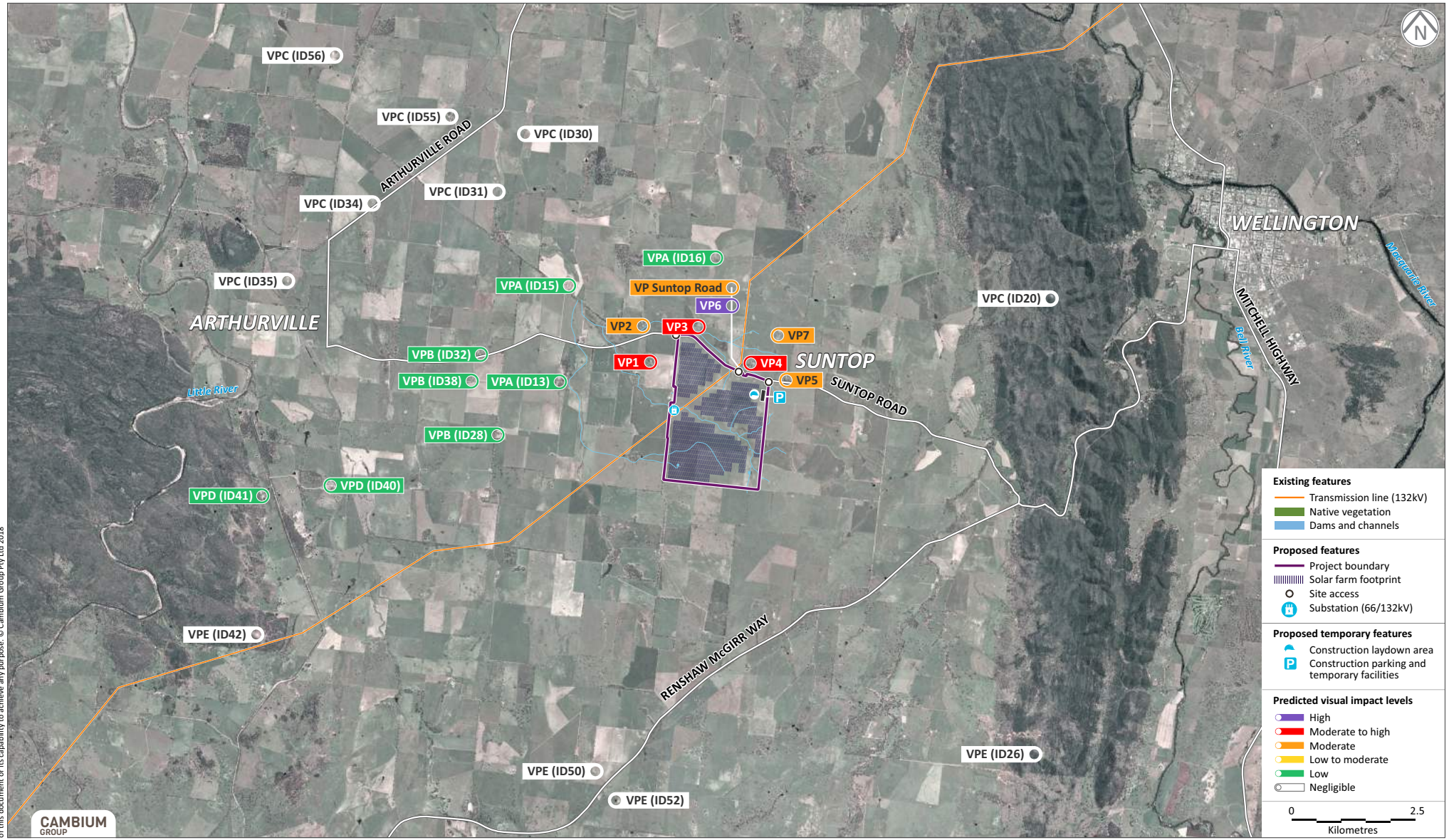

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7.3 Summary of results to viewpoints

In summary, the assessment of impact to viewpoints finds there are 26 private viewpoints with potential views of the proposed PV solar farm, one with potential views of the substation, and one public, linear viewpoint. Several potential viewpoints would view the face of the PV panels, however, their exposure to the face of the panels would be shorter in duration in comparison to fixed angle panels that did not move during the day.

Ratings are summarised below:

- One private viewpoint with a **high impact** (VP6):
    - Is in close proximity to the proposed panels and inverters (approximately 200m away), and in close proximity to the proposed construction compound (approximately 300m)
    - The proposed solar farm would surround, and would be visible from, three sides of the private property (eastern, western and southern sides)
    - Views of the panels and inverters may be likely from the residence, as well as the yard
    - Colour changes due having a side view of the panels would be possible (when looking south)
    - The face of panels would be possible in the morning (when looking west) and the afternoon (when looking east)
    - The substation would not be seen.
- Three viewpoints with a **moderate-high** impact (VP1, VP3 and VP4):
    - In close proximity to panels and inverters
    - VP1 is on an elevated ridge and likely to see the substation. However, views toward the Site are only possible from the yard on the eastern side of the residence, not from the residence
    - VP3 and VP4 are viewpoints directly opposite the Site, however, existing vegetation within each private property, and along Suntop Road, would likely significantly obstruct views
- Three private viewpoints with a **moderate** impact (VP2, VP5 and VP7):
    - Less than, or near to, 1km from the proposed panels and inverters
    - All unlikely to see substation
    - Existing vegetation within VP2 and VP5, and along Suntop Road, would be likely to significantly obstruct views. These residences do not directly face the Site, and the Site is not the focus of views

- VP7 is on an elevated ridge. Views toward the Site are only possible from the yard on the south-western side of the residence, not from the residence

- Remaining private viewpoints have a **low** or **negligible** impact rating.
- Visual impact from the public viewpoint (Suntop Road) has been assessed as **moderate**:
  - Users of Suntop Road would be in close proximity to the panels and inverters
  - Views of the solar farm would be temporary (only possible while travelling the approximately 2km distance past the northern boundary of the Site)
  - The substation would not be seen
- Visual impact from the air has been assessed as **low.**

Following the anticipated growth and screening effects of proposed mitigation planting, for most viewpoints, the impact rating would reduce so that there would be:

- Three private residences rated moderate (VP1, VP6 and VP7), and
- Four private residences and one public viewpoint rated moderate-low (VP2, VP3, VP4, VP5 and VP Suntop Road)

8 Photomontages

Photomontages included in this report have been independently prepared by, and verified by, Cambium Group.

Photomontages have been prepared for VP1, VP6, VP7 and VP Suntop Road. It is acknowledged that it is not feasible to illustrate all views. Some of these viewpoints were explicitly selected due to the potential visual impact level (such as VP1 and VP6), others (such as VP Suntop Road) were selected as they represent public views.

The photomontages illustrate the predicted view at a momentary point in time, approximately 9am in the morning, mid-summer, when the tracking panels would be oriented east (+60 degrees).

A plan showing the location of photomontage viewpoints is shown at **FIGURE 8-1** (at the end of this Section). For each viewpoint, four images are provided:

- The existing view toward the Proposal
- Analytical - using the same image as the existing view, the analytical image shows the location of the proposed solar farm in pink
- Photomontage - this image shows the likely view following construction of the proposed solar farm
- Photomontage with mitigation - this image shows the likely view five years following construction when proposed screen planting has grown. Note it has been assumed that a height of 5-7m of dense vegetation would be achievable in that timeframe. More detail is provided in **SECTION 9-1**.

A brief description of each viewpoint is provided below. The photomontages illustrating the view from each viewpoint are consolidated at the end of this section (refer **FIGURES 8-2 to 8-20**).

8.1 Viewpoint 1 (VP1)

VP1 is a private residence on an elevated ridge approximately 490m west of the western Site boundary. Direct views from the VP1 residence are not possible, however the Site can be seen from the paddock immediately east of the residence, This is the only viewpoint that could potentially see the substation.

The assessment findings are presented at **TABLE 7-1**. The assessed visual impact level, without landscape screening, was assessed at moderate-high. The viewpoint has mostly unimpeded views and can view a moderately large proportion of the Site. During the late afternoon, a front view of the tracking panels would be seen as the panels tilt to face the west.

Five years following construction, the assessed visual impact is assessed to reduce to moderate. Proposed screen planting near the boundary between the Site and VP1 property would reduce views of the closest rows of panels, and thereby the front face of the panels. Planting along the boundary could also reduce views of the substation.

A typical existing view from VP1 toward the Site is shown at **FIGURE 8-2**. The analytical image of the proposed solar farm (coloured pink) is shown at **FIGURE 8-3**. **FIGURE 8-4** illustrates the view following construction and **FIGURE 8-5** the view five years following construction.

8.2 Viewpoint 6 (VP6)

VP6 is located immediately north of the proposed solar farm, on the southern side of Suntop Road. It is the closest private residence to the Site. The property is lower in elevation than the surrounding slopes of the Site and the outlook is toward Suntop Road.

The assessment findings are presented at **TABLE 7-1**. The assessed visual impact level, without landscape screening, was assessed as high. Although a relatively small proportion of the Site would be seen, the Proposal would occur on three sides of the property. In the morning when looking west, and again in the afternoon when looking east, the viewer would face a front view of the panels. At all times of the day when looking south, the viewer could potentially see colour changes from viewing the long rows of panels at different angles.

Five years following construction, the visual impact is assessed to reduce to moderate. Proposed screen planting along all three sides of the boundary between the Site and VP1 property would reduce views into the Site.

Two views have been selected for photomontages of VP6 (view A and view B), both from Suntop Road showing the western corner of the VP6 property with the proposed solar farm property seen behind.

Existing view A is shown at **FIGURE 8-6**. Photomontages of the proposed view from View A are shown at **FIGURE 8-7**, **FIGURE 8-8** and **FIGURE 8-9**.

Existing view B is shown at **FIGURE 8-10**. Photomontages of the proposed view from View B are shown at **FIGURE 8-11**, **FIGURE 8-12** and **FIGURE 8-13**.

8.3 Viewpoint 7 (VP7)

VP7 is a private residence approximately 950m north of the Site. Direct views from the house to the Site are not possible, however, the Site can be seen from the paddock immediately south-west of the residence.

The assessment findings are presented at **TABLE 7-1**. The assessed visual impact level, without landscape screening, was assessed as moderate. Although a relatively small proportion of the Site would be seen, the view is unobstructed and from an elevated vantage point.

Five years following construction, the visual impact is still assessed as moderate. Proposed screen planting would not be seen from VP7, therefore, the extent of the Site seen would not reduce.

A typical existing view from VP7 toward the Site is shown at **FIGURE 8-14**. Photomontages of the proposed view are shown at **FIGURE 8-15** and **FIGURE 8-16.** An image five years post construction is not included as there is no change in the view.

8.4 VP Suntop Road

VP Suntop Road is a linear viewpoint. The Road passes immediately to the north of the Site. Views from Suntop Road are in close proximity of the proposed solar farm, however, are temporary and for short-periods.

The assessment findings are presented at **TABLE 7-1**. The assessed visual impact level, without landscape screening, was assessed at moderate. The viewer is likely to see the colour of the panels change rapidly from black to various shades from blue to white if looking directly down the rows of panels when travelling past.

Five years following construction, the assessed visual impact is still assessed as moderate-low. Proposed screen planting along the Suntop Road boundary would reduce views into the Site.

A typical existing view from Suntop Road toward the Site is shown at **FIGURE 8-17**. Photomontages of the proposed view are shown at **FIGURE 8-18, FIGURE 8-19** and **FIGURE 8-20.**

FIGURE 8-1

Photomontage locations

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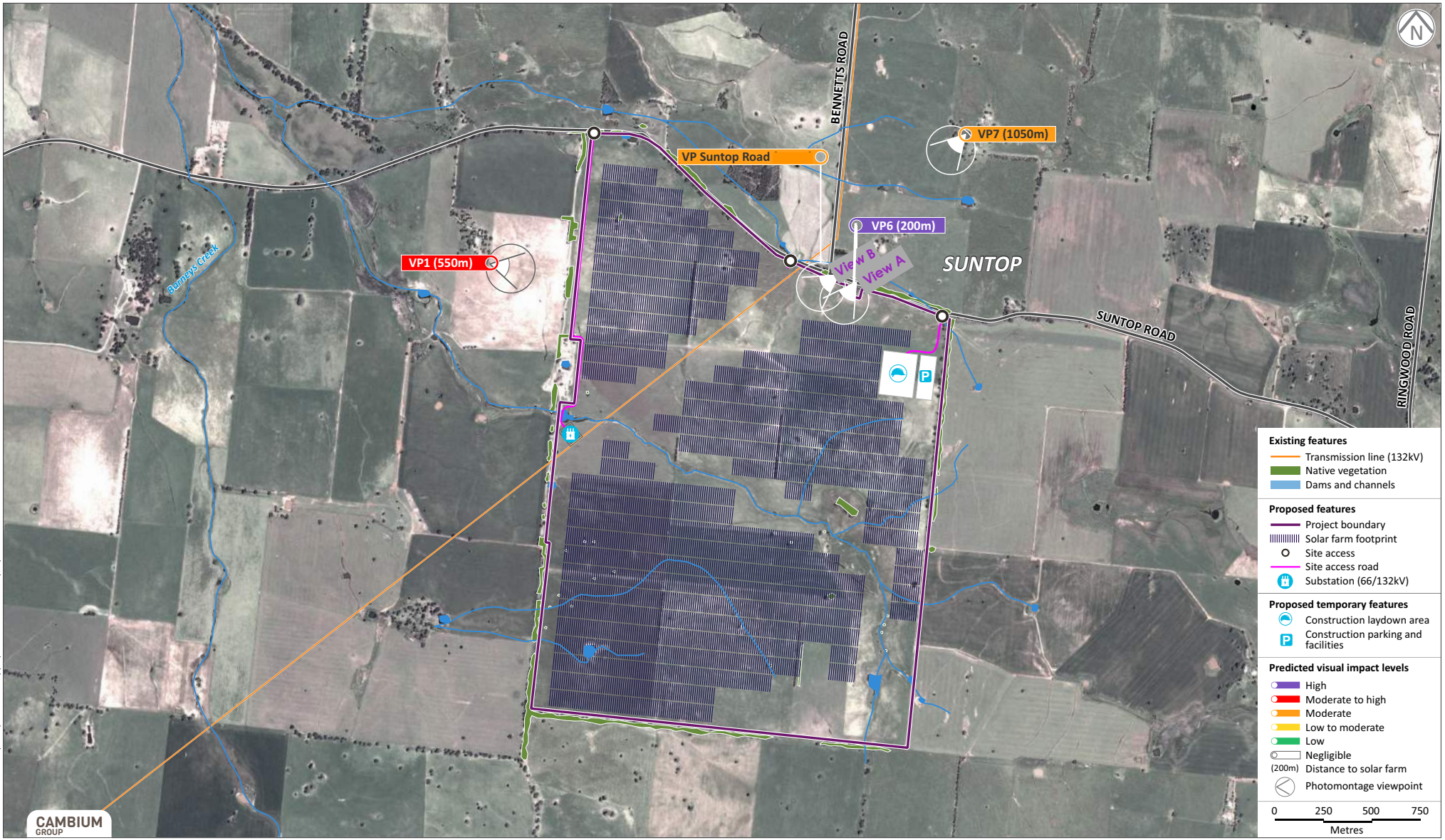

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FIGURE 8-2

VP1 - Existing view

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FIGURE 8-3

VP1 - Analytical view of likely visibility of Proposal

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FIGURE 8-4

VP1 – Photomontage of likely view of proposal post construction

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FIGURE 8-5

VP1 – Photomontage of likely view of Proposal with landscape screening 5 years after construction

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FIGURE 8-6

VP6, View A – Existing view

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FIGURE 8-7

VP6, View A - Analytical view of likely visibility of Proposal

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FIGURE 8-8

VP6, View A – Photomontage of likely view of Proposal post construction

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FIGURE 8-9

VP6, View A – Photomontage of likely view of Proposal with landscape screening 5 years after construction

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FIGURE 8-10

VP6, View B – Existing view

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FIGURE 8-11

VP6, View B - Analytical view of likely visibility of Proposal

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FIGURE 8-12

VP6, View B – Photomontage of likely view of Proposal post construction

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FIGURE 8-13

VP6, View B – Photomontage of likely view of Proposal with landscape screening 5 years after construction

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FIGURE 8-14

VP7 – Existing view

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FIGURE 8-15

VP7 - Analytical view of likely visibility of Proposal

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FIGURE 8-16

VP7 – Photomontage of likely view of Proposal post construction

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FIGURE 8-17

VP Suntop Road – Existing view

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FIGURE 8-18

VP Suntop Road - Analytical view of likely visibility of Proposal

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FIGURE 8-19

VP Suntop Road – Photomontage of likely view of Proposal post construction

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FIGURE 8-20

VP Suntop Road – Photomontage of likely view of Proposal with landscape screening 5 years after construction

SUNTOP SOLAR FARM - VISUAL IMPACT ASSESSMENT

9 Mitigation

This section of the report specifies mitigation measures to avoid, reduce, or compensate for the visual impacts of the Proposal.

9.1 Best practice

Visual impact mitigation for the PV solar farm includes a range of measures that could be undertaken to avoid, reduce or compensate for potential impacts. The following is a list of best practices applicable to PV solar facilities when considering potential mitigation options[23]:

1. Minimise impact through use of design features (refer also to 'vegetation screening' in sidebar at **SECTION 9.3**)
2. Minimise and repair ground disturbance
3. Site facilities away from most prominent land features (locate in less prominent locations and away from focal points)
4. Avoid night sky impacts
5. Site facilities in already disturbed landscapes or clearings
6. Increase distance to reduce visual dominance
7. Use site-specific location and topographic features to reduce visibility
8. Use colour to reduce contrast
9. Monitor visual impacts.

9.2 Existing measures and proposed mitigation

The Proposal already features a number of elements that serve to mitigate potential landscape character and visual impacts to key viewpoints. **TABLE 9-1** lists the best practices, the positive features of the Proposal, and additional mitigation measures which are recommended to achieve the reduced landscape character and visual impact ratings determined in this report.

[23] Adapted from Apostol, D. 2017 (180)

TABLE 9-1: MITIGATION MEASURES

Best-practice	Existing positive measures within the Proposal	Additional measures recommended
1. Minimise impact through use of siting and design features	- The proposed solar farm has been located in a rural area with a small local population, and limited visual exposure due to the surrounding hills - There are only a few elevated viewpoints to the Site, and none that are visually prominent - The Site is located along a local road generally only accessed by residents and visitors to local Suntop properties - The solar farm has a low profile with panels a maximum height of 4m above the ground - The surface of the panels would be non-reflective - The substation is proposed to be located away from the public viewpoint (Suntop Road) and would only be seen from one private viewpoint	Prior to construction: - A Concept Landscape Plan has been prepared (refer to **FIGURE 9-1**) to provide screening where likely to reduce visibility. The plan has been adapted to the local topography and viewpoints. Prior to construction, consult with the community and develop a Detailed Landscape Plan. - Select vegetative screening plant species. Provide community feedback to refine and detail proposed planting in a Detailed Landscape Plan. - Check vegetative screening plans with bushfire study currently being prepared for the Proposal and local authorities (if relevant) to reduce potential for fire risk by introducing an additional fuel source. Construction: - Group ancillary facility structures where possible to minimise sprawl. - Stabilise new access road within the Site required for operations - Locate the construction compound and storage areas away from nearest residents. Operation: - Do not install commercial messages, or large-scale signage. Signage required at the Site should be of sufficient size to be readable at driver height within short range (0-20m) and contain only information sufficient for basic facility and company identification, for safety, navigation, and delivery purposes. - Keep Site tidy and neat, remove weeds, and undertake necessary repairs

Best-practice	Existing positive measures within the Proposal	Additional measures recommended
2. Minimise and repair ground disturbance	- The Proposal is located within an area already cleared of trees - The Proposal would require minimum cut and fill - Trenches for cabling would be backfilled as soon as possible - Installation of the panels are on pile driven mounts, foundations are not required.	Construction: - Minimise grading across the Site and undertake the minimum levelling necessary to install panel supports. Do not bench the Site - Rehabilitate exposed ground surfaces as soon as possible - Implement dust and wind erosion controls to avoid visual issues associated with dust. E.g.: water cart on site; avoid ground disturbance on high wind days; water exposed surfaces; cover stockpiles - Implement erosion and sediment controls to avoid visual issues associated with erosion and water pollution.
3. Site facilities away from most prominent land features (locate in less prominent locations and away from focal points)	- The PV panels would be sited to avoid the two higher ridges within the site, thereby reducing the number of potential viewers - The Proposal would avoid waterways and existing vegetation - The development footprint would avoid the existing surface water bodies on the site where possible. - A buffer of 40m would be provided between infrastructure and any waterway. - A 10m minimum buffer would be provided from the Site boundaries. - The footprint would also avoid the majority of tall woody vegetation present on the site. - The substation is proposed to be located in a low-lying area of the Site, away from the public viewpoint (Suntop Road)	

Best-practice	Existing positive measures within the Proposal	Additional measures recommended
4. Avoid night sky impacts	- The Proposal would not be operated at night. Lighting of the site at night is not required, and is not anticipated unless in emergency situations	Operations: - Undertake maintenance activities (such as cleaning the panels and other routine tasks) during daylight hours - Use amber lighting if lights are required, rather than bluish-white lighting
5. Site facilities in already disturbed landscapes or clearings	- The panels and ancillary infrastructure would be generally located in already cleared areas. - Minimal tree clearing is required.	Construction: - Retain existing grass cover beneath solar panels and supports if possible to do so safely, and not interfering with facility management Decommissioning: - Develop a remediation plan to include the following actions: o recontour, cultivate, seed, and stabilise the majority of disturbed surfaces with pasture grass species following the removal of infrastructure o re-establish any previously removed native vegetation with appropriate, similar species.
6. Increase distance to reduce visual dominance	- There is a significant buffer between the linear, public viewpoint (Suntop Road) to the panels - The panels are well set back from the closest residence to the Site	
7. Use site-specific location and topographic features to reduce visibility	- The PV panels would be sited to avoid the two higher ridges within the site, thereby reducing the number of potential viewers - The substation is proposed to be located in a low-lying area of the Site, away from the	Construction: - Protect existing vegetation by installing temporary fencing around vegetation areas to be retained and demarcating as a no-go zone. No storage or equipment, stockpiling or disturbance is to occur within the zone.

Best-practice	Existing positive measures within the Proposal	Additional measures recommended
	public viewpoint (Suntop Road) and not visible to the residence closest to the Site - Existing vegetation on site would be retained	
8. Use colour to reduce contrast		Construction: - Treat the support structures of PV panels and ancillary structures such as inverters, with a non-reflective finish. - Paint or colour-treat facility components to better match the surroundings and decrease their visibility and contrast. Choose a colour two to three shades darker than the background colour. Dark grey is generally considered a good colour for ancillary infrastructure. Do not paint components white unless there is a safety or functional requirement to do so. White is generally the most conspicuous colour. Lighter colours should be avoided. - Test colour selection prior to implementing across the site for visually compatibility and minimal contrast. Assess colours as they would be seen from the most affected viewpoints to determine which colour is more effective blending with the background. - Colour treat grouped structures using the same colour. Use semi-gloss finish rather than flat or gloss finish - Specify substation to have a low-reflectivity, neutral colour finish. Insulators at substations should be non-reflective and non-refractive. Choose a colour for the substation surfaces two to three shades darker than the background colour. As the substation is located near a line of trees, a deep green or dark grey may be suitable.

Best-practice	Existing positive measures within the Proposal	Additional measures recommended
		- Chain-link fences surrounding the substations should have a dulled, darkened finish to reduce contrast. Black or dark grey is generally a suitable colour for substation fencing. Operation: - Keep non-reflective finishes and colour-treated coatings in good repair. Reapply if surface is subject to fading or flaking.
9. Monitor visual impact		Operation: - Periodically contact the nearest residents to the facility to determine if visual issues are being experienced - Monitor performance of screen planting areas via a three-year planting maintenance period. Replant as necessary if plants die, and supplement planting with alternative species if plants do not adapt to the Site. Ensure density and growth is satisfactory to achieve screening effect. - Record complaints of visual issues - Discuss possible remedies for visual issues with the resident or complainant - Take meaningful action to remedy visual issues. For example: o introduce planting to screen views, o colour treat ancillary site infrastructure, or o install fabric-covered screening fences to reduce views from particular viewpoints

9.3 Landscape Plan

One of the mitigation measures is screen planting. A Concept Landscape Plan has been provided at **FIGURE 9-1** which identifies strategic locations for screen planting within the Site to reduce visual impacts. General issues regarding planting at solar farms are discussed in the side bar "*Vegetation Screening*" and "*Shading cast by vegetation*".

Vegetation Screening

Vegetation, typically trees, may screen views fully or partially, especially close to the viewpoint*. But in many cases, vegetation is not tall enough to screen views of large-scale infrastructure. Such infrastructure extends over a wide area of land, and, particularly if viewpoints are elevated, vegetation is not sufficient to block or even reduce views. However, in some instances, where elevation is favourable, it would be possible to plant trees of adequate height and density, within a wide planting area, to minimise or even eliminate some views.

* United States Department of the Interior. 2013. *Best Management Practices for Reducing Visual Impacts of Renewable Energy Facilities on BLM-Administered Lands.* Bureau of Land Management.

Shading cast by vegetation

Solar farms require maximum exposure to sunlight to generate energy. Screen planting close to the northern, eastern and western sides of a solar farm could shade the panels closest to the planting area during part of the day. The shadow cast in summer would be minimal, however, longer during winter months.

Proposed landscape screening also needs to consider the implications of any bushfire restrictions which could affect the suitability of different types of plant species, screening locations and planting densities.

The Concept Landscape Plan has been developed in consultation with affected property owners. Following further discussions with landowners and Dubbo Council, a Detailed Landscape Plan would be prepared.

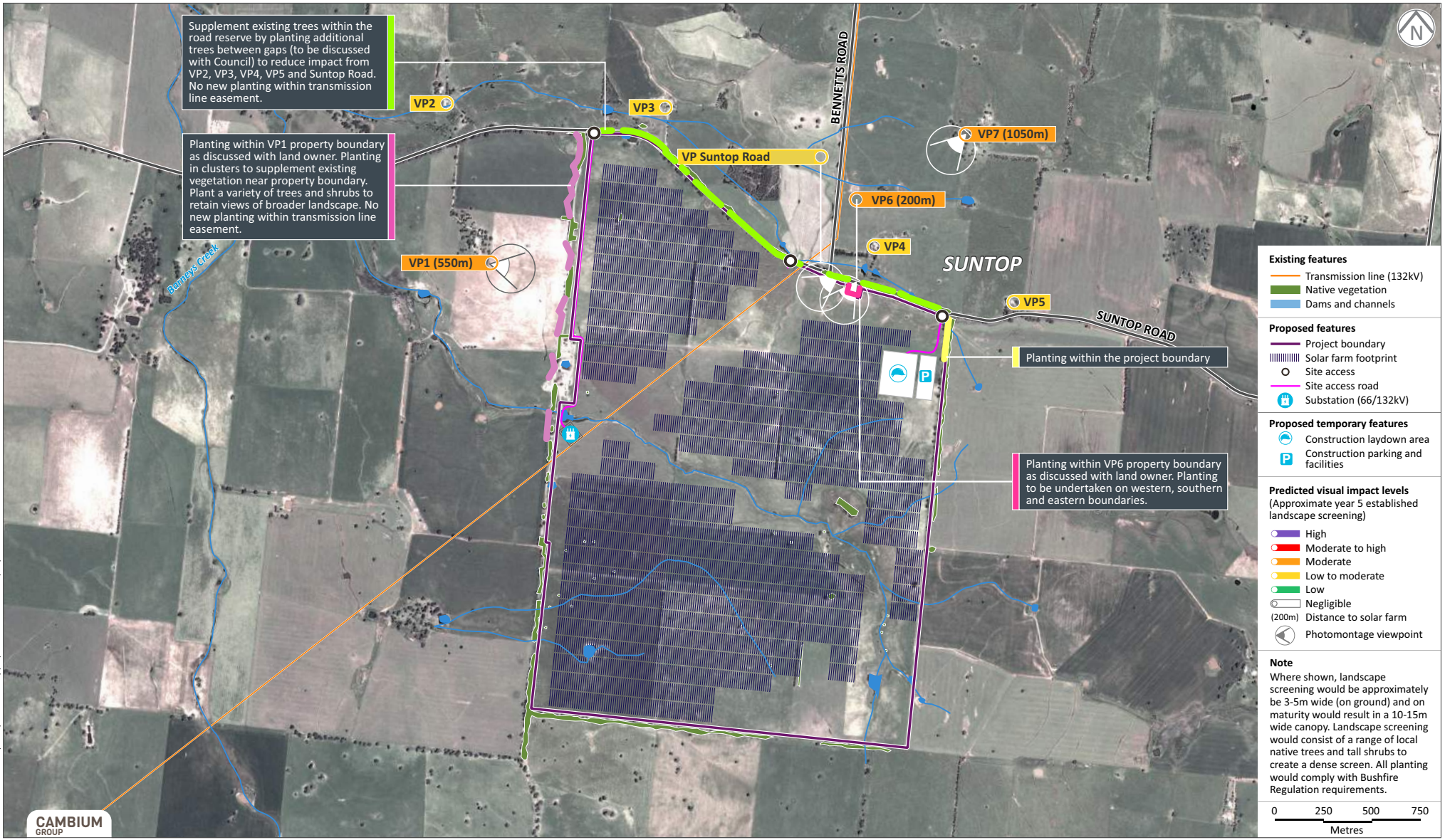
The key features of the Concept Landscape Plan are:

- Planting within the VP6 property along all three boundaries with the Site. Planting to include trees and shrubs to create a dense screen
- Planting within the VP1 property within the vicinity of the western boundary of the Site. Planting would comprise a variety of trees so as to not create a tree line that removes views of the wider landscape and to mitigate the key impact which is the leading row of panels
- Planting to continue along the western boundary to screen the location of the substation
- Planting along the northern boundary of the Site (Suntop Road) to screen views from the public viewpoint (VP Suntop Road) as well as private viewpoints along Suntop Road. Planting is proposed to occur within the road reserve (to be discussed with Dubbo Council)
- Planting within the Site along the eastern boundary for approximately 200m
- All planting would comply with Bushfire Regulation requirements
- In general, planting areas would be approximately 3-5m wide (on ground) and consist of a range of local native trees and tall shrubs to create a dense screen
- Where space and regulation requirements permit, a wider planting area (10m) is recommended within the Site along the northern boundary to allow for increased planting rates and greater potential for denser screen planting.

FIGURE 9-1

Concept landscape plan

SUNTOP SOLAR FARM - VISUAL IMPACT ASSESSMENT



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10 Cumulative impact

Cumulative visual effects occur as we move through the landscape. The combined effects from the Proposal with other past, present, and likely future projects or activities, are discussed below.

At note in **SECTION 3.3.3,** Photon Energy, is also proposing PV solar farms at Mumbil and Maryvale. Each proposed farm would comprise the same low-profile, non-reflective solar panels, and include a substation.

Should all of the proposed PV solar farms be realised it would not be possible to see more than one of the solar farms within the same view. When driving through the landscape, however, it would be possible to see more than one, or all three, within the same day, although such a journey would be probably unusual (refer to **FIGURE 3-3**). Regardless, the locations of each of the farms are in different directions from Wellington, along routes to different destinations:

Mumbil solar farm is proposed to be located south-east of Wellington on Burrendong Way. It would be visible to travellers heading to Lake Burrendong, and visible to travellers using Burrendong Way as an alternative route from Orange to Wellington.

Maryvale solar farm is proposed to be located north of Wellington. It would be visible to travellers using the Mitchell Highway, the major northern access road to Wellington.

Suntop solar farm, on the western side of the Mount Arthur Reserve, would only be visible to residents and their visitors of local Suntop properties. Suntop Road is not a major through route.

It is possible that travellers from Sydney heading to Lake Burrendong could see two solar farms during the same day of their journey. However, it would be unlikely, in the normal routine of residents or visitors, that views of all three solar farms would occur in the same day.

The proposed solar farms are separated by driving distances of over 20km, the urban centre of Wellington, and by the major landform of the Mount Arthur Reserve. When driving past each solar farm, the panels would only be in view momentarily.

Considering the physical separation and visual characteristics of the PV solar farm and surrounding environs, the combined effects from the three proposed solar farms is unlikely to change the dominant agricultural setting of the physical landscape.

11 Conclusion

The assessment results of Impact to landscape character finds there is a moderate impact.

The assessment results of impact to viewpoints finds that there are seven private viewpoints and one public viewpoint with moderate to high impact:

- 1 private viewpoint with a high impact (VP6)
- 3 private viewpoints with a moderate-high impact (VP1, VP3, VP4)
- 3 private viewpoints with a moderate impact (VP2, VP5, VP7)
- the public viewpoint (Suntop Road) has been assessed as moderate

Remaining viewpoints have a **low** or negligible impact rating. Visual impact from the air has been assessed as low.

When assessing the Proposal against visual impact components of the NSW State Government's draft *Large Scale Solar Energy Guideline*, the result is that the Site is suitable. **TABLE 11-1** lists the key visual factors from the Guideline to be taken into account when considering the likely impact of solar energy developments, together with the findings from this assessment.

TABLE 11-1: APPLICATION OF DRAFT LARGE SCALE SOLAR ENERGY GUIDELINE

Relevant component of Guideline	Visual consideration from Guideline that may assist in minimising localised impacts:	Finding from this assessment
Site selection	▪ land that does not contain native vegetation or has previously been cleared and utilised for industrial – type purposes (brown field sites) in rural settings	▪ The proposed Site at Suntop is mostly cleared and within a rural setting. The Site has been used for agricultural purposes. The majority of existing native vegetation would remain on site as part of the Proposal
	▪ Unobtrusive sites with flat, low-lying topography	▪ The proposed Site at Suntop is generally well concealed. There are two ridges within the Site, however, the PV panels would not be located over the two ridges ▪ There are few external locations where elevated views into the proposed Site are possible
	▪ Sites with potential to be screened, such as those that can be readily vegetated along boundaries, to reduce visual impacts	▪ The proposed site at Suntop has good screening potential for the majority of viewers which would see the Site as they travel along Suntop Road. Planting along the boundary with Suntop Road has been proposed and would reduce the number of viewers and impact of views

Relevant component of Guideline	Visual consideration from Guideline that may assist in minimising localised impacts:	Finding from this assessment
Site constraints	▪ sites with high visibility, such as those on prominent or high ground positions ('high visibility or prominence is of particular concern if the solar infrastructure at the site would be juxtaposed against significant scenic, historic or cultural landscape'), or sites which are located in a valley with residences with elevated views looking toward the site	▪ The proposed Site at Suntop does not have high visibility, is not on a prominent or high ground position. It does have two ridges within the Site, however, the proposed footprint of the solar farm would not run over the ridges ▪ The Site does not comprise and is not near significant scenic, historic or cultural landscape. The Mount Arthur Reserve is the most prominent scenic landscape feature of the area. However, the Reserve is approximately 5km from the Site and the Proposal would not be seen from publicly accessible areas within the Reserve ▪ The proposed Site at Suntop is not located in a valley with residents with elevated views looking toward the site
Key assessment issues	The visual impact of solar energy development will depend on: ▪ the scale and type of infrastructure,	▪ The proposed infrastructure is low-profile, with a maximum height above ground level of approximately 4m
	▪ the prominence and topography of the site relative to the surrounding environment,	▪ The proposed Site is not prominent relative to the surrounding environment. ▪ The two ridges within the Site would not be included in the PV panel footprint
	▪ and any proposed measures to screen or otherwise reduce visibility of the site.	▪ A Concept Landscape Plan has been prepared which proposes screening along Suntop Road, and along the western boundary of the Site ▪ Further mitigation measures have been proposed, such as colour treating ancillary facilities, as set out in **TABLE 9-1**.

This assessment concludes that the proposed Suntop Site is appropriate for the proposed solar development. The Site is within a rural setting, is generally cleared of native vegetation, is not visually prominent, and has relatively few sensitive receptors viewing the Site. Importantly, the Proposal incorporates a number of key measures that limit potential visual impacts. In particular: the proposed PV solar panels are low-profile and non-reflective; two existing ridges within the Site would not be included within the PV solar footprint; and the Site is suitable for screen planting which would reduce exposure of the PV solar panels over time.

Following the anticipated growth and screening effects of proposed mitigation planting, the impact rating would reduce so that there would be:

- Three private residences rated moderate (VP1, VP6 and VP7), and
- Four private residences and one public viewpoint rated moderate-low (VP2, VP3, VP4, VP5 and VP Suntop Road)

Overall the Proposal would represent a moderate and acceptable level of change to the landscape character of the Site and its surrounds. Initial high impacts to close viewpoints are predicted to reduce over time as proposed planting increases in height and is able to adequately screen the Site.

12 References

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Appendix A

Preliminary findings

A map of the viewpoints initially investigated is provided at **FIGURE A-1**. Identification (ID) numbers were allocated to identify each viewpoint.

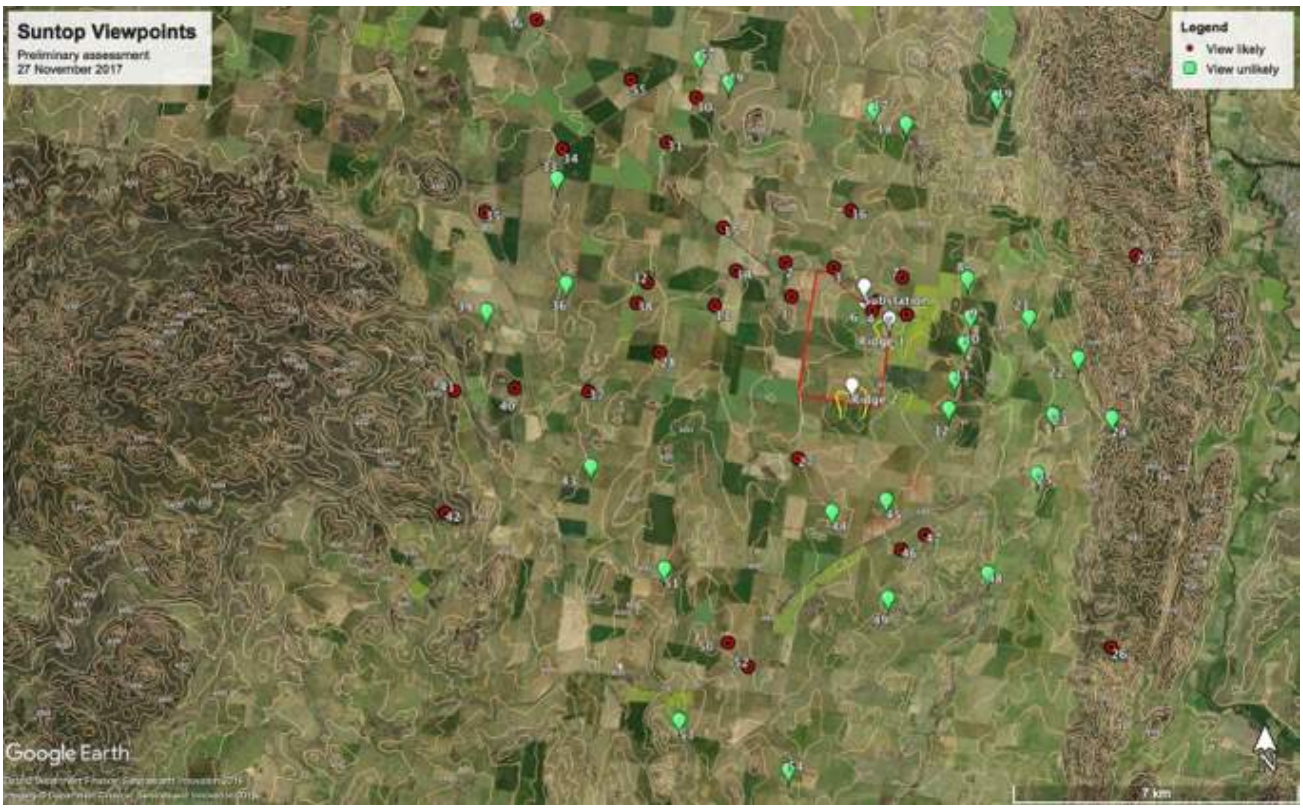

FIGURE A-1: INITIAL VIEWPOINTS INVESTIGATED

The initial identification and assessment of viewpoints was based on a preliminary PV solar panel footprint shown at **FIGURE A-2**. Based on the preliminary footprint, the following high-level findings were determined:

- The proposed location of the substation would potentially be seen from three residential properties, however, would be seen by all users of Suntop Road
- Of the 29 residences that could potentially see some sections of the solar farm, the proportion of the solar farm seen ranged from less than 5% to 90%
- The distance of the viewer from the solar farm ranged from approximately 150m to 12km

The initial site investigation findings are shown at **TABLE A-1.**

FIGURE A-2: PRELIMINARY FOOTPRINT

TABLE A-1: PRELIMINARY SITE INVESTIGATION

House ID number	Likely to see solar farm?	Approximate % of solar farm seen	Approximate distance / range of visual access to solar farm	Could see ridge 1?	Could see Ridge 2?	Could see Substation?	Could impact be reduced if no panels on high points?	Could impact be reduced through planting?
1	yes	40%	0.5 - 3.25km	unlikely	yes	no	minor	yes. Planting along western boundary could reduce views
2	possibly although trees between property and solar farm may limit views	possibly 30%	0.75 - 4km	possibly	possibly	unlikely	minor	no

House ID number	Likely to see solar farm?	Approximate % of solar farm seen	Approximate distance / range of visual access to solar farm	Could see ridge 1?	Could see Ridge 2?	Could see Substation?	Could impact be reduced if no panels on high points?	Could impact be reduced through planting?
3	yes	20%	150m - 2km	possibly	no	yes	Ridge 1. Reduce viewing area by 10%	planting along northern 'Suntop Road' boundary could reduce views
4	yes. although trees between property and solar farm may limit views	15%	200m - 1.5km	no	no	yes	n/a	planting along northern 'Suntop Road' boundary could reduce views
5	yes. although trees between property and solar farm may limit views	5%	400m - 1.5km	yes	no	no	Ridge 1. Reduce viewing area by 10%	minor
6	yes	15%	adjacent - 1.5km	no	no	yes	n/a	planting around the property could reduce views
7	yes	30%	1 - 3.25km	yes	yes	yes	Ridge 1 & 2. Reduce viewing area by 20%	minor
8	no							
9	no							
10	no							
11	no							
12	no							
13	yes	40%	2.25 - 4.25km	yes	yes	no	Ridge 1 & 2. Reduce viewing area by 20%	unlikely

House ID number	Likely to see solar farm?	Approximate % of solar farm seen	Approximate distance / range of visual access to solar farm	Could see ridge 1?	Could see Ridge 2?	Could see Substation?	Could impact be reduced if no panels on high points?	Could impact be reduced through planting?
14	yes							
15	Possibly, although existing vegetation likely to reduce potential viewing area	20%	3 - 5.75	no	yes	no	Ridge 2. Reduce viewing area by 20%	unlikely
16	Possibly, although existing vegetation likely to reduce potential viewing area	5%	2.5 - 3km	yes	no	no	Ridge 1. Reduce viewing area by 25%	no
17	no							
18	unlikely							
19	no							
20	yes. Unsure if this is a private home	10%	7 - 8.25km	no	yes	no	Ridge 2. Reduce viewing area by 20%	no
21	no							
22	no							
23	no							
24	no							
25	no							
26	yes	10%	8 - 9.75km	yes	yes	no	Ridge 1 & 2. Reduce viewing area by 50%	no
27	Visit to the property confirmed no home at this location							

House ID number	Likely to see solar farm?	Approximate % of solar farm seen	Approximate distance / range of visual access to solar farm	Could see ridge 1?	Could see Ridge 2?	Could see Substation?	Could impact be reduced if no panels on high points?	Could impact be reduced through planting?
28	Possibly	>10%	4.5 - 5.5km	yes	unlikely	no	Ridge 1. Reduce viewing area by 50%	no
29	no							
30	Possibly	>10%	7.25 - 8.5km	no	yes	NO	Ridge 2. Reduce viewing area by 25%	no
31	possibly although trees between property and solar farm may limit views	20%	6.25 - 8.25km	no	yes	no	. Ridge 2. Reduce viewing area by 25%	no
32	Possibly. Although obscured by trees	90%	4 - 6.5km	yes	yes	no	minor	no
33	no							
34	Possibly. Although obscured by trees	90%	6.75 - 10km	yes	yes	no	minor	no
35	Possibly. Although obscured by trees	90%	8.25 - 10km	yes	yes	unlikely	minor	no
36	no							
37	Possibly. Although obscured by trees	5%	7.25 - 7.5km	yes	no	no	Ridge 1. Reduce viewing area by 80%	no
38	Possibly. Although obscured by trees	90%	4.25 - 6.25km	yes	YES	no	minor	minor
39	no							
40	Possibly. Although obscured by trees	30%	7.5 - 9.25km	yes	possibly	no	minor	no

House ID number	Likely to see solar farm?	Approximate % of solar farm seen	Approximate distance / range of visual access to solar farm	Could see ridge 1?	Could see Ridge 2?	Could see Substation?	Could impact be reduced if no panels on high points?	Could impact be reduced through planting?
41	Possibly. Although obscured by trees	90%	8.5 - 10.75km	yes	yes	no	minor	minor
42	Possibly. Although obscured by trees	90%	9.25 - 11.5km	yes	yes	no	minor	minor
43	no							
44	no							
45	unlikely							
46	Possibly. Although obscured by trees	>5%	5 - 5.5km	possibly	no	no	Ridge 1. Reduce viewing area by 100%	no
47	Possibly. Although obscured by trees	>5%	5 - 5.5km	possibly	possibly	no	Ridge 1 & 2. Reduce viewing area by 100%	no
48	no							
49	no							
50	Possibly. Although obscured by trees	15%	6.5 - 9.25km	no	possibly	no	no	no
51	no							
52	Possibly. Although obscured by trees	20%	6.75 - 9.75	no	possibly	no	no	no
53	no							
54	no							
55	Possibly. Although obscured by trees	80%	7-10km	yes	yes	unlikely	minor	no
56	Possibly. Although obscured by trees	90%	9.25 - 12km	yes	yes	unlikely	minor	no
57	No							

Revised footprint

Since the initial site investigation findings were determined, the footprint of the PV solar panels and location of the substation has been updated. The revised footprint proposed by the Proponent is shown in the body of this report at **FIGURE 4-1**. Based on the revised footprint, in comparison to the initial footprint, the following high-level findings were determined:

- The revised location of the substation would potentially be seen from only one residential property (VP1), and would be unlikely to be seen by users of Suntop Road
- Potential views of the solar farm would be eliminated for three properties (VP37, VP46 and VP47), reducing the overall number of residences that would potentially see some sections of the solar farm from 29 to 26
- It is highly likely that views would be eliminated for a further 12 properties, reducing the overall number of residences that would potentially see some sections of the solar farm to 14
- Of the remaining 14 residences that are more likely to potentially see some sections of the solar farm, the extent of the solar farm likely to be seen would reduce for 11 of the residences, by 10-20%.