



WARRAL SOLAR FARM

Visual Analysis, Landscape Concept and Reflectivity Statement

Prepared for:

Providence Asset Group

704/99 Bathurst Street, SYDNEY NSW 2000

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PROJECT NAME

Location	
Project Number	631.00000.20400
Client	Providence Asset Group

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1. INTRODUCTION

1.1 Background

This Visual Analysis and Landscape Concept has been prepared for the proposed Solar Farm near Warral, NSW.

This visual analysis assessment has been prepared to provide an effective and objective assessment of the anticipated high level impacts of the project on the surrounding visual environment.

SLR has worked closely with other members of the project team in determining and rating visual impacts of the proposed solar farm project works on its immediate surrounds as well as suggesting mitigation measures to further reduce any impacts that may occur.

There are 3 parts to this report.

- Visual Analysis
- Landscape Concept and
- Reflectivity Analysis

1.2 Site Location

The land on which the Solar Farm is located (the subject site) for the proposed Solar Farm (the project) is situated approximately 6.5km south west of Tamworth Business Centre.

The site is located at 329 Country Road, and the proposed development will consist of solar panels mounted on single-axis trackers connected to a power conversion station with an access and hardstand area from Country Road. The development will be confined to Lot 4 DP1048145 (**Figure 1**).

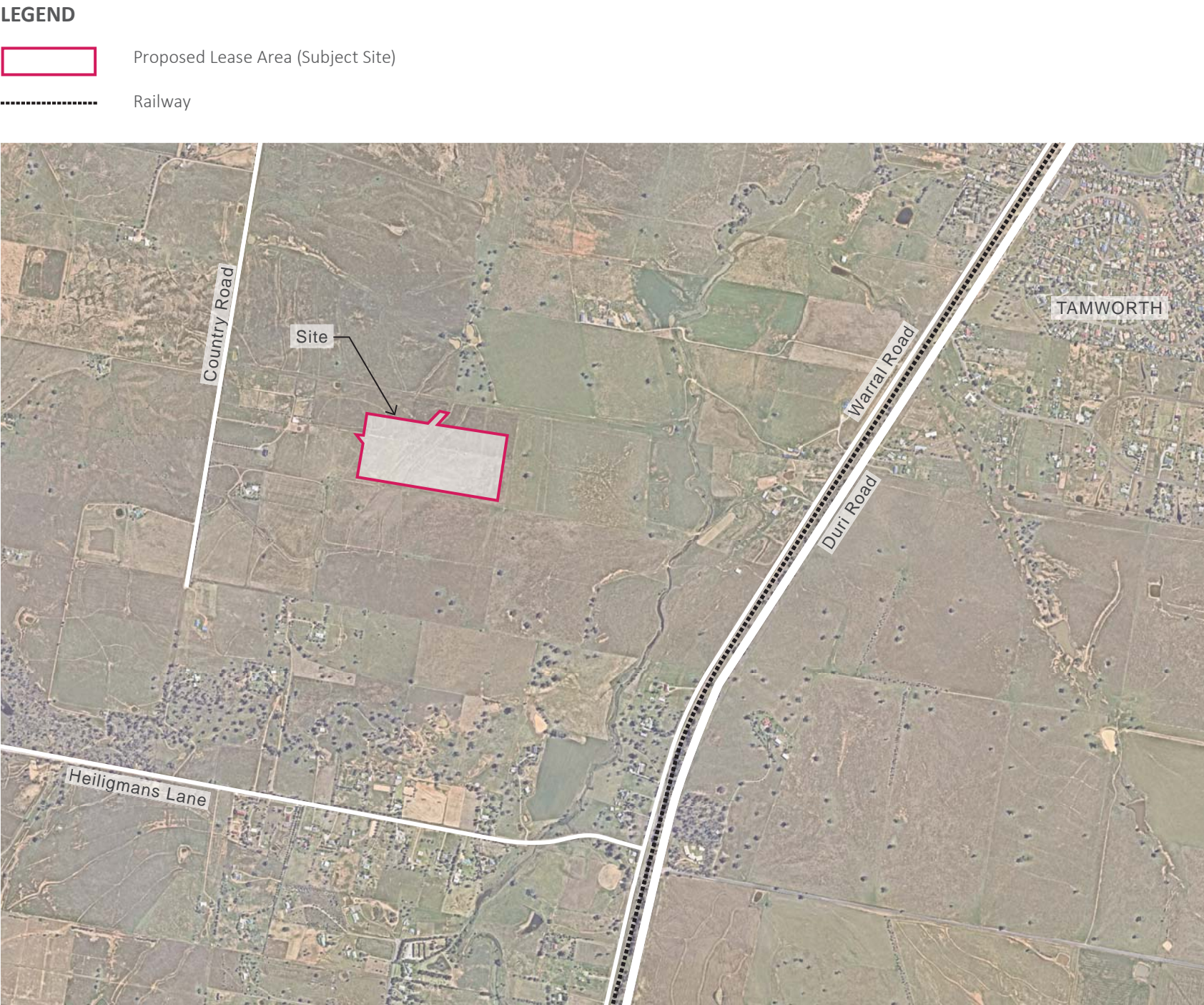


Figure 1. Locality Plan

Scale (m) 



2. BASELINE VISUAL ENVIRONMENT

2.1 Subject Site and Surrounding Context

The subject site is located on the eastern side of Country Road, Warral and is a typically open grassed rural site, similar to those rural properties surrounding it. The site is approximately 6.5km south west of Tamworth Business Centre. The site falls generally from north west to south east from approximately AHD 418m to AHD 394m.

2.1.2 Roads and Access

The subject site is accessed by one road, Country Road which is an unsealed local road that is adjacent to the west of the subject site. Duri Road is a local road that is east of the subject site and connects Warral to Tamworth in a north east direction. Duri road has the most public views available to the subject site.

Warral Road is a local road that is located parallel to Duri Road and located also to the east of the subject site. Like Duri Road, there are a range of views from it to the subject site in the west.

Gunnedah Road (B56) is aligned in an east west direction and connects to Tamworth in the east. It is located approximately 3km north of the subject site and there are no clear views of the site available from along this road.

2.1.3 Vegetation

The subject site has been cleared of vegetation except for a few scattered shrubs remaining which are located on the western edge of the proposed Solar Farm.

The local area in general is very sparsely vegetated, with some established vegetation along a localised gully to the south of the subject site being the most visible in the area.

Duri Road and Heiligmans Lane have some scattered vegetation along the verges that appear visible to commuters and residents when travelling into and out of Tamworth.

2.1.4 Structures

There are no structures on the subject site. There are a number of rural residential dwellings around the subject site immediately to the west and dwelling, shed and 10 horse stables further to the south.

Higher density residential development (subdivisions) are located further toward Tamworth in the east and north, but clear views of the site are not discernible from these areas.

2.1.5 Infrastructure

The subject site has power poles and lines running through it generally from east to west on the northern side of the site.

3. LANDSCAPE CHARACTER ANALYSIS

3.1 Regional Context

The landscape character of the region surrounding the site is flat to gently undulating, open rural lands used with a mix of pastoral and agricultural uses. Whilst the vegetation is sparse on the agricultural lands, it is typically concentrated on the elevated local hills of the Melville Range to the west of Tamworth. This however is generally not within the local visual context of the site.

3.2 Baseline Visual Character of Subject Site and Surrounds

The subject site is typical of the rural landscape character of the region in that it is open, gently undulating and typically grassed (minimal tree coverage). As the size of the site is small in the context of its surrounds, it utilises the ‘borrowed landscape’ of the adjoining rolling hills to define its visual context and define local views. The vegetation on the hills provides the local visual context a more vegetated feel when viewing the site from the south and east.

4. PROPOSAL

4.1 Project Description

A full description of the proposal is provided within the main Statement of Environmental Effects and site plans, but a brief description is as follows. Section 4.1.1 identifies key elements of the proposal that are of particular relevance to an assessment of impacts on the visual analysis

4.1.1 Indicative project Layout

The solar electricity generating facility will consist of the following elements:

- Solar array area of approximately 9.95 hectares within a total fenced area of approximately 13.3 hectares
- Solar array mounted on trackers (142 sets)
 - Rectangular photovoltaic module
 - Trackers area horizontal single-axis type
 - Solar array up to 2.6m high with +/-60° rotation angle
 - Trackers orientated north - south
- Associated infrastructure
 - Power Conversion Station (PCS)
 - Entry to the site via improved access from Country Road
 - Security fencing
 - Car park area
 - Offload and hardstand area
 - Berm for on site water detention

During construction, temporary facilities located within the site may include:

- Construction office

4.1.2 Solar panel dimensions and arrangement

The proposed solar array module dimensions are approximately 1.1 m wide x 2.3m high. They are mounted on a tracking system that will maximise the electricity production. The tracking system rotates about a north-south axis to follow the sun with the aim of orienting each panel to be as close to perpendicular as possible to the incoming sun.

The tracking systems will be arranged in rows running in a north-south direction as indicated in **Figure 2** The enclosure for the solar panel arrays and associated equipment will cover approximately 12Ha.

The diagram in **Figure 2.1** illustrates the dimensions and rotation of the panels. The panels only rotate from east to west and are not tilted toward the north.

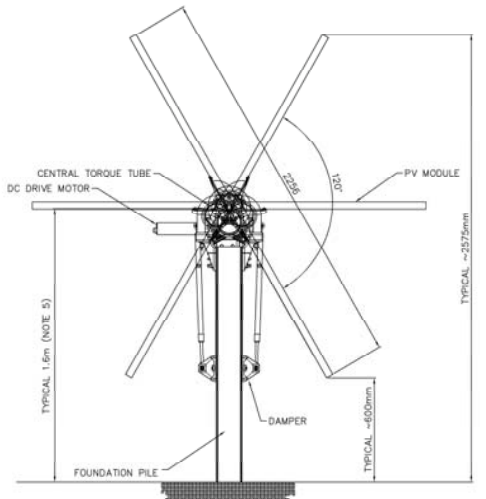


Figure 2.1 Solar panel / tracking system

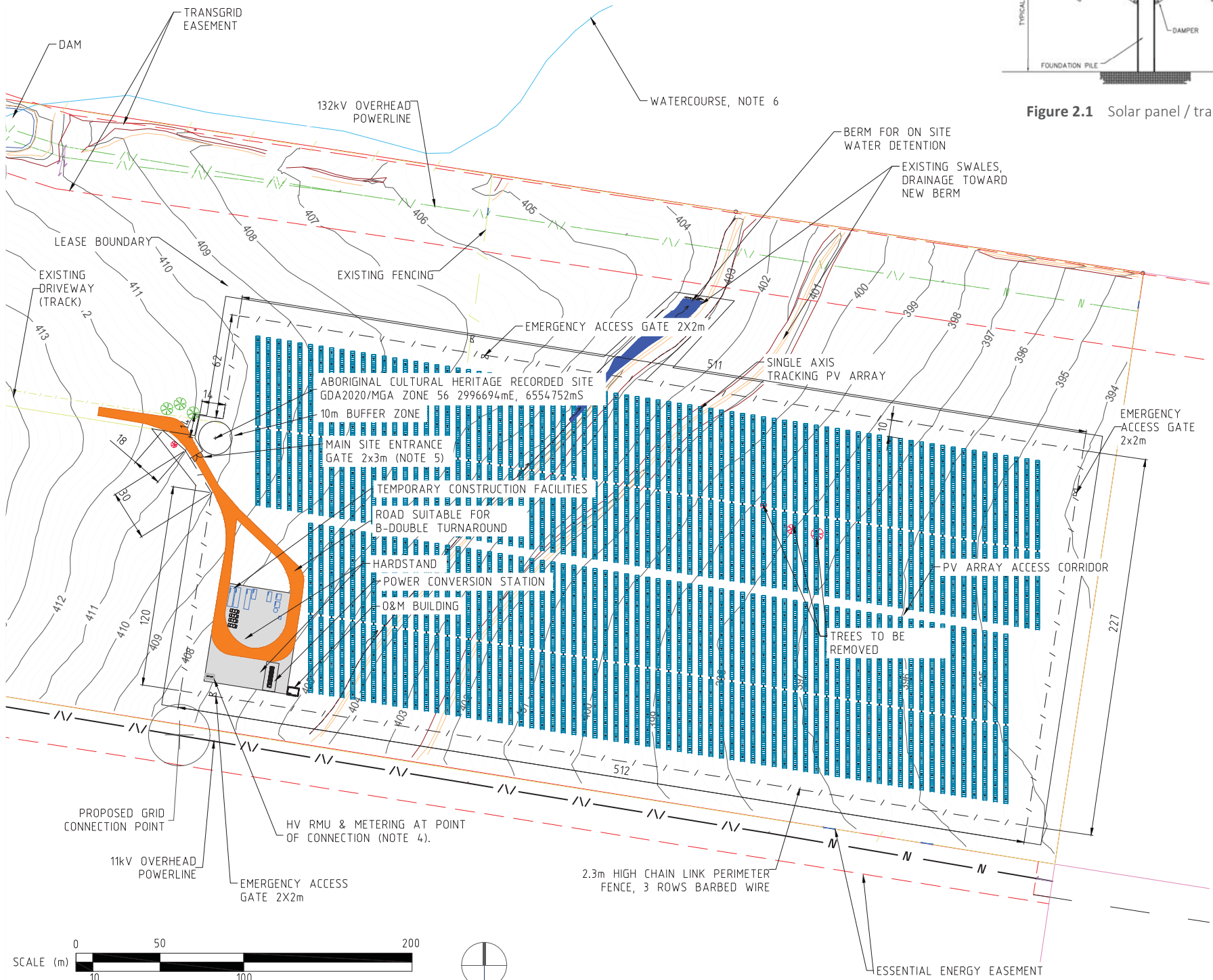


Figure 2. Concept layout of the project

5. VISUAL IMPACT ASSESSMENT

5.1 Process

The Visual Impact Analysis generally applies the assessment techniques set out in the ‘Guidelines for Landscape and Visual Impact Assessment, Third Edition’ (2013) prepared by The Landscape Institute and the Institute for Environmental Management and Assessment (UK).

The analysis includes the following:

- Review of the proposal (scale, bulk, height, technical specifications and landscape);
- Analysis of the subject site (visual exposure, visual qualities and landscape values);
- Identification of potential impacts on key receptors including the rating of magnitude for each receptor group;
- Rating of impact significance for each receptor group.
- The significance is evaluated as a product of the sensitivity or value of the receptor, and the magnitude of impacts on the receptor;
- Potential mitigation measures to meet the necessary planning requirements and any community expectations;
- The report included a desktop analysis and a visual site investigation in November 2020. The desktop review included the review of aerial photography, site topography and vegetation cover;

Photo-montages were also prepared to inform the analysis.

5.2 Assessment of Visual Impacts for Key Receptors

Photographic imagery was taken of the site to assist in the assessment of visual impacts. Photos were taken with a Canon EOS 6D Mark II digital single-lens reflex (DSLR) camera with a 50 mm lens.

Five photomontage images were prepared to assist in the Visual Analysis process; all from public receptor points.

The five receptors used in the photomontage were selected to investigate a range of visual solutions and illustrating views from areas of perceived sensitivity. During the site investigation, local areas around the site were observed to determine the potential visibility of the proposed Solar Farm.

For the purposes of this Visual Analysis a Photomontage image was produced from each of the five viewpoints chosen. The approximate extent of the proposed Solar Farm has been identified to give a general impression of the location on site and the approximate height.

The Photo montage Images are represented in Section 5.6 and show the following overlays of information.

- Existing visual baseline (existing landform);
- Overlay of the final solar farm proposed development

5.3 Receptor Sensitivity

The receptor sensitivity is derived from a combination of factors including:

- Receptors interest in the visual environment (high, medium or low interest in their everyday visual environment and the duration of the effect);
- Receptors viewing opportunity (prolonged, regular viewing opportunities); and
- Number of viewers and their distance/ angle of view from the source of the effect, extent of screening/ filtering of view.

Whilst the assessment of visual values and effects is largely measured on a qualitative basis, assessment against scale enables a more objective evaluation and comparison of sensitivity of receptors and magnitude of effects. The Receptor Sensitivity Rating is described as being High, Medium, Low or Negligible as described in **Table 1**.

5.4 Magnitude of Landscape Change

The Magnitude of Change to the landscape character depends on the nature, scale, intensity, extent and duration of the impacts/ change due to proposal. The magnitude of change also depends on the loss, change or addition of any feature to the existing landscape and is based on the character type that is most likely to be impacted by the project prior to the addition of any mitigation measures.

The Magnitude of Change is described as being High, Medium, Low or Negligible as described in **Table 2**.

Descriptions of Magnitude and Sensitivity are illustrative only and there is no defined boundary between levels of impacts.

Table 1. Receptor Sensitivity Rating

Receptor Sensitivity	Description
High	<ul style="list-style-type: none">• Visitors to heritage sites, regionally important locations, scenic routes, lookouts within 2.5km with quality views, important views of the site and surrounding areas where landscape is the specific focus.• High numbers of visitors• Views to landscape that are rare and or unique and are possibly vulnerable to change• Views from residences within 1km of the site or are representative of high quality views
Medium	<ul style="list-style-type: none">• Travellers/visitors along roads or rail routes that are not scenic routes but offer quality views within 2.5km of the site• Medium numbers of visitors/ residents (rural communities or townships)• Views that are representative of local character or sense of place but are not rare or unique• Views from residences beyond immediate vicinity (1km-5km) of the site or are representative of moderate quality views• Recreational users/ viewers beyond 2.5km from the site with moderate interest in their surrounds
Low	<ul style="list-style-type: none">• Travellers/visitors along roads or rail routes that are not scenic routes but offer reasonable views within 4km of the site• People at place of work where setting or views not important to quality of working environment• Recreational users not dependent on views or scenic quality of landscape• View experience takes in broad context with which site is visible but not an important element.• Small numbers of visitors with passing interest in their surroundings (those travelling along mid-level roads)• Viewers whose interest is not specifically focused on landscape or scenic qualities (commuters, workers)
Negligible	<ul style="list-style-type: none">• Very occasional or low level of users with passing interest in their surrounds (those travelling along minor roads or views from the air)• Travellers/visitors along unsealed roads offering views greater than 4km of the site

5.5 Impact of Significance on Landscape Character

The Impact Significance is evaluated according to 2 key criteria as noted above and is reflected in **Table 3**. The rating is a means of comparing impacts on different receptors. Professional judgement and experience have been applied in order to identify the level of significance for each character type which has been assessed on its own merits.

- The sensitivity of the receptor or existing landscape; and
- The magnitude of the change or impact that is likely to occur.

The process of assessment and the use of the ratings tables reflect typical outcomes for visual impacts.

- Impacts on receptors that are particularly sensitive to change in views and visual amenity are more likely to be significant.
- Impacts that constitute a substantial change to the visual environment are likely to be more significant than the impacts that do not cause substantial change.

5.6 Summary of Potential Landscape Character Impacts

The following sheets summarise the assessment of impacts on each of the identified visual receptor groups.

Three representative viewpoints were identified where the site could be seen preferably from public locations. Due to the distances from the site, presence of topographic and vegetated features, surrounding structures and the limited views from publicly accessible areas, the choice of viable views was limited. The following sheets describe and rate the sensitivity of each viewpoint, the nature and magnitude of impacts likely to occur and the resultant significance of impacts for each receptor.

Typically views to the site from local roads and other public locations in the area were very limited. Photos from each receptor are provided and photomontages prepared to show how the proposed Solar Farm will be perceived from that particular viewpoint. Mitigation measures have been included where appropriate.

Table 2. Magnitude of Change

Magnitude of Change	Description
High	<div>Dominant Change</div> <ul style="list-style-type: none">Major change in view at close distances, affecting substantial part of the view continuously visible for a long duration or obstructing a substantial part or important elements of the viewOverwhelming loss or additional features in the view such as the nature of view or character of landscape fundamentally changedViews to key landscape features affectedVisual amenity of local residents or road users substantially diminishedSubstantial change to the landscape due to loss of and or change to elements, features or characteristics of the landscape creating an overall worsening of landscape quality
Medium	<div>Considerable Change</div> <ul style="list-style-type: none">Clearly perceptible changes in views at intermediate distances resulting in either distinct new element in a significant part of the view or a more widely ranging, less concentrated change across a wider areaSignificant loss or addition of features in the view, such that nature of view or character of landscape is alteredNoticeable contrast of any new features in the view such that the nature of the view or landscape character is changedNoticeable contrast of any new features or changes compared to existing landscapeViews to key landscapes partially obstructed but views remain intact
Low	<div>Noticeable Change</div> <ul style="list-style-type: none">Minor memorable change to the landscape or viewsTemporary or reversible impactLandscape dominant element and built form/ development well integrated within itLittle permanent change or no fundamental change to local landscape character
Negligible	<div>Barely Perceptible Change</div> <ul style="list-style-type: none">No memorable or rarely perceptible change to landscape character or key views

Table 3. Effect Significance Rating

Receptor Sensitivity	Magnitude of Change in Landscape				
		High (Dominant Change)	Medium (Considerable Change)	Low (Noticeable Change)	Negligible (Barely Perceptible Change)
	High	High	Moderate-High	Moderate	Minor-Moderate
	Medium	Moderate-High	High	Minor-Moderate	Minor
	Low	Moderate	Minor-Moderate	Minor	Minor-Negligible
	Negligible	Minor-Moderate	Minor	Minor-Negligible	Negligible

5.6.1 Selected Viewports

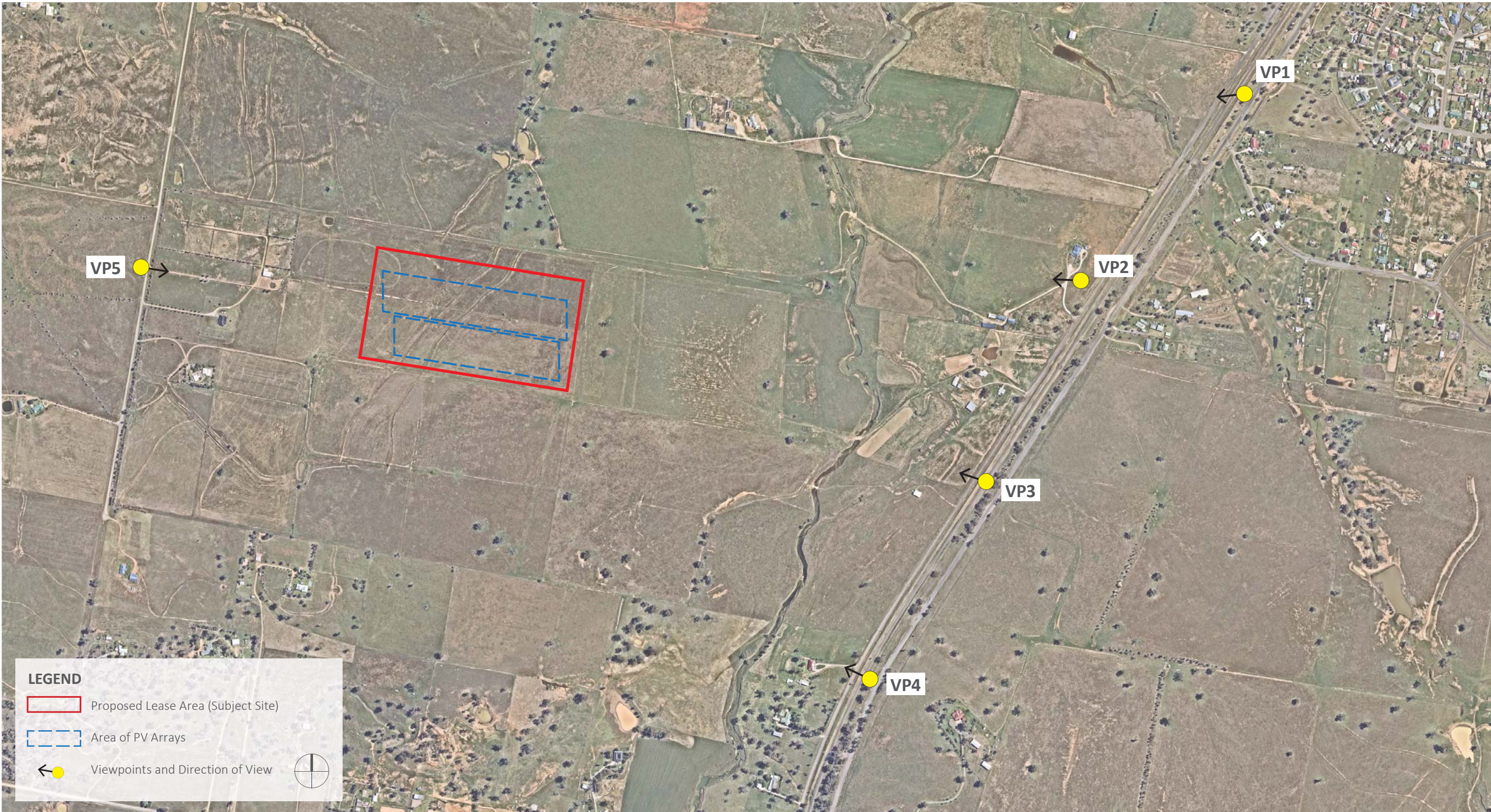


Figure 3. Selected Visual Receptors and Direction of View

5.6.2 Viewpoint 1 - Existing



Receptor - VP1	Duri Road, Warral
Coordinate Location	31°7’8.808” S 150°53’27.708” E
View Description	View from Duri Road looking south west toward the proposed solar farm site.
Distance from Site	Approximate 1.7km
Comments <ul style="list-style-type: none">Open rural (pastoral) landscape, with minimal canopy vegetation in the background except along the local ridge behind the site to the west. Established vegetation visible in the foreground and middle ground of the view.Hills to the south and west of the subject site from this viewpoint are clearly visible and prominent.	

5.6.3 Viewpoint 1 - Proposed



Receptor - VP1 Summary of Impact Assessment	
Receptor Sensitivity	Medium
View Magnitude of Landscape Change	Low
Impact Significance	Minor - Moderate
Mitigation Measures	<ul style="list-style-type: none">• Informal shrub planting (to a maximum height of 3-4m) adjoining lease boundary could integrate the solar array appearance into the landscape. This would be on the eastern and northern sides of the array.• No tree planting or formal shrub planting.

5.6.4 Viewpoint 2 - Existing



Receptor - VP2	Warral Road, Warral
Coordinate Location	31°7'23.646" S 150°53'12.624" E
View Description	View from Warral Road, looking west
Distance from Site	Approximate 1.36km
Comments <ul style="list-style-type: none">Open rural (pastoral) landscape, with minimal canopy vegetation in the foreground with a sparsely vegetated ridge behind the site in the middle ground that terminates most of the views. Hills in the background are not prominent from this view point.The site slopes up gently to Country Road in the west.	

5.6.5 Viewpoint 2 - Proposed



Receptor - VP2 Summary of Impact Assessment	
Receptor Sensitivity	Medium
View Magnitude of Landscape Change	Low
Impact Significance	Minor to Moderate
Mitigation Measures	<ul style="list-style-type: none">• Informal shrub planting (to a maximum height of 3-4m) adjoining lease boundary on the eastern and northern sides, could integrate the solar array appearance into the landscape.• No tree planting or formal shrub planting.

5.6.4 Viewpoint 3 - Existing



Receptor - VP3	Warral Road, Warral
Coordinate Location	31°7'40.056" S 150°53'1.464" E
View Description	View from Warral Road, looking north west towards the solar farm site
Distance from Site	Approximate 1km to the edge of the site
Comments	
<ul style="list-style-type: none">Open rural (pastoral) landscape, with minimal canopy vegetation in the foreground with a sparsely vegetated ridge behind the site in the middle ground that terminates most of the views.The site slopes up gently to Country Road in the west.	

5.6.5 Viewpoint 3 - Proposed



Receptor - VP3 Summary of Impact Assessment	
Receptor Sensitivity	Low
View Magnitude of Landscape Change	Low
Impact Significance	Minor
Mitigation Measures	<ul style="list-style-type: none">• Informal shrub planting (to a maximum height of 3-4m) adjoining lease boundary could integrate the solar array appearance into the landscape. From this viewpoint the planting would be required on the southern and eastern sides of the array.• No tree planting or formal shrub planting.

5.6.6 Viewpoint 4 - Existing



Receptor - VP4	Duri Road, Warral
Coordinate Location	31°7'57.3" S 150°52'51.264" E
View Description	View from Duri Road, looking north east towards the solar farm site
Distance from Site	Approximate 1km
Comments	
<ul style="list-style-type: none">Open and gently undulating pastoral landscape character in the foreground with sparsely vegetated hills in the background of the view. Vegetation along Warral Road and Duri Road in the foreground is visible.Roads and rail lines are visible in the foreground although not prominent.	

5.6.6 Viewpoint 4 - Proposed



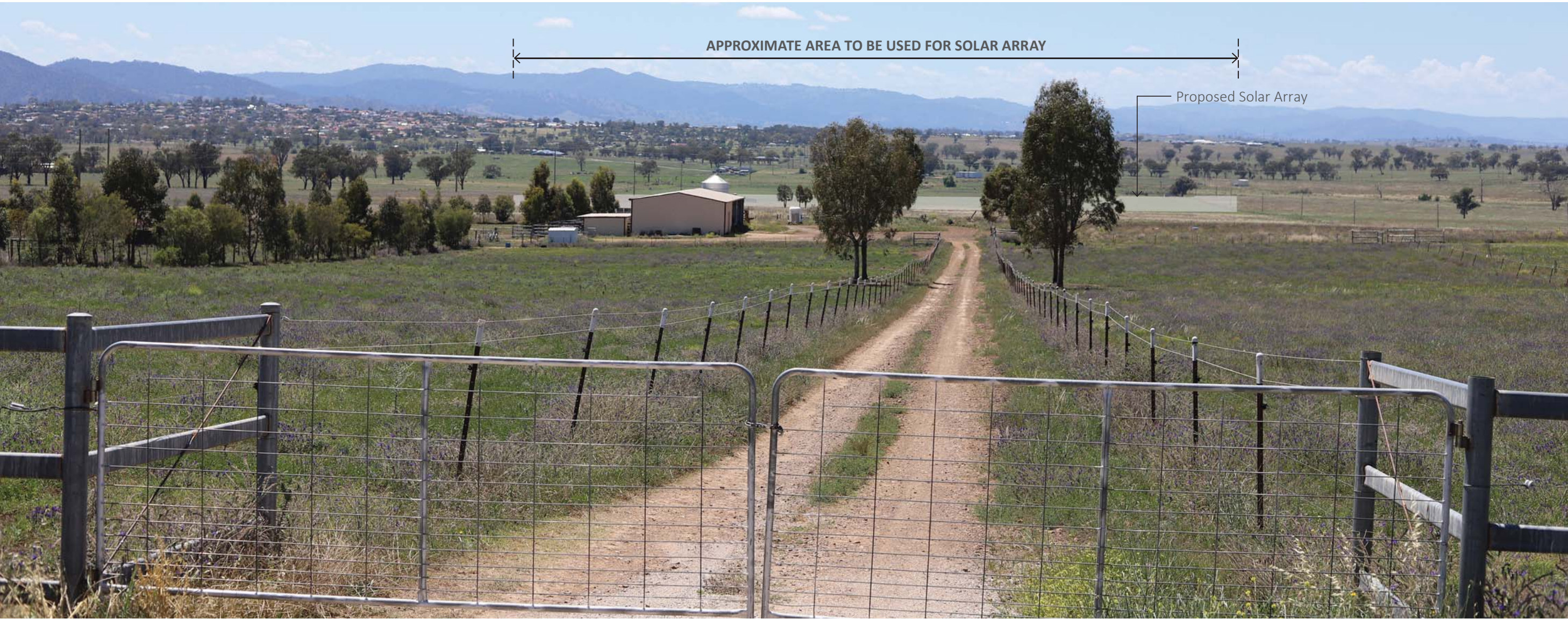
Receptor - VP4 Summary of Impact Assessment	
Receptor Sensitivity	Low
View Magnitude of Landscape Change	Low
Impact Significance	Minor
Mitigation Measures	<ul style="list-style-type: none"> Informal shrub planting (to a maximum height of 3-4m) adjoining lease boundary could integrate the solar array appearance into the landscape. From this viewpoint the planting would be required on the southern and eastern sides of the array. No tree planting or formal shrub planting.

5.6.6 Viewpoint 5 - Existing



Receptor - VP5	Country Road, Warral
Coordinate Location	31°7'22.59" S 150°51'43.032" E
View Description	View from Country Road at the entrance to the site viewing east towards Tamworth
Distance from Site	Approximate 600m
Comments <ul style="list-style-type: none">Open, flat and gently sloping rural landscape character with sparse vegetation coverage and scattered rural residential dwellings.Outskirts of Tamworth in the middle ground with residential built form and established vegetation.Elevated vegetated hills in the background are a prominent element in the visual setting.	

5.6.6 Viewpoint 5 - Proposed



Receptor - VP5 Summary of Impact Assessment	
Receptor Sensitivity	Low
View Magnitude of Landscape Change	Low
Impact Significance	Minor
Mitigation Measures	<ul style="list-style-type: none">• Informal shrub planting (to a maximum height of 3-4m) adjoining lease boundary could integrate the solar array appearance into the landscape. This would be on the western side of the array.• No tree planting or formal shrub planting.

6. SUMMARY OF ASSESSMENT

6.1 Summary of Assessment

The visual environment for the subject site and surrounding area is characterised by open, gently undulating rural land.

Whilst the subject has been cleared of vegetation, established specimens and groups of trees on adjoining properties reinforce the local rural character of the area.

Although the subject site is located within a relatively short distance from Tamworth, views of the site from public viewpoints are only generally visible along Duri Road and Warral Road. This is due to the low flat areas adjoining Duri Road where the site is located. As there are very few obstructions between the road and the site it is visible but the distance from the road reduces the clarity of views.

The height and visual permeability of the array will mean that the relative visual impacts of the Solar Farm are generally low, especially given the distance from the most notable public vantage points.

Given similar distances and degrees of visibility of views from viewpoints along Duri Road and Warral Road, VP01-VP04 will generally have a similar Impact Significance Rating. As the landscape view shed from these viewpoints are considered to be wide, the proposed solar farm would not be a prominent element in the landscape nor would it change the existing rural character.

Overall the Solar Farm is considered to have an Effect Significance rating of **Minor**.

6.2 Mitigation Measures

As described in the summary for each of the 5 viewpoints, the height and nature of the solar farm along with the distances from the site will mean that it will not be a highly visible element within the landscape. However as it represents a minor visual change to the rural landscape some mitigation would be recommended on those sides that are visible from the main public viewpoints.

Given the relatively low height of the Solar Farm, the informal planting of native shrubs to compliment the existing rural landscape character along the Duri Road (eastern) side of the lease area, outside of the fence line would assist in minimising visual impacts of the development on the surrounding rural landscapes. The planting of trees directly adjoining the solar farm would not be encouraged due to the potential for shadows to be cast over the array during certain times of the day.

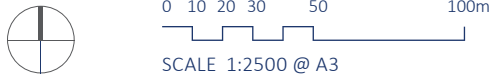
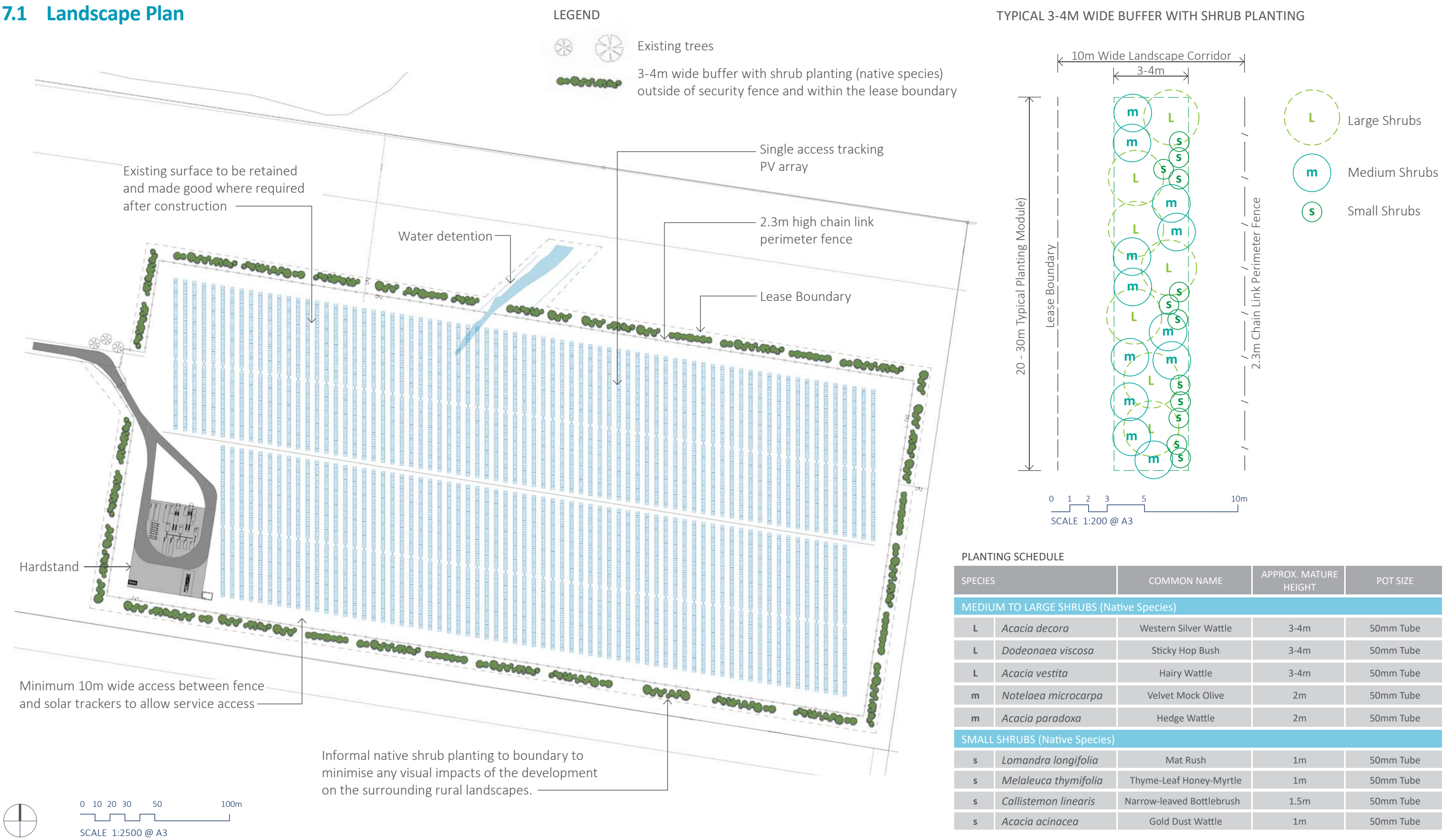
This planting will help screen the Solar Farm as viewed from the viewpoints VP1, VP2, VP3, VP4 and VP5.

Table 4. Summary of Visual Impact Ratings for each Receptor

Receptor	Receptor Sensitivity	Magnitude of Change	Effect Significance
VP1	Medium	Low	Minor - Moderate
VP2	Medium	Low	Minor - Moderate
VP3	Low	Low	Minor
VP4	Low	Low	Minor
VP5	Low	Low	Minor

7. LANDSCAPE CONCEPT

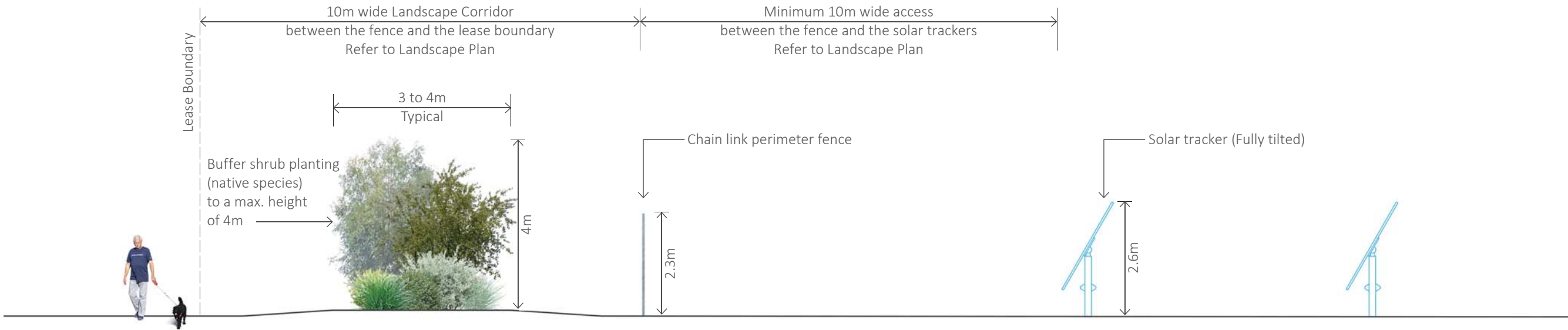
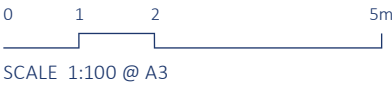
7.1 Landscape Plan



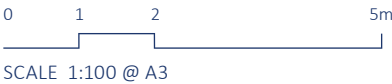
7.2 Landscape Screening



TYPICAL VEGETATION BUFFER (FRONT ELEVATION)



TYPICAL VEGETATION BUFFER SECTION



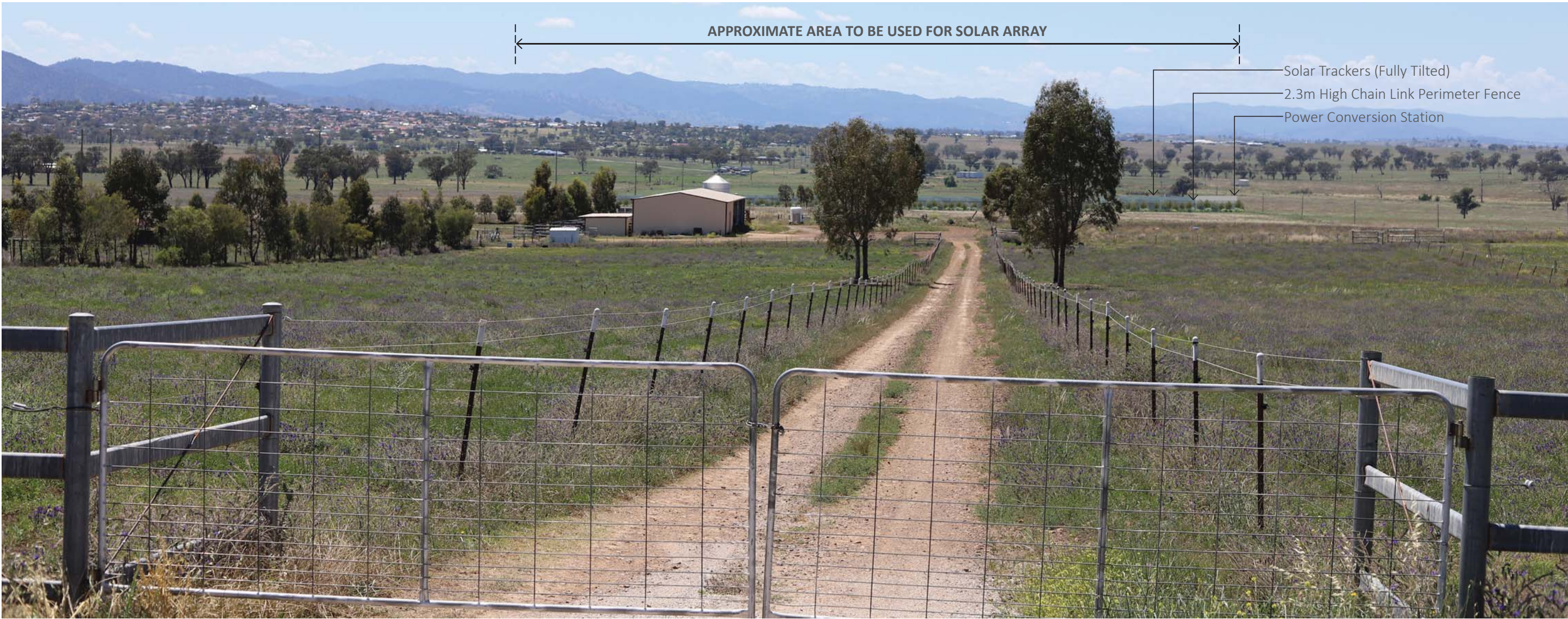
Viewpoint 3 - Proposed with Landscape Screening - 3 Years Growth



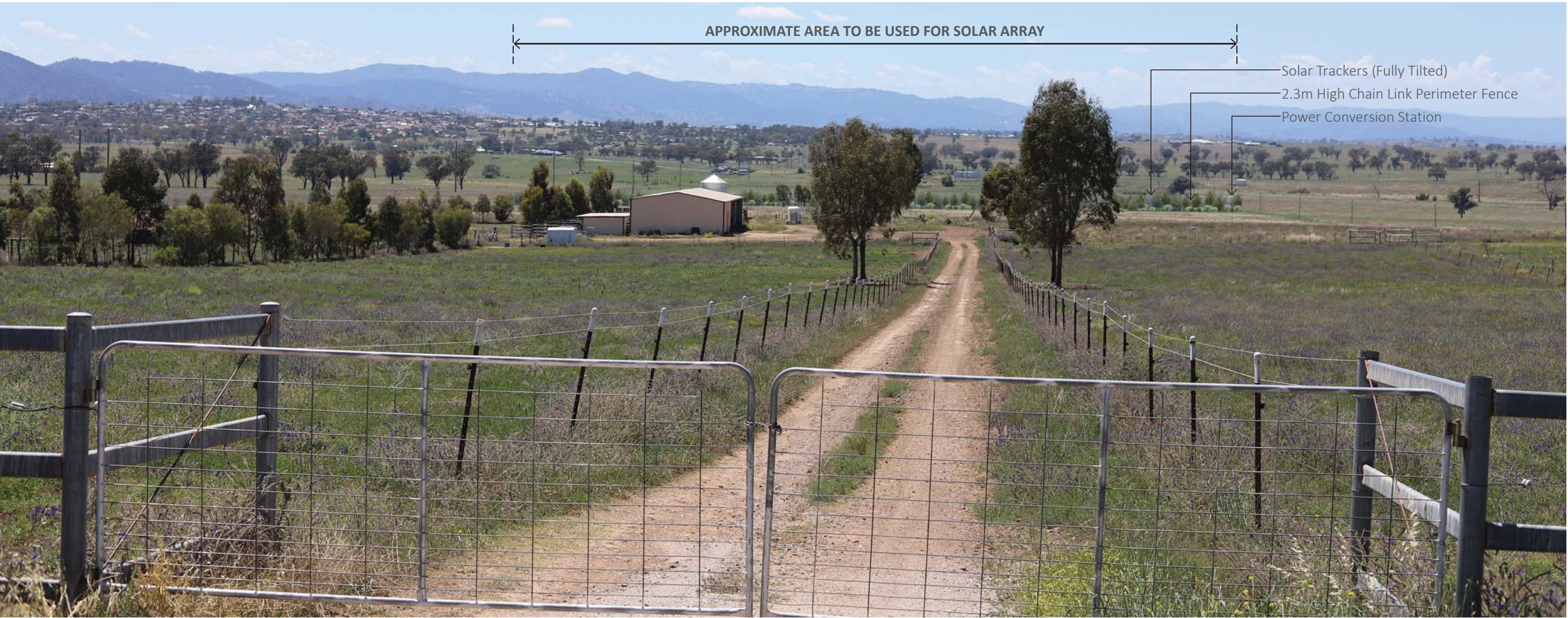
Viewpoint 3 - Proposed with Landscape Screening - 10 Years Growth



Viewpoint 5 - Proposed with Landscape Screening - 3 Years Growth



Viewpoint 5 - Proposed with Landscape Screening - 10 Years Growth



7.3 Landscape Works Construction Notes

The following outline of Landscape Works to be undertaken by the Landscape Contractor (unless otherwise stated). This will not override future detail documentation that will be undertaken as part of the project works, prior to construction.

7.3.1 Civil Works

The EPC Contractor will ensure the following minimum depths of site topsoil are provided.

- Planting areas to be a minimum 200 mm depth site topsoil.
- Grass/ turf areas to be a minimum of 100mm site topsoil
- Finished level of topsoil to be generally 100-150 mm above surrounding existing ground surface levels to ensure topsoil/planting areas are free from water-logging.

7.3.2 Locate Existing Services

The Landscape Contractor shall locate all existing services prior to commencing works, contacting Dial Before You Dig, the project EPC Contractor and/or the relevant authorities as required. Identify all overhead services prior to commencing works.

7.3.3 Set Out the Works

The Landscape Contractor shall accurately set the works out in accordance with the future detailed documentation set.

7.3.4 Soil Testing

The Landscape Contractor shall undertake soil sampling & testing of the existing topsoil as stripped and stockpiled by the EPC Contractor. An approved agricultural soil testing laboratory shall be used to test and provide amelioration recommendations for the soil shall be in accordance with AS 4419:2018 Soils for landscaping and garden use. Any recommended adjustments must be made for native tree & shrub planting.

7.3.5 Planting Areas Preparation

The Landscape Contractor shall undertake the planting preparation works in line with best practice, consideration of local conditions and timing of the works.

Eradicate broad-leaf, woody and noxious weeds from all planting areas using selective, non-residual herbicides. Manual removal of larger woody weeds may be required. Inspect the site prior to commencement to confirm extent of weed treatment and follow up with secondary treatment if required.

- If the existing soil is heavily compacted, deep rip along planting line to minimum 300 mm depth with tines at a maximum of 750 mm centres to break up/aerate natural subgrade and to relieve compaction, grade & level.
- Apply fertilisers and additives at rates recommended by soil test results.
- Cultivate planting lines to a minimum of 150mm depth to break up soil clods and provide an appropriate planting medium. Re-cultivate planting lines to break up soil clods and provide an appropriate planting medium if required.
- Remove any deleterious material brought to the surface, consolidate soil and grade surface to even grades, free of any depressions or undulations.
- DO NOT WORK WET SOIL.

7.3.6 Plant Supply

All plants shall be healthy, free from any pests or diseases, be attractive, well grown and well-formed plant specimens (typical of the individual species) and shall have a healthy, well-formed root system commensurate in size with the foliage mass (root systems must not be pot bound). Plant container sizes shall be as listed in the detail planting schedule, but shall be min. hiko, ViroTube or 50 mm round/square pot size.

7.3.7 Planting

The Landscape Contractor shall set out plants in accordance with future detailed documentation. Individual holes are to be dug (tree planter, mini-auger, etc.) in the prepared planting areas of sufficient size to easily accommodate the plant’s root system and relieve any polishing. Create broad, shallow watering bowl to ALL plants to facilitate effective watering (min. 15 litre capacity). All plants shall be watered-in immediately after planting and at such times during the Contract period as is required to maintain growth free of water stress. Planting medium must be moist - do not plant into dry soil. Handle and plant all plants at all times in accordance with best horticultural practice.

7.3.8 Mulch

The Landscape Contractor shall supply and place 100mm organic mulch to all new planted areas. Preference is for Forest Mulch or local tub-ground mulch where possible. Mulch shall be free of deleterious material such as rubbish, soil, stones and large sticks.

7.3.9 Weed Mats

Where weed matting is to be used, the Landscape Contractor is to supply & install proprietary (TreeMax or similar approved) jute weed mat to each plant. Installation shall be strictly in accordance with manufacturer’s recommendations.

7.3.10 Tree / Plant Guides

Where tree/ plant guards are to be used, the Landscape Contractor is to supply & install proprietary tree guards (TreeMax or similar approved) to all nominated plants. Installation shall be strictly in accordance with manufacturer’s recommendations.

7.3.11 Grassing (Where Required)

Where grass works are required (grass seeding or turfing), the Landscape Contractor is to supply and install the specific grass treatment.

Do not sow seed in periods of extreme heat, cold or wet, or where wind velocities are excessive unless otherwise approved.

Seeding shall be programmed when there is a period of anticipated weather conditions (i.e. rain) that will provide the best chance for germination of grass seed. Any areas affected by heavy rain, wind removing seed or other cause shall be re-seeded as specified to achieve an even cover of grass.

Slash grass when growth height has reached 100 mm or otherwise as directed by Council. Should all the areas not require cutting at one time, complete all further cuts as necessary until 100% of the area has achieved successful coverage and all areas have received at least first cut.

7.3.12 Landscape Establishment / Maintenance Period

Landscaping Contractor shall be responsible for maintenance of the landscaping from planting until final project completion and handover to the asset owner (approximately 2 years). Following handover, the site O&M contractor shall be responsible for maintenance and replacement for the lifetime of the asset.

Maintenance shall include care of the contract area by accepted horticultural practices, and rectification of any issues which arise during this period. Maintenance tasks to be carried out as required during the maintenance period shall include (but shall not be limited to) slashing/ mowing, watering, weed control, pest & disease control/ management, tree guard adjustment/ replacement and rubbish removal. Plant establishment at the end of the Maintenance Period is to achieve a minimum 90% success rate.

- WEED CONTROL - Planted areas are to be maintained in a weed-free condition.
- GRASS MANAGEMENT - Slash all grass areas on a regular basis to maintain grass height to max. 100 mm. Slashing shall comply with all local Council and RFS guidelines with regard to grass heights.
- JUTE MAT & PLANT GUARDS - Maintain jute mat and tree guards for first two summers minimum, repair and replace as required during this period.
- PLANT REPLACEMENT - Replace any failing, failed, or dead plants during the maintenance period. The Council and the Contractor will inspect the full planting areas at the end of each summer and will identify the number and species of plants that are failing, have failed/died for replacement

- WATERING - Ensure all plants planted/maintained under this contract receive adequate (but not excessive) watering to maintain optimum growth and health. Watering shall be localised to each plant, not broad spraying across the entire planting area, to limit weed/grass growth between planting rows.
- FERTILISING - All plants shall be fertilised with an approved proprietary fertiliser suitable for native gardens (in particular members of the Proteacea family and plant species and to be applied in strict accordance with the manufacturer’s recommended rates. Fertiliser shall be locally spread on soil surface around plants during planting operations. Allow for one fertiliser application in Year 1 and second application in Year 2.
- PESTS & DISEASES - Regularly monitor all planted and grassed areas maintained under the contract for evidence of pest and/or disease attack. Identify and treat any/all problems arising. Identify any predation by rabbits, hares and other pests with potential to damage or destroy the landscape works under this contract and maintain all tree guards in good condition to limit such damage.

8. REFLECTIVE GLARE

8.1 Glare Conditions Assessed

The following potential glare conditions have been considered:

- Daytime Reflective glare (and glint) arising from the solar PV panels within the facility;
- Aviation Sector Reflective Glare;
- Motorist “Disability” Reflective Glare and Pedestrian “Discomfort” Reflective Glare;
- Rail Operator Reflective Glare;
- Industrial critical machinery operators (heavy vehicles, etc) Reflective Glare; and
- Residential “Nuisance” Glare
- Night-time Illumination glare if any 24/7 security lighting is incorporated into the Project in the future; none is currently planned.

8.2 Key Project Characteristics Relevant to Glare

The proposed solar array would consist of 153 trackers oriented in a north-south direction, each supporting either 52 or 84 x 540W solar panels (11,928 panels in total);

- The trackers are “single-axis” capable of rotating solar panels to a maximum of $\pm 60^\circ$ - **refer Figure 4;**
- Individual panels (2.3 m x 1.1 m) reach a maximum height above ground of 2.57 m at their full 60° tilt angle; and
- The trackers are oriented north-south and spaced 6.25m apart.

8.3 Receivers and Associated Impacts

The issues of concern assessed in this study in relation to daytime reflective glare and night-time illumination glare are detailed below – **refer Figure 5** for receivers of interest.

8.3.1 Aviation-Related Glint & Glare

Potential impacts on pilots during landing and air traffic control tower operations (if relevant).

8.3.2 Traffic Disability & Pedestrian Discomfort Glare

Potential impacts on motorist disability glare and pedestrian discomfort (relevant to pedestrian crossings).

8.3.3 Train Driver Disability Glare

Potential impacts on train operator’s activities, eg reflections obscuring railway signals.

8.3.4 Industrial Critical Machinery Operators

Potential impacts on operators of critical industrial machinery, eg mining draglines.

8.3.5 Residential Nuisance Glare

Potential impacts on surrounding residences in relation to “nuisance” glare and light spill from night-time illumination (if relevant)

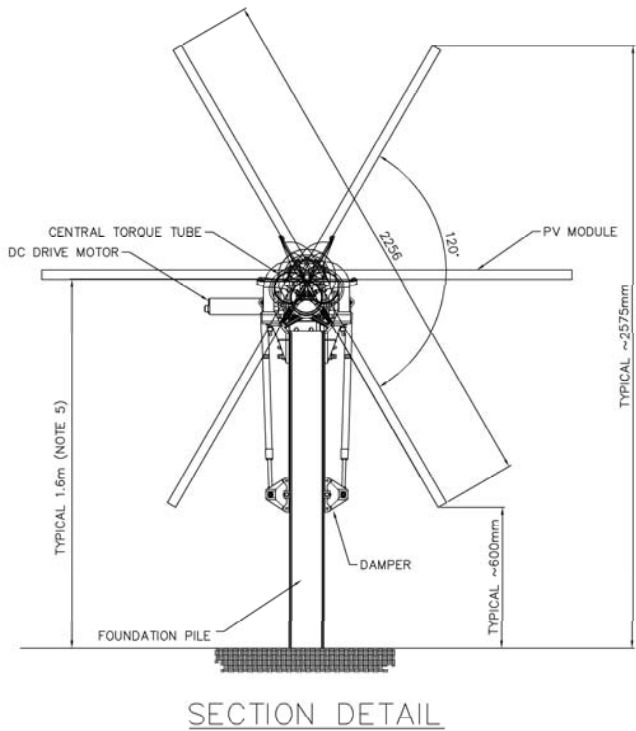


Figure 4 Warral Solar Farm Single-Axis Trackers

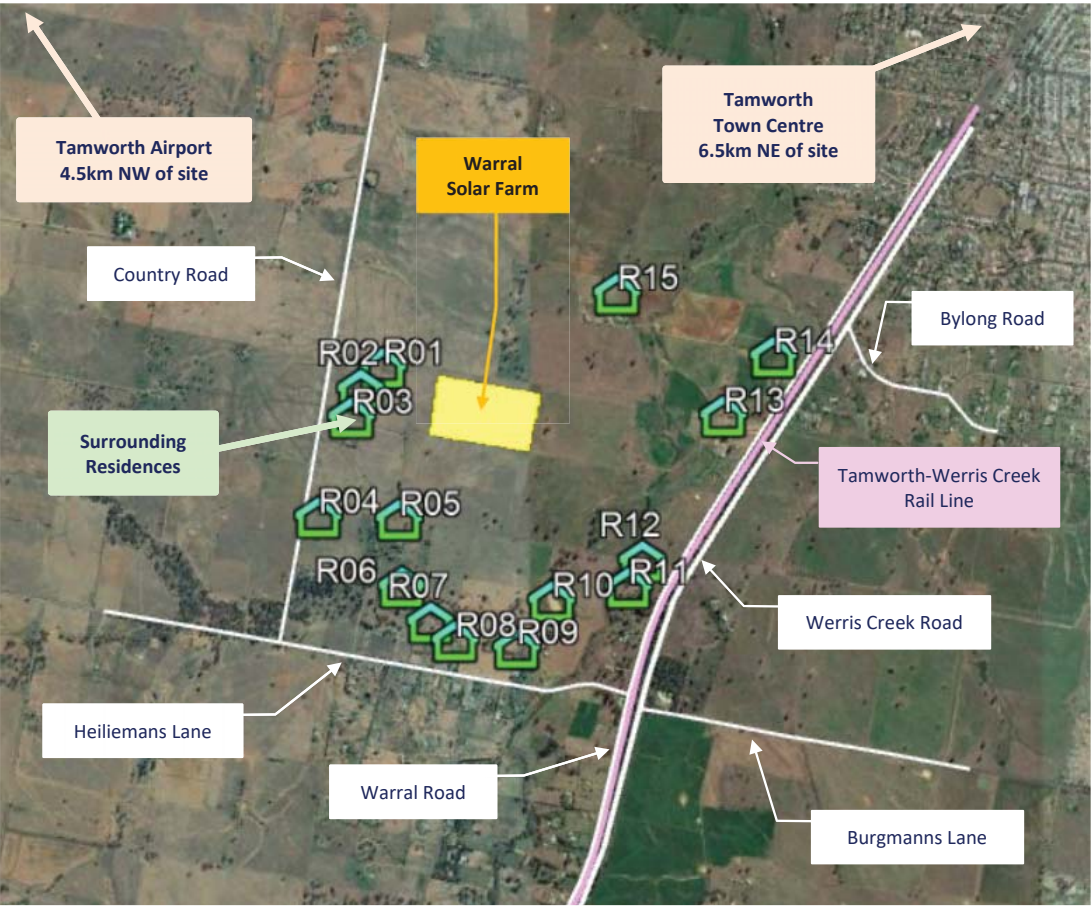


Figure 5 Surrounding Receivers of Interest

8.4 Glare Criteria

8.4.1 Aviation-Related Glint & Glare

In relation to the potential impact of solar PV systems on aviation activity, guidance is available from the US FAA which regulates and oversees all aspects of American civil aviation.

- FAA, “*Technical Guidance for Evaluating Selected Solar Technologies on Airports*”, Federal Aviation Administration, Washington, D.C., Version 1.1, April 2018.

In support of the above, the FAA contracted Sandia Labs to develop their **Solar Glare Hazard Analysis Tool** (SGHAT) software as the standard tool for measuring the potential ocular impact of any proposed solar facility. SGHAT utilises the Solar Glare Ocular Hazard Plot to determine and assess the potential for glare.

A sample SGHAT Ocular Hazard Plot is shown in **Figure 6**. The analysis contained in this plot is derived from solar simulations that extend over the ENTIRE CALENDAR YEAR in 1-MINUTE intervals, sunrise to sunset.

The SGHAT criteria state that a proposed solar facility should satisfy the following:

- Airport Traffic Control Tower (ATCT) cab: NO Glare
- Final approach paths for landing aircraft: Glare to NOT exceed “Low Potential for After-Image”

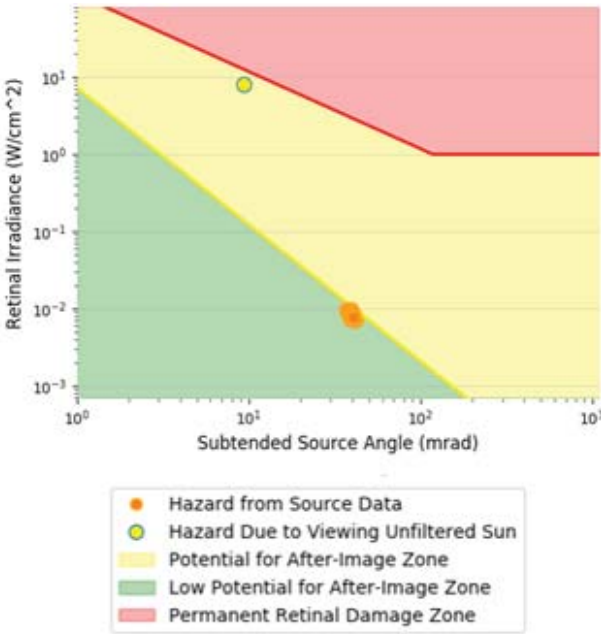


Figure 6 Example SGHAT Plot

In **Figure 6**, the following is noted:

- SGHAT ocular impact is a function of both the “retinal irradiance” (ie the light seen by the eye) and “subtended source angle” (ie how wide an arc of view the light appears to be arriving from).
- The occurrence of glare is shown in the plot as a series of **orange** circles, one circle for each minute that a reflection is visible.
- SGHAT ocular impact falls into three categories:
 - GREEN: low potential to cause “after-image”
 - YELLOW: potential to cause temporary “after-image”
 - RED: potential to cause retinal burn (permanent eye damage)
- “After Image” can occur for example when a photo with flash is taken in front of a person who then sees spots in front of their eyes for a few seconds. A more extreme example of “after-image” occurs when staring at the sun.
- The SGHAT plot also provides an indication of the relative intensity of the sources of light itself (ie the sun) – refer the **green** circle in the plot.
- Finally, in relation to PV Solar facilities, it is important to note that a “RED” category outcome is **not possible**, since PV modules DO NOT FOCUS reflected sunlight.

8.4.2 Motorist Disability & Pedestrian Discomfort Glare

The criteria commonly used by Australian Local Government Authorities to assess the acceptability or otherwise of potential adverse reflections from glazed façade systems onto surrounding roadways and pedestrian crossings utilise the so-called **Threshold Increment** (TI) Value of the reflection condition, defined in AS/NZS 4282:2019 as:

“the measure of disability glare expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present. Note: Higher values of TI correspond to greater disability glare.”

The TI Value is calculated as the ratio of “veiling” luminance (eg from a reflection) to the overall average background (“adaptation”) luminance, with the necessary constant and exponent parameters provided in AS 1158.2:2005.

The formula for calculating the TI Value is ...

TI = 65 Lv / Ltb0.8, where:

- Lv = veiling luminance from a source of interest (eg reflection) – Cd/m2
- Ltb = so-called “adaptation” luminance (total background) – Cd/m2

For (Motorist) Traffic Disability Glare, the TI Value should remain:

- Below 10 for major roads
- Below 20 for minor roads

For Pedestrian Discomfort Glare, the TI Value should remain:

- Below 2 at critical locations such as pedestrian crossings
- Below 3 for other locations

8.4.3 Rail Operators Reflective Glare

Almost all Australian Rail Authorities have guidelines covering glare in general (ie not specific to solar PV panel glare) aimed at avoiding discomfort/distraction to train operators and obscuring train signals. Most guidelines refer either to Table 2.10 of AS 1158.3.1 for the TI Value criterion and/or Table 3.2 of AS 1158.4 for the Cd (Candela) criterion associated with the control of glare.

For Rail Traffic Disability Glare, the relevant AS1158 criteria are:

- The TI Value should remain below 20
- The Cd Value at 70° incidence should remain below 6,000.

8.4.4 Residential “Nuisance” Glare

There are currently no national or state guidelines in Australia governing the acceptability or otherwise of residential nuisance glare specific to solar PV.

Existing guidance from state governments that exists in relation to solar panels typically covers installation audits and compliance checks.

Accordingly, to assist in addressing residential nuisance glare, reference has been made of the concepts used for TI Value pedestrian discomfort glare acceptability criteria outlined in the preceding sections.

8.4.5 Industrial Critical Machinery Operations

There are currently no (Australian) national or state guidelines governing the acceptability or otherwise of reflective glare for industrial site critical operations (eg dragline operations). Instead, the concepts used for the TI Value acceptability criteria can assist when dealing with this issue.

8.4.6 Night-Time Illumination Glare

The effect of light spill from outdoor lighting impacting on residents, transport users, transport signalling systems and astronomical observations is governed by AS 4282-2019.

The adverse effects of light spill from outdoor lighting are influenced by a number of factors:

- The topology of the area. Light spill is more likely to be perceived as obtrusive if the lighting installation is located higher up than the observer. Lighting installations are usually directed towards the ground and an observer could hence have a direct view of the luminaire.
- The surrounding area. Hills, trees, buildings, fences and general vegetation have a positive effect by shielding the observer from the light installation.

- Pre-existing lighting in the area. Light from a particular light source is seen as less obtrusive if it is located in an area where the lighting levels are already high, eg in cities. The same lighting installation would be seen as far more bothersome in a less well-lit residential area.
- The zoning of the area. A residential area is seen as more sensitive compared to commercial areas where high lighting levels are seen as more acceptable.

The Project is located outside the Warral township area and has the potential to impact on surrounding residential properties – refer **Figure 5**. As these properties are not located within township environs proper, they would therefore be classed as being in a residential area with “Dark Surrounds” - refer AS 4282-2019.

It is noted that night-time lighting is not currently incorporated into the Project.

If at some point of time in the future such lighting is incorporated into the facility, the following criterion will apply:

- Light spill from the Project onto the facades of any surrounding residential dwellings should be kept below 1 lux during relevant curfew hours.

Finally, it has been known for some time that night-time artificial lighting has the potential to disrupt the natural behaviour of nocturnal fauna species such as arboreal mammals, large forest owls and microbats. Biodiversity associated with the Project is discussed in the Flora and Fauna Assessment Report prepared for the Project. As far as is known, no adverse eco-lighting issues are apparent.

8.5 Glare Impact Assumptions

8.5.1 Project Site Solar Angles

One of the challenging issues encountered with daytime solar panel glare is the varying nature of the reflections, whose duration will vary with time of day and day of the year as the sun’s rays follow variable incoming angles between the two extremes of the summer and winter solstices.

Any solar glare analysis must take into account the complete cycle of annual reflection variations noted above.

The potential range of incoming solar angles at the Project site relevant to daytime glare is shown in **Figure 7** with relevant critical angles summarised in **Table 5**.

Table 5 Key Annual Solar Angle Characteristics

Day of Year	Summer Solstice	Equinox	Winter Solstice
Sunrise	4:58 am	6:02 am	6:56 am
Sunset	6:59 pm	6:05 pm	4:58 pm
Daily Azimuth Range	±117° E/W	±91° E/W	±62° E/W
Max Altitude	82.3°	59.4°	35.4°

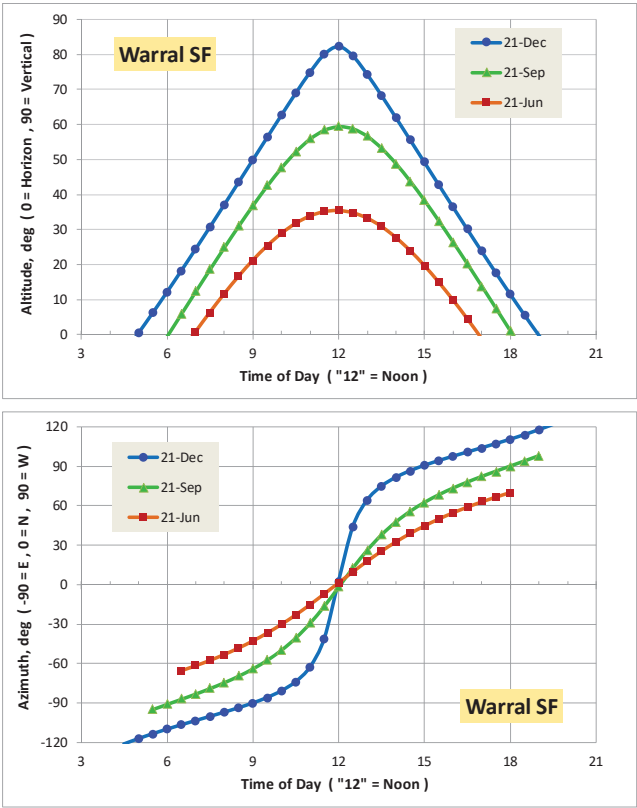


Figure 7 Project Site Solar Angle Variations

8.5.2 Project Site Panel Reflection Angles

The project will use single-axis tracking panels with a north-south axis of rotation). In “plan” view, reflections from the Project’s panels will be directed as shown in **Figure 8** for a representative area of panels, with the direction of reflected rays shown for typical mid-summer days. As a result of the tracking motion of the solar panels throughout the day, reflections will generally be directed upwards and hence not visible by ground-based receivers at roughly the same elevation as the facility.

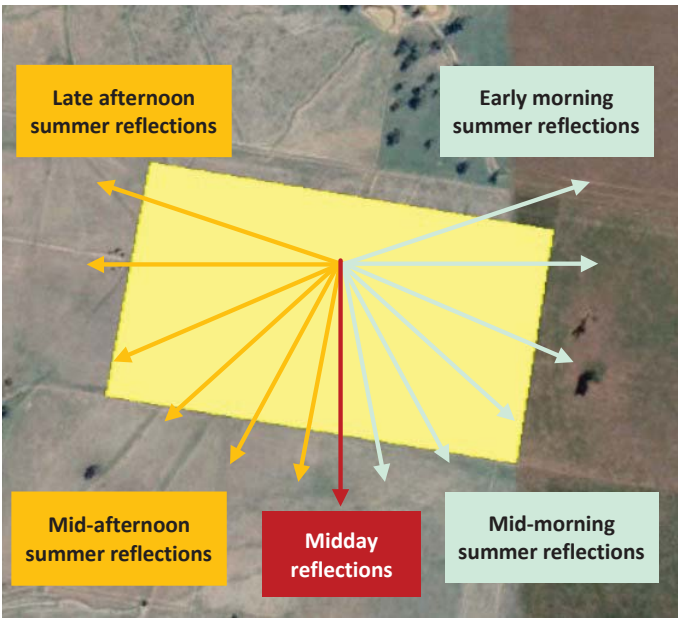


Figure 8 Potential Summer Reflection Angles

8.5.3 Solar Panel Reflectivity

Solar PV panels are designed to capture (absorb) the maximum possible amount of light within the layers below the front (external) surface. Consequently, solar PV panels minimise reflections which are a function of:

- the angle at which the light is incident onto the panel (which will vary depending on the specific location, time of day and day of the year), and
- the index of refraction of the panel surface and associated degree of diffuse (non-directional) versus specular (directional or mirror-like) reflection. Typical values of the refractive index “n” range from n = 2.0 (fresh, flaky snow) to n = 1.3 (standard solar glass).

Figure 9 shows the reflectivity off typical solar panel surfaces and the still surface of a lake as a function of incidence angle.

The reflectivity of the PV panels assumed in this study is the same as that shown for the standard solar glass shown in **Figure 9**.

- When an oncoming solar ray strikes the surface of a solar PV panel close to perpendicular to the panel surface (i.e. low “incident” angle), the reflectivity percentage is minimal (less than 5% for all solar panel surface types).
- It is only when an incoming solar ray strikes the panel at a large “incidence” angle, i.e. almost parallel to the panel, that reflectivity values increase. When this happens, reflections become noticeable and potentially at “glare” level for all solar panel surface types.
- However, for very high incidence angle, it would almost always be the case that the observer (motorist, train driver, pedestrian, etc) would perceive reflections coming from virtually the same direction as the incoming solar rays themselves. Such a condition would not constitute a glare situation as the intensity of the incoming solar ray itself would dominate the field of vision perceived by the observer.

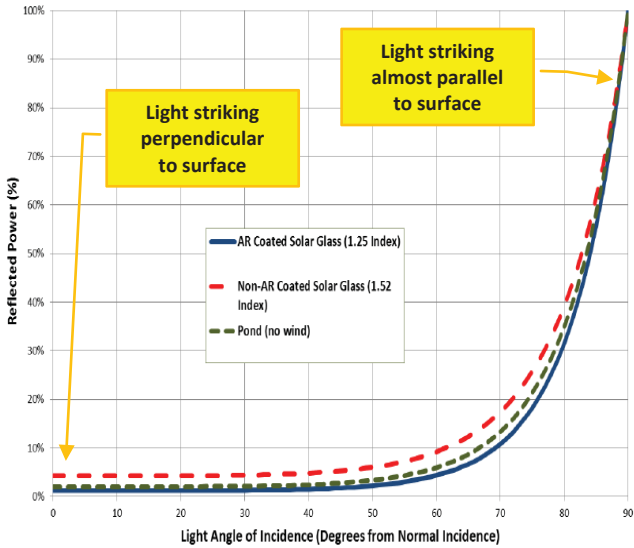


Figure 9 Typical Reflectivity v Incidence Angle

8.5.4 Operational Tracking Axis Configurations

Current single-axis tracking systems, as would be used for this project, are capable of operating in a number of different panel position modes. Possible options are shown in **Figure 10**.

- “A”: Fixed Tilt Mode:** in this mode, all panels are assumed to remain at a user-defined fixed angle all day long, eg horizontal, 15°East, 10°West, etc;
- “B”: Normal Tracking Mode:** in this mode, panels move between maximum tilt angles once the sun is above the relevant altitude angle (eg an altitude angle of 30° for ±60° single-axis trackers). They remain at the maximum tilt angles at all other times, switching over during the night;
- “C”: Normal Tracking Mode / Fixed Tilt Stowed:** in this mode, panels move during the day in “normal tracking”: mode, but then move (instantaneously) to any user-defined fixed tilt angle at all other times, eg 0° (horizontal);
- “D”: “Real-World Back-Tracking”:** in this mode, panels move during the day in “normal tracking”: mode, but then gradually move to a horizontal position, thereby minimising shading of one panel array from adjacent arrays – the example shown is from an operating solar farm.



Figure 10 Single-Axis Tracking Mode Options

8.6 Glare Impact Assessment

8.6.1 Aviation Glint & Glare

As can be seen in **Figure 5**, the nearest airfield to the Project site is Tamworth Airport (just over 4.5km northwest of the site to the nearest runway).

Due to the distances involved (refer above) and the possible angles of reflections from the Project’s solar PV panels (refer **Figure 8**) in relation to the pilot line of sight on landing approach on Runways 12L and 12R, potential glare conditions for aircraft landing from the northwest are deemed non-existent.

Similarly, aircraft approaching Tamworth Airport from the southeast (landing on Runways 30L or 30R) would have flown over the proposed facility by the time where they are 2 miles out from the airport, which is the point where aviation glare assessments are considered. Again, potential glare conditions are deemed non-existent.

Accordingly, a quantitative analysis (eg using Sandia Labs SGHAT) is not deemed necessary to assess the potential for adverse and unacceptable glare (and glint) conditions.

8.6.2 Aerial Spraying / Crop Dusting

Given the surrounding agricultural land usage in the vicinity of the Project site, it is possible that aerial spraying might take place within several kilometres of the Project. There are no “standard” aircraft flight paths associated with such aviation activity.

SLR has previously undertaken quantitative analyses using the SGHAT software tool of such activities, for the following scenario:

- Assume potential flight paths whereby an aircraft is flying horizontally towards a Project site from any direction and at an elevation of 200 ft (60 m) above local ground level;
- Assume that the aircraft can get as close as 1 km to the nearest part of the Project’s solar array; and
- Assume that solar panels track the sun during the day, tilting from 60 east to 60 west, about a horizontal axis oriented north-south.

When run for a full year of potential incoming solar angles at latitudes similar to the Project site (hence similar incoming solar angles), the resulting SGHAT Ocular Plots showed that the potential for aviation glare was negligible. This was primarily due to the low incidence angle of reflected rays (regardless of the time of the year) arising from the tilting action of the tracking systems.

8.6.3 Motorist Disability & Pedestrian Discomfort Glare

The “major” and “minor” thoroughfares in the immediate vicinity of the Project (refer **Figure 5**) are:

MAJOR (TI Values should be less than 10)

- Werris Creek Road– northbound, southbound

MINOR (TI Values should be less than 20)

- Warral Road – northbound, southbound
- Heiligmans Lane– eastbound, westbound
- Burgmanns Lane - westbound
- Country Road – northbound, southbound

Important factors influencing the potential for traffic disability glare include:

- Any difference in elevation between the motorist and the solar panel array;
- Obstructions by intervening terrain, vegetation and topography; and
- The difference between the line of sight of a driver (i.e. in the direction of the road) and the line of sight relative to incoming reflections. Significant TI values can only occur when this difference is small. In some cases, such reflections become essentially non-visible to the motorist, eg east moving traffic on Burgmanns Lane.

TI calculations have been made for the roadways surrounding the Project site. It is noted that the elevations at the site range from 411m at the western perimeter to 395m at the eastern perimeter, ie the terrain falls gently towards the east at the site.

The results, shown in **Table 6**, indicate the following:

- TI Values registered for all carriageways were zero at all times of the year for the “±60° Normal Tracking” mode, where reflections are directed upwards for all incoming solar angles, all year round.
- Low TI Values are possible if the panels are left in a FIXED TILT mode either flat or slightly eastwards and westwards at surrounding at a low angle to the horizontal – this applies to on carriageways which are elevated relative to the proposed facility.

In the FIXED/LOW TILT mode cases examined, the relevant Motorist Traffic Disability Glare criteria and Pedestrian Discomfort Glare criteria are satisfied, as a result of:

- The difference between driver line of sight and the angle of incoming solar reflection and distances involved.

Table 6 Roadway TI Value Calculation Results

Roadway	TI Values	Comment
Werris Creek Road	Max 5	If panels left tilted slightly, east (highest values for north moving traffic)
Warral Road	Max 5	If panels left tilted slightly, east (highest values for north moving traffic)
Heiliemans Lane	Nil	All year round
Burgmanns Lane	Max 2	If panels left flat or tilted slightly east
Country Road	Max 4	If panels left flat or tilted slightly west

8.6.4 Train Driver Disability Glare

Figure 5 shows Tamworth to Werris Creek Rail Line running to the east of the site, 1km from the proposed facility’s eastern perimeter at its closest point of approach.

TI calculations yield the following result:

- TI Values registered were zero at all times of the year for the “±60° Normal Tracking” mode, where reflections are directed upwards for all incoming solar angles, all year round.
- Low TI Values (maximum TI=6) are possible if the panels are left in a FIXED TILT mode either flat or tilted slightly eastwards for north moving train traffic – this is due to the elevated nature of the rail line to the east and east-southeast of the site.

The above TI Values comply with the relevant train driver disability glare.

Finally, it is also noted that the corridor currently available to a future proposed East Coast High Speed Rail Link and the currently planned corridor for the Melbourne to Brisbane Inland Rail Line are nowhere near the proposed facility.

8.6.5 Industrial Critical Machinery Operators

There are no industrial operations in the vicinity of the Project (e.g. mining operations) and none planned (mining or otherwise), with the kind of machinery where the relevant operators have the potential to experience reflective glare from the Project, eg elevated cabins in draglines, etc.

8.6.6 Residential Nuisance Glare

The nearest residential receivers to the Project are identified in **Figure 2**.

- They surround the site at varying distances from the proposed facility, with the closest (R01) approximately 300 from the western perimeter of the proposed facility.
- Their ground elevations reflect the gentle undulations of the surrounding topography, with several small hillocks located around the site. The terrain slopes generally down from west to east and then up again further to the east, relevant to residences located along Country Road to the west of the Project site as well as to the east of the site (along Warral Road).

There are no formal criteria governing residential reflective nuisance glare from solar facilities.

Accordingly, SLR has carried out TI Value calculations for the receivers discussed above, to gain an understanding of the potential for nuisance glare conditions from the project. The results are shown in **Table 7**.

No account was taken of the potential “shielding” benefit to surrounding residences from any vegetation and trees lying between a property and the Project site.

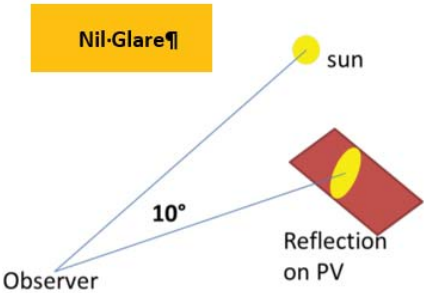


Figure 11 Nil Glare Condition for Residential Nuisance Glare

Table 7 Residential TI Value Calculations Results

Receivers	TI Values	Comment
R01-R05	Up to ~4	If panels left flat or tilted slightly westwards
R06-R10, R13-R15	Nil	All year round
R10, R11	Up to ~1	If panels left flat or tilted slightly eastwards

The results indicate the following:

- For the standard operational “±60° Normal Tracking” mode, the TI Values were NIL at all receivers;
- For any modes involving panels being left in a FIXED TILT mode either horizontal or slightly eastwards or westwards, reflections will be potentially visible at residences both to the east and west of the site, in particular residences to the west which are at a higher elevation than the solar array.
- For the most part, this would not constitute a glare condition because these reflections will occur (in the case of western residences) early in the morning when visible reflections would be in the same line of sight as the solar rays (ie the sun) themselves - as is shown in **Figure 11**.

To minimise the potential for visible reflections to occur at the site, it is recommended that solar panels be left with a either an eastwards or westwards tilt of at least 15° when not in normal tracking mode (eg for maintenance) so as to completely eliminate the visibility of reflections to any surrounding residences. Note that this would also eliminate visible reflections to surrounding road and rail traffic.

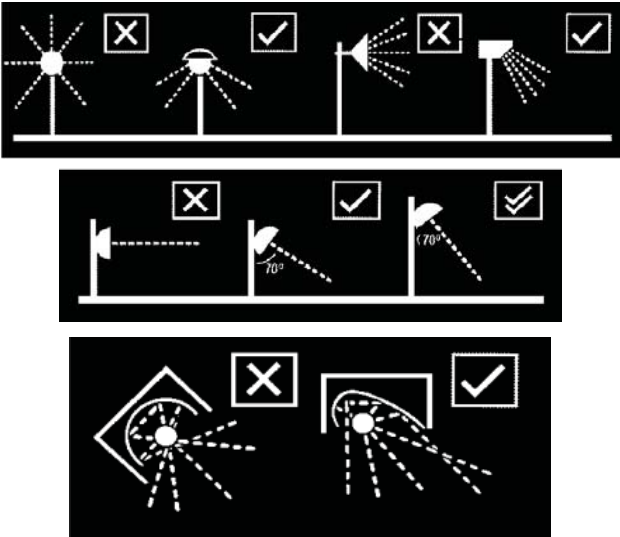


Figure 12 Luminance Design Features that Minimise Light Spill

8.6.7 Night-Time Illumination Glare

Although presently not fully defined, it is assumed that an area within the Warral Solar Farm Project site will be set aside for an Operation and Maintenance building, power conversion unit, fire access routes and egress, etc, and that some of these may need to be operational 24/7.

Although night-time illumination is not presently planned for the Project, it may be required in the future for some of the above relevant areas and, as such, is addressed in principle in this assessment.

The only potential for any future night-time illumination glare would be associated with the nearest thoroughfares and residential and other sensitive receivers to the Project.

Consideration has also been given to the potential for adverse eco-lighting impacts on nocturnal fauna habitats in close proximity to the Project site, especially within any close-by native vegetation areas. On the basis of the Flora and Fauna Assessment Report carried out for the Project, there are no such habitats close to the Project site.

The recommendations set out below are therefore made in the event that future 24/7 lighting is incorporated into the Project, to achieve the best lighting performance (taking into account safety considerations) while having a minimal impact on the surrounding properties, carriageways and nocturnal fauna.

In terms of any future potential night-time lighting, the adopted goal of limiting night-time light spill to no more than 1 lux falling on the nearby residential facades during curfew hours will be easily achieved given the distances to the nearest residential and other receivers.

Accordingly, the potential for any future nuisance glare will be non-existent.

AS4282-1997 Control of the Obtrusive Effect of Outdoor Lighting sets out general principles that should be applied when designing outdoor light to minimise any adverse effect of the light installation.

- Do not waste energy and increase light pollution by over-lighting.
- Direct lights downward as much as possible and use luminaires that are designed to minimise light spill, e.g. full cut-off luminaires where no light is emitted above the horizontal plane, ideally keeping the main beam angle less than 70°.
- Less spill-light means that more of the light output can be used to illuminate the area and a lower power output can be used, with corresponding energy consumption benefits, but without reducing the illuminance of the area – refer **Figure 12**.
- Wherever possible use floodlights with asymmetric beams that permit the front glazing to be kept at or near parallel to the surface being lit.

8.7 Glare Assessment Conclusion

8.7.1 Aviation-Related Potential Glare

There will be nil impact from the Project in relation to aviation-related glare.

8.7.2 Motorist “Traffic Disability” Glare

Primarily due to the selection of the single-axis tracking system for the mounting of the ground-based array panels and line of sight of drivers relative to the solar array, solar reflections from the proposed facility will comply with National criteria for road traffic disability glare.

8.7.3 Rail Traffic “Disability” Glare

Similarly, solar reflections from the proposed facility will comply with National criteria for rail traffic disability glare.

8.7.4 Residential Nuisance Glare

Reflections from the proposed facility may be visible at several surrounding residences, namely those to the east and west which are at higher elevations than the Project site.

Although the TI Values calculated for this occurrence are minimal/modest, a recommendation has been made to eliminate this occurrence.

If panels need to be left in a horizontal or near horizontal position when not in normal tracking mode (eg for maintenance), it is recommended that panels be left with an eastwards or westwards tilt of at least 15°.

8.7.5 Night-Time Illumination Glare

Although presently not incorporated into the Project, consideration has been given to the future potential for night-time lighting related to equipment and/or buildings, fire access routes and egress, etc.

Recommendations have been made to ensure that the potential for any future possible night-time illumination glare will be non-existent.

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Flora and Fauna Assessment Report



KDC Pty Ltd

Warral Solar Farm

Lot 4 DP 1048145, 329 Country Road,
Warral NSW

21 May 2021

Flora and Fauna Assessment Report

Warral Solar Farm

Lot 4 DP 1048145, 329 Country Road, Warral NSW

Kleinfelder Document Number: NCA20R119062

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- Appendix 3: Threatened Species 'Likelihood of occurrence'
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- Appendix 5: Assessment of significance (pursuant to Section 7.3 of the BC Act)
- Appendix 6: Aerial Imagery
- Appendix 7: Licenses and Permits

1. INTRODUCTION

1.1 PROJECT BACKGROUND

Kleinfelder has been engaged by KDC Pty Ltd (KDC) on behalf of Providence Asset Group to prepare a Flora and Fauna Assessment Report for a proposed solar farm located at Lot 4 DP 1048145, 329 Country Road, Warral NSW, 2340 (**Figure 1**). The project will be assessed under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) with Tamworth Regional Council as the determining authority.

The following terms are used throughout this report to describe geographical areas:

- Study area – Lot 4 DP 1048145 (27.17 ha).
- Subject site (development footprint) – areas of the study area proposed for development (13.6 ha) as shown in **Figure 2** and **Figure 3**.
- Locality – land within a 5 km radius of the study area.

This report identifies flora, fauna and threatened species present, or likely to occur within the study area based on species and/or habitats detected during field surveys and threatened flora and fauna records from the locality. An assessment of the likely impacts on identified threatened species, habitat features, wildlife corridors and vegetation communities as a result of the proposed development has also been undertaken.

1.2 SITE DESCRIPTION

The Study Area is located in the suburb of Warral, approximately 2.5 km southwest of the township of Tamworth within the Tamworth Regional Council Local Government Area (LGA). The study area is zoned 'RU4 – Primary Production Small Lots' under the *Tamworth Local Environmental Plan 2010* (Tamworth LEP, 2010). The Study Area exhibits historical and ongoing land use consistent with category 1- exempt land under Section 60H of the *Local Land Services Act 2013* (LLS Act) (See **Section 2.2.3**).

Access to the study area is achieved via an unsealed road from Country Road to the west. The study area is surrounded on all sides by agricultural development. Rural dwellings occur to the south west and central west of the study area. A constructed dam and an unnamed first order

stream are located in the northwest portion of the study area. The first order stream is a tributary of Timbumburi creek, which is located approximately 670 m to the east of the study area. Timbumburi creek will be intersected by the proposed grid connection route via the powerline easement near Duri Road.

The predominant land use within the locality is agricultural development, as the topography within the area is relatively flat. The study area has an elevation ranging from 329 m in the west to 400 m in the east and has previously been cleared of native vegetation for agricultural purposes (i.e. grazing). Remaining native vegetation consists of areas of native/exotic grassland and isolated paddock trees. Site photographs are provided in **Appendix 1**.

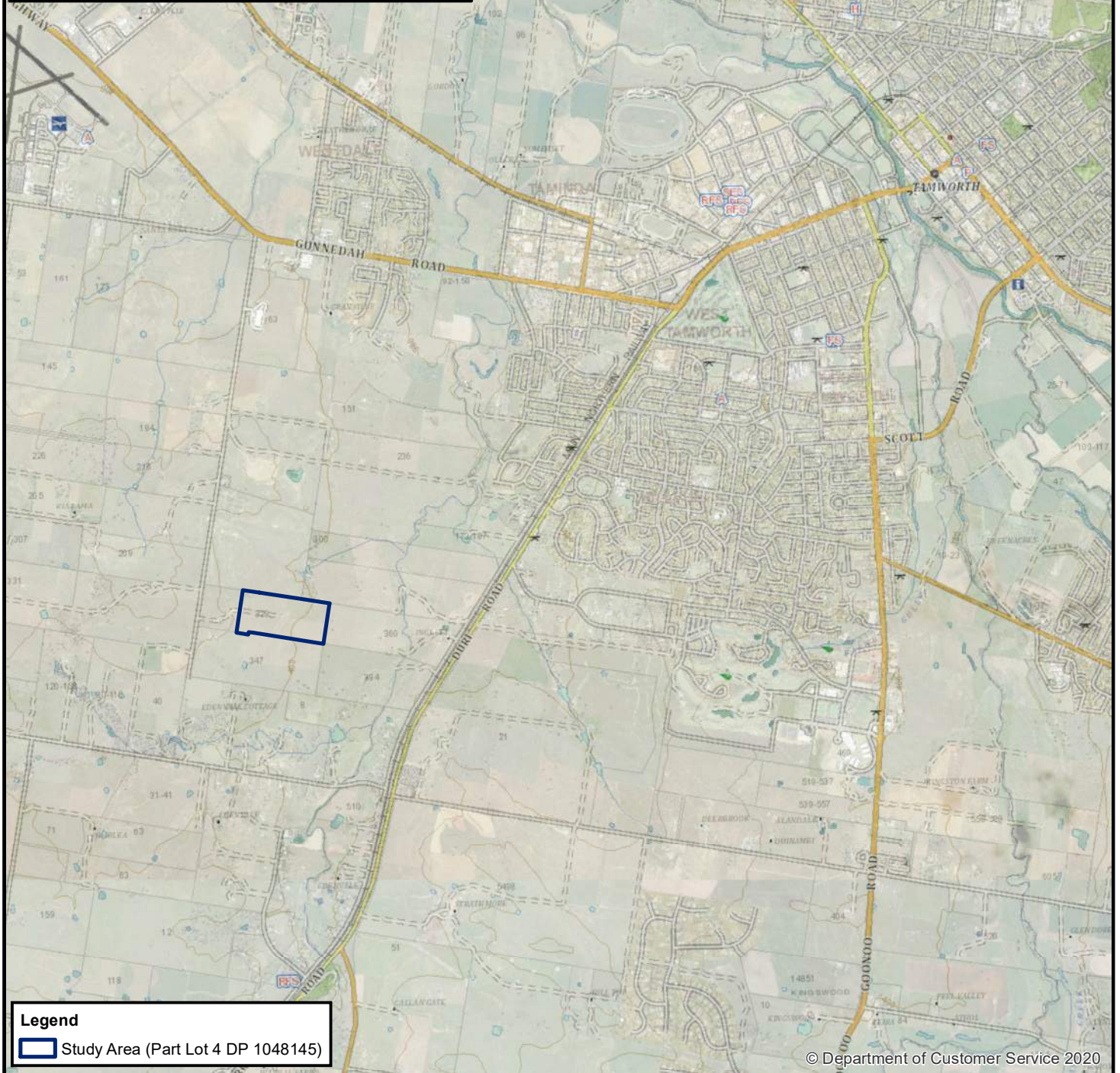
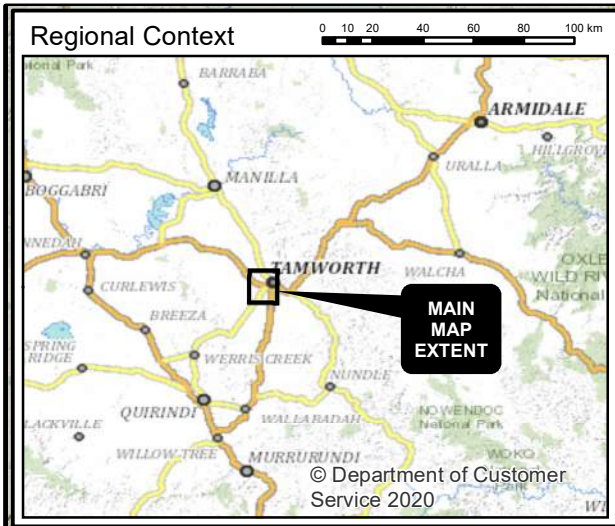
1.3 PROPOSED DEVELOPMENT

The Warral Solar Farm project will include a 5 MW grid-connected solar PV installation. The proposed project layout is approximately 13.6 ha in area and is provided in **Figure 3**. The location of the proposed solar farm is situated near the eastern boundary of the study area. Access to the site will occur from the west via Country Road. Connection to the grid will be achieved via a powerline easement to the east near Duri Road.

1.4 REPORT OBJECTIVES

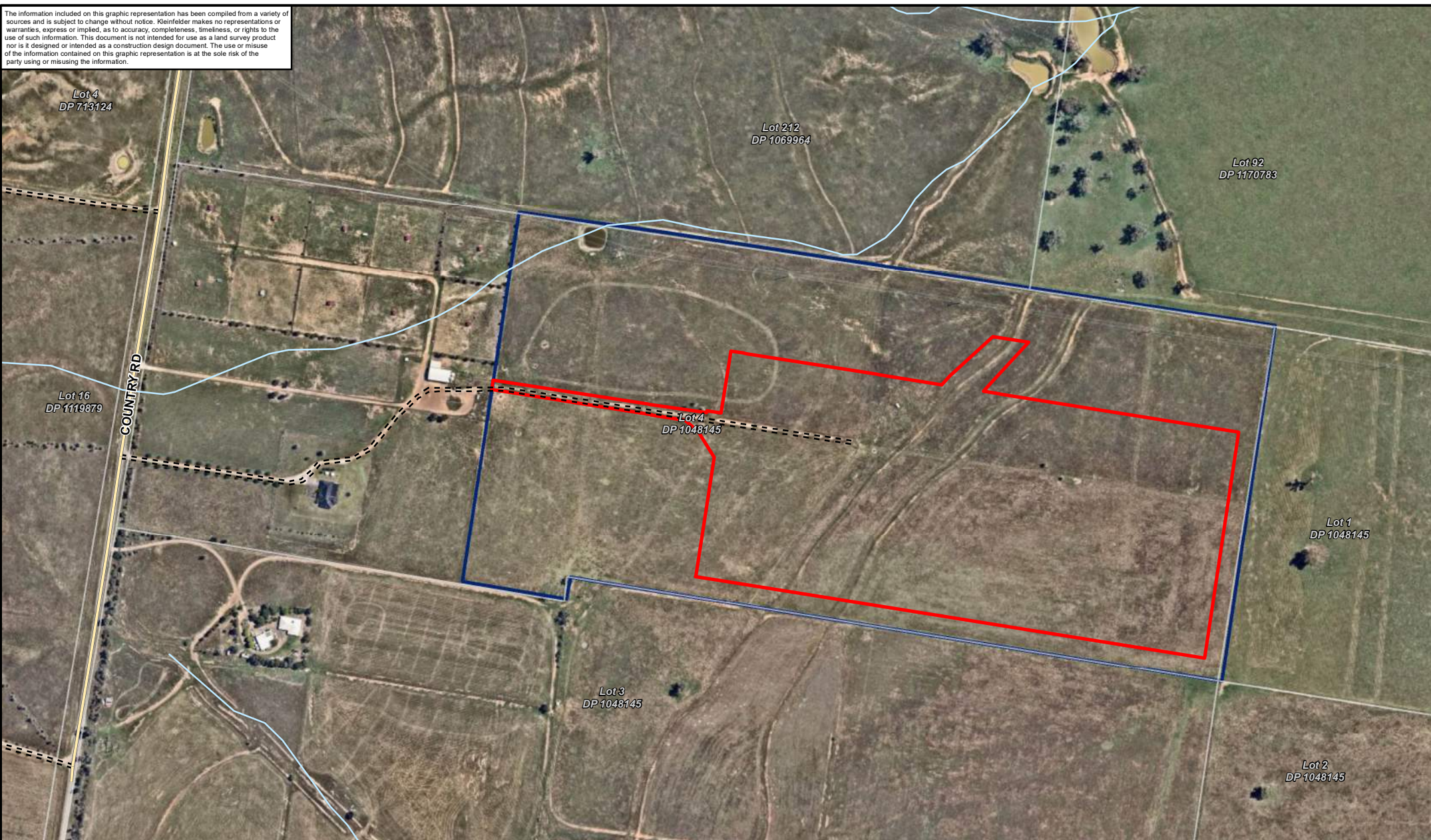
The objectives of the Flora and Fauna Assessment Report include:

- Describe the flora and fauna (and their habitats) present on, or likely to occur on the subject site.
- Assess the relevance and value of the subject site for threatened species and ecological communities (and their habitats) listed under the NSW *Biodiversity Conservation Act 2016* (BC Act).
- Assess the potential impacts of the proposed development on threatened species and ecological communities, pursuant to Section 7.3 of the BC Act (5-part test).
- Comment on the likely occurrence and relevance of matters of national environmental significance listed under the Commonwealth *Environment Planning and Biodiversity Conservation Act 1999* (EPBC Act).
- Describe steps to avoid and mitigate any identified impacts on flora and fauna and to protect the natural environment of the subject site.



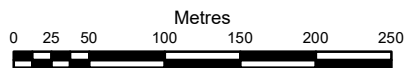
<p>0 0.25 0.5 1 1.5 2 2.5 km</p> <p>KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com</p>	<p>PROJECT REFERENCE: 20212647</p> <p>DATE DRAWN: 2020/11/26 22:04 Version 1</p> <p>DRAWN BY: GJoyce</p> <p>DATA SOURCE: NSW DFSI - 2020 KDC - 2020</p>	<p>Locality</p> <p>Flora and Fauna Assessment Report Warral Solar Farm Lot 4 DP 1048145 329 Country Road, Warral NSW</p>	<p>FIGURE:</p> <p>1</p>
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Legend

- Study Area (Part Lot 4 DP 1048145)
- Subject Site
- Cadastre Lot Boundaries
- Unnamed Watercourse
- Local Road
- Track



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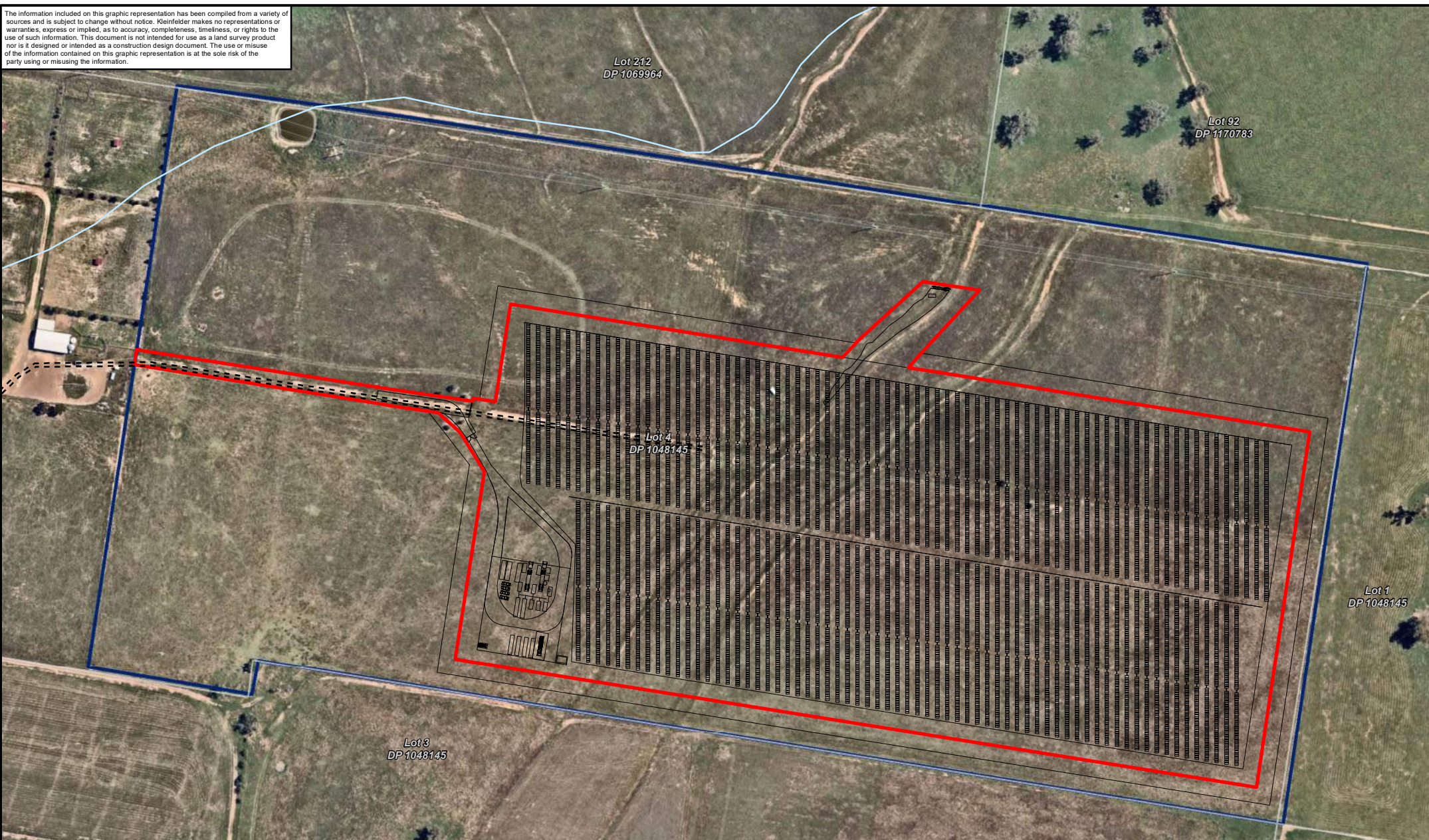
Subject Site

Flora and Fauna Assessment Report
Warral Solar Farm
Lot 4 DP 1048145
329 Country Road, Warral NSW

FIGURE:

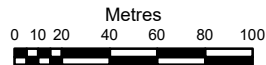
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Legend

- Study Area (Part Lot 4 DP 1048145)
- Subject Site
- Proposed Layout
- Cadastre Lot Boundaries
- Unnamed Watercourse
- Track



PROJECT REFERENCE: 20212647

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DATA SOURCE:
NSW DFSI - 2020
KDC - 2020
Nearmap - 2020

Proposed Site Layout

Flora and Fauna Assessment Report
Warral Solar Farm
Lot 4 DP 1048145
329 Country Road, Warral NSW

FIGURE:

3

2. LEGISLATIVE CONTEXT

2.1 COMMONWEALTH LEGISLATION

2.1.1 Environment Protection & Biodiversity Conservation Act 1999

The purpose of the EPBC Act is to ensure that actions likely to cause a significant impact on 'matters of national environmental significance' undergo an assessment and approval process. Under the EPBC Act, an action includes a proposal, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things. An action that 'has, will have or is likely to have a significant impact on a Matter of National Environmental Significance (MNES)' is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Australian Minister for the Environment.

The EPBC Act identifies nine MNES:

- World heritage properties.
- National heritage places.
- Wetlands of international importance (Ramsar Wetlands).
- Threatened species and ecological communities.
- Migratory species.
- Commonwealth marine areas.
- The Great Barrier Reef Marine Park.
- Nuclear actions (including uranium mining).
- A water resource, in relation to coal seam gas development and large coal mining development.

As part of the current assessment, MNES that are predicted to occur within the locality (applying a 5 km buffer) were obtained from the on-line Protected Matters Search Tool (DoEE, 2020a). These records are discussed in **Section 4**. The EPBC Act has been further addressed in this assessment through:

- Field surveys for EPBC Act listed threatened biota and migratory species.
- Assessment of potential impacts on EPBC Act listed threatened species and migratory biota.

- Identification of suitable impact mitigation and environmental management measures for EPBC Act listed threatened species and migratory biota.

2.2 STATE LEGISLATION

2.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act forms the legal and policy platform for proposal assessment and approval in NSW and aims to ‘*encourage the proper management, development and conservation of natural and artificial resources*’. All development in NSW is assessed in accordance with the provisions of the EP&A Act and the EP&A Regulation 2000.

Development activities that require consent are assessed and determined in accordance with Part 4 of the EP&A Act. The determining authority for the project is Tamworth Regional Council.

2.2.2 Biodiversity Conservation Act 2016

The NSW BC Act, the NSW *Biodiversity Conservation Regulation 2017* (NSW BC Regulation) and amendments to the NSW *Local Land Services Act 2013* (LLS Act) commenced on 25 August 2017. The legislation aims to deliver “a strategic approach to conservation in NSW while supporting improved farm productivity and sustainable development”. The NSW BC Act repeals several pre-existing Acts, most notably the NSW *Threatened Species Conservation Act 1995*, the NSW *Nature Conservation Trust Act 2001* and the NSW *Native Vegetation Act 2003*.

In accordance with the NSW BC Act, entry into the Biodiversity Offsets Scheme (BOS) is not required for the proposed development due to the following:

- The proposed development is not deemed to be ‘State Significant’ under the NSW EP&A Act.
- The proposed development will not impact an Area of Outstanding Biodiversity Value (AOBV) as listed under Part 3 of the NSW BC Act.
- The proposed development is unlikely to cause a significant impact on a threatened species, population or ecological community, as listed under Schedules 1 and 2 of the NSW BC Act, as determined by application of a five-part-test of significance under Section 7.3 of the NSW BC Act.

- The proposed development will not impact areas mapped as having 'high biodiversity value' as indicated by the NSW Biodiversity Values Map (BV Map).
- The proposed development will result in the removal of minimal native vegetation (further discussed in **Section 5.1.1**) therefore, the project will not involve clearing of native vegetation that exceeds the BOS threshold for the site (1 ha threshold for a minimum lot size of 40 ha) as determined by the NSW *Biodiversity Conservation Regulation 2017*.

In consideration of the criteria listed above, a Biodiversity Development Assessment Report (BDAR) is not required for the proposed development. As part of the current assessment, threatened species and ecological communities as listed under the NSW BC Act that have previously been recorded within the locality (applying a 5 km buffer) were obtained from the on-line BioNet Atlas of NSW Wildlife (DPIE, 2020a). These records are discussed in **Section 4** of this report. The NSW BC Act has been further addressed in this assessment through:

- Field surveys to assess the presence of threatened species, populations and ecological communities, as listed under Schedules 1 and 2 of the NSW BC Act, within the subject site.
- Assessment of potential impacts threatened species, populations and ecological communities, as listed under Schedules 1 and 2 of the NSW BC Act, as determined by application of a five-part-test of significance under Section 7.3 of the NSW BC Act.
- Identification of suitable impact mitigation and environmental management measures.

2.2.3 Local Land Services Act

The Study Area exhibits historical and ongoing land use consistent with category 1- exempt land under Section 60H of the Local Land Services Act 2013 (LLS Act), which defines category 1-exempt land as follows:

(1) Land is to be designated as category 1-exempt land if the Environment Agency Head reasonably believes that:

- (a) the land was cleared of native vegetation as of 1 January 1990, or
- (b) the land was lawfully cleared of native vegetation between 1 January 1990 and the commencement of this Part.

(2) Land is to be designated as category 1-exempt land if the Environment Agency Head reasonably believes that:

- (a) the land contains low conservation value grasslands, or
- (b) the land contains native vegetation that was identified as regrowth in a property vegetation plan referred to in section 9 (2) (b) of the *Native Vegetation Act 2003*, or

(c) the land is of a kind prescribed by the regulations as category 1-exempt land.

For developments requiring some degree of land clearing as defined in Part 5A of the LLS Act, the BC Act stipulates under what conditions the BAM is to be used to determine possible entry into the BOS. In relation to category 1-exempt land, Clause 6.8(3) of the BC Act states:

(3) The biodiversity assessment method is to exclude the assessment of the impacts of any clearing of native vegetation and loss of habitat on category 1-exempt land (within the meaning of Part 5A of the LLS Act, other than any impacts prescribed by the regulations under section 6.3.

As the Native Vegetation Regulatory Map, which is intended to show the extent of areas of classified as category 1-exempt and category 2-regulated, is still under development, transitional arrangements require assessment against multiple data sources and field surveys. Classification of the subject site for the purposes of this development application as category 1-exempt was assessed using the following data sources:

- An ecological field survey (described in this report).
- Historical aerial photography – 1989, 1998, 2011 and 2014 (**Appendix 6**).

In relation to Section 60H of the LLS Act, no aerial imagery was available for 1 January 1990. Consequently, images from 1989, 1998, 2011 and 2014 were assessed (**Appendix F**) Aerial imagery from 1989 shows the subject site to be extensively modified and cleared of native vegetation for cropping and/or pastoral improvement purposes. Based on the above data sources, the Development Site has been under regular cropping, grazing and pasture improvement since prior to 1990. Therefore, in accordance with the LLS Act, the Development Site would meet the definition of category 1-exempt land.

2.2.4 Biosecurity Act 2015

The NSW *Biosecurity Act 2015* provides a streamlined statutory framework to protect the NSW economy, environment and community from the negative impact of pests, diseases and weeds. The primary objective of the Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

In NSW, all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

Weed species recorded within the subject site during the current investigation are discussed in **Section 4**.

2.2.5 National Parks and Wildlife Act 1974

The NSW *National Parks and Wildlife Act 1979* (NPWS Act) aims to conserve nature, objects, places or features (including biological diversity) of cultural value within the landscape. The Act also aims to foster public appreciation, understanding and enjoyment of nature and cultural heritage, and provides for the preservation and management of national parks, historic sites and certain other areas identified under the Act.

No areas of National Park estate occur within or adjacent to the subject site.

2.2.6 Water Management Act 2000

Controlled activities carried out in, on or under waterfront land are regulated by the NSW WM Act. The NSW Natural Resource Asset Regulator (NRAR) administers the WM Act and is required to assess the impact of any proposed controlled activity to ensure that no more than minimal harm will be done to 'waterfront land' as a consequence of carrying out the controlled activity. Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 m of the highest bank of the river, lake or estuary (NRAR, 2018). This means that a controlled activity approval must be obtained from the NRAR before commencing the activity.

One unnamed stream is mapped across the north west portion of study area. This stream is a tributary of Timbumburi creek, which intersects the proposed grid connection to the east (**Figure 2**). No vegetation clearing or disruption to the creek is likely to occur as a result of the construction of the grid connection. Notwithstanding, the application of the WM Act and an assessment of indirect impacts of the proposed development on aquatic habitat and downstream aquatic habitats is provided in **Section 5.1**.

2.2.7 State Environmental Planning Policy (Koala Habitat Protection) 2019

State Environmental Planning Policy (Koala Habitat Protection) aims to encourage the conservation and management of areas of natural vegetation that provide habitat for Koalas to support a permanent free-living population over their present range and reverse the current trend of Koala population decline.

A Koala Plan of Management (KPoM) has not been prepared for the study area; therefore, provisions of Clause 9 of the SEPP (Koala Habitat Protection) is applicable to the proposed development. As such, Council must take into account the requirements of the Koala Habitat Assessment Guideline (DPIE, 2020b), or information prepared by a suitably qualified and experienced person in accordance with the guideline to determine if the land is classified as Highly Suitable Koala Habitat or Core Koala Habitat.

See **Section 4.9** for a summary of the Koala habitat assessment.

2.3 LOCAL PLANNING INSTRUMENTS

2.3.1 Tamworth Local Environmental Plan 2010

The study area is located within the Tamworth Regional Council LGA. The *Tamworth Local Environmental Plan 2010* (Tamworth LEP, 2010) controls development within the study area through zoning and development controls. These controls are described in greater detail by the supporting *Tamworth Development Control Plan* (Tamworth DCP, 2010).

2.3.2 Tamworth Regional Development Control Plan 2010

The Tamworth DCP supports the Tamworth LEP by providing additional detail and guidance on addressing biodiversity issues associated with development. In regard to biodiversity, the DCP contains provisions that relate to environmental effects, soil and erosion control and vegetation. These provisions have been considered during the assessment.

3. MATERIALS AND METHODS

3.1 DESKTOP ASSESSMENT

Existing information on the flora and fauna of the subject site and the locality, including relevant threatened biota was obtained from:

- Regional vegetation mapping: Extant natural vegetation for Cobbadah, Manilla and Tamworth (VIS_ID 3796) (DPIE, 2009).
- The BioNet Atlas of NSW Wildlife (DPIE, 2020a) for previous records of threatened species, populations and ecological communities (as listed under the BC Act) within a 5 km radius of the subject site (data retrieved 24/11/2020).
- The Department of the Environment and Energy (DoEE, 2020a) Protected Matters Search Tool, which involved a search for matters of national environmental significance within a 5 km radius of the subject site (conducted on 24/11/2020).
- Relevant published literature on threatened biota (see **References**).

The results of the database searches were used to compile a list of threatened species, populations and communities, as listed under the BC Act and EPBC Act that could potentially occur on the subject site, and their likelihood of occurrence.

3.2 FIELD SURVEY

3.2.1 Vegetation Assessment

A diurnal inspection of the subject site and surrounds was undertaken on 11 November 2020 to provide specific observations for this report.

Native vegetation types were identified based on dominant flora species present within each structural layer (i.e. canopy, shrub and ground layers). Exotic or highly modified native vegetation was defined based on structure and species composition. Boundaries of vegetation types and communities were marked with a hand-held GPS and mapped using geographical information system (GIS) software.

Vegetation types were assessed against identification criteria for State and Commonwealth listed threatened ecological communities (DoEE, 2020b; DPIE, 2020d). Vegetation and habitats were compared with descriptions provided in the BioNet Vegetation Classification to identify Plant Community Types (PCTs).

Two 400 m² floristic plot/transects were sampled in accordance with Section 5.3.4 of the NSW Biodiversity Assessment Method (BAM) (OEH, 2017). Percentage cover and relative abundance was recorded for all plant species within each plot/transect. Plot/ transects were positioned to sample areas that were most representative of the floristic characteristics of each PCT.

Plant identification and nomenclature were based on species descriptions presented within The Flora of New South Wales Volumes 1 to 4 (Harden, 1993) and with reference to taxonomic updates in PlantNET - The Plant Information Network System of Botanic Gardens Trust, Sydney, Australia (Botanic Gardens Trust, 2020). The locations of all floristic plot/ transects are presented in **Figure 4**.

3.2.2 Fauna Habitat Assessment

The locations of any important habitat features, such as microbat roosting habitat, hollow-bearing trees, terrestrial refugia and nests/burrows were captured with a handheld GPS device and photographed where appropriate.

Searches for potential habitat for threatened fauna species included but were not limited to:

- Koala feed trees.
- Foraging trees for threatened birds.
- Hollow-bearing trees.
- Potential roosts for microbats.
- Vegetated ponds, riparian vegetation and drainage lines for frogs and waterbirds.
- Woody debris, leaf litter and bush rock.

Diurnal opportunistic observations of fauna species and fauna activity such as scats, tracks, burrows or other traces were recorded during survey.

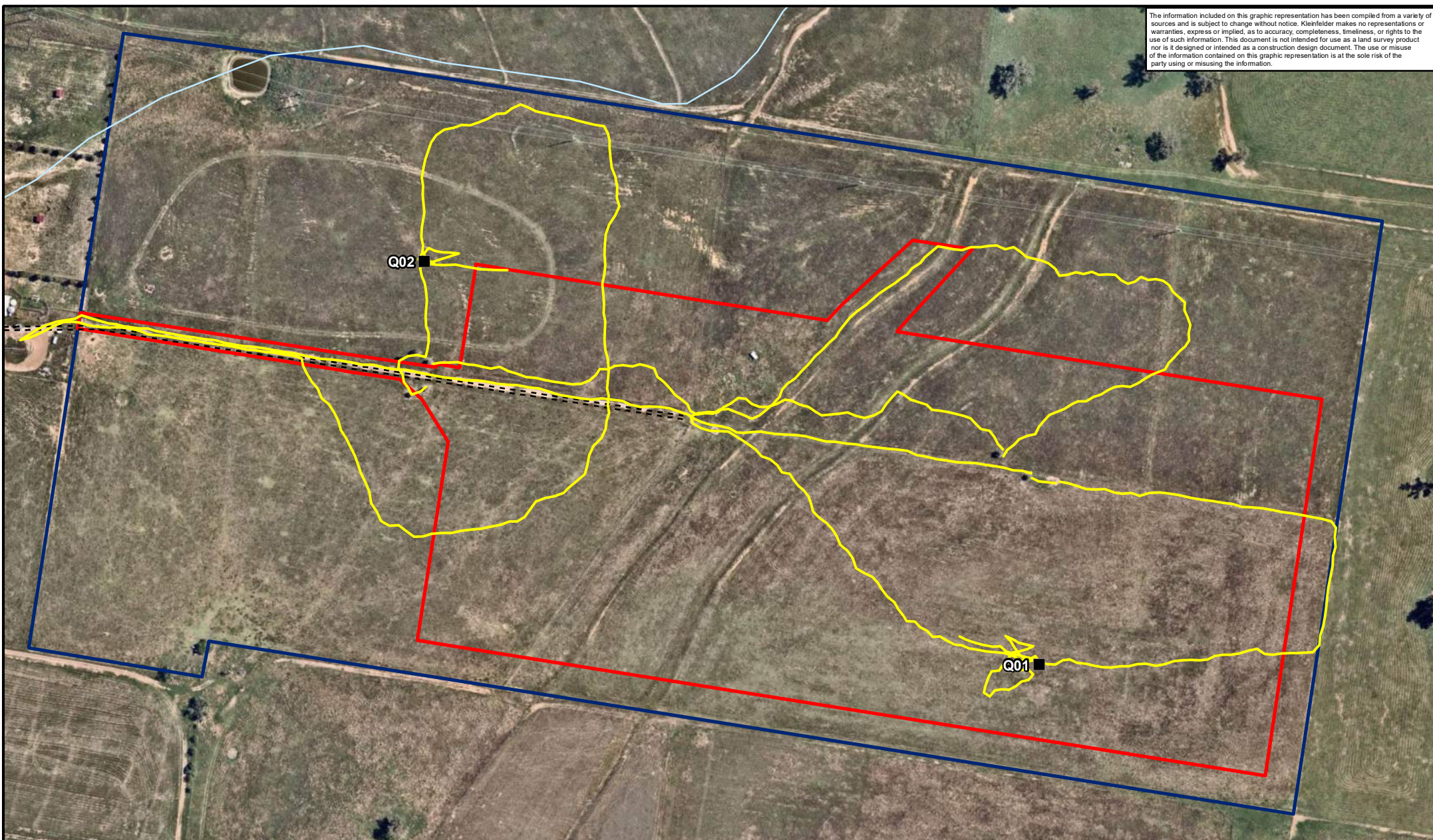
3.3 SURVEY LIMITATIONS

The survey techniques and survey effort applied for this study were commensurate with the nature and condition of the subject site. Due to these limitations, priority was given to habitat assessment for relevant threatened biota. A 'likelihood of occurrence' assessment was applied to all species previously recorded or predicted to occur within the locality based on State and Commonwealth information sources.

The field survey was undertaken during an eight-hour survey period by one ecologist. While a moderate diversity of native and exotic flora species was recorded, a longer survey duration or multiple seasonal surveys would likely result in the detection of a greater diversity of species. The majority of the subject site is considered to be degraded and unsuitable for most threatened plant species known to occur in the locality; therefore, the survey effort that is recommended in *The NSW Guide to Surveying Threatened Plants* (OEH, 2016) is not considered to be applicable.

No targeted fauna surveys, microchiropteran bat surveys (i.e. Anabat), fauna trapping or targeted surveys for cryptic fauna species was undertaken, as the proposed development will avoid the stream and the constructed dam and will not clear any habitat features. No 'call playback' for arboreal fauna, large forest owl species were conducted. Given the limited availability of native vegetation within the subject site and the lack of hollow bearing trees, the survey effort was considered adequate to detect the fauna species most likely to be present.

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Legend

- Study Area (Part Lot 4 DP 1048145)
- Subject Site
- Unnamed Watercourse
- Track
- Flora Quadrat
- Flora Meander

Metres
0 10 20 40 60 80 100



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DATA SOURCE:
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KDC - 2020
Nearmap - 2020

Survey Effort

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Warral Solar Farm
Lot 4 DP 1048145
329 Country Road, Warral NSW

FIGURE:

4

4. RESULTS

4.1 PLANT DIVERSITY

A total of 53 plant species were identified during the assessment. These were comprised of 34 exotics and 19 natives. A complete list of flora species is presented in **Appendix 2**. The majority of the exotic plant species were comprised of annual herbs and grasses associated with the grasslands. Native plant species were comprised mainly of forbs and grasses.

4.2 WEEDS

No major infestations of priority weeds (DPI, 2020) or Weeds of National Significance (DoEE, 2020c) were identified. Minor infestations of weeds were identified, including the following species:

- *Carthamus lanatus* (Saffron Thistle)
- *Centaurea solstitialis* (St Barnaby's Thistle)
- *Echium plantagineum* (Patterson's Curse)
- *Xanthium spinosum* (Bathurst Burr)

Mitigation measures to prevent the spread of weeds are presented in **Section 5.2**.

4.3 PLANT COMMUNITY TYPES

The regional vegetation mapping (DPIE, 2009) indicates that the north of the subject site is comprised of *White Box Grassy Woodland to Open Woodland* (PCT 433); however, the assessment revealed that the entirety of the subject site is comprised of exotic grassland. The dominant species throughout the grassland are exotic grass species such as *Lolium rigidum* (Wimmera Ryegrass), *Bromus catharticus* (Prairie Grass) and *Avena sativa* (Oats). The dominant herbs are introduced species such as *Carthamus lanatus* (Saffron Thistle) and *Echium vulgare* (Patterson's Curse). Occasional native species include *Austrostipa aristiglumis* (Plain's Grass), *Calotis lappulacea* (Yellow Burr-daisy) and *Vittadinia cuneata* (Fuzzweed). All of these species were found in low abundance in most areas.

Three tree species were detected within the subject site: *Eucalyptus sideroxylon* (Mugga Ironbark), *Angophora floribunda* (Rough-barked Apple) and *Casuarina cristata* (Bela) (**Figure 5**). All trees lacked hollows. Historical imagery indicates the trees were not present on the site prior to 2006. The trees are likely to be less than 15 years old.

The assemblage of tree species observed within the Study Area is not encountered naturally in the locality. For example, Mugga Ironbark tends to occur in dry woodland and forest environments, while Rough-barked Apple tends to occur on river flats and drainage channels. Bela tends to occur on clay soils (i.e. often in monotypic stands). The closeness of the trees, similarity in age and species composition indicates that all trees within the Study Area are likely to have been planted.

The vegetation assessment determined that the subject site is far too degraded to be representative of any of the PCT's occurring in the locality (**Figure 5**).

4.4 THREATENED ECOLOGICAL COMMUNITIES

The grasslands within the subject site are dominated by exotic species and are considered to be too degraded to represent any TEC's. The number of trees within the site are too few for the woody vegetation to represent woodland vegetation and the grasslands are considered too degraded to represent derived native grasslands.

4.5 THREATENED FLORA SPECIES

No threatened flora species were identified within the subject site during the assessment. A search of the BioNet Atlas of NSW Wildlife (DPIE, 2020a) returned one record of a threatened plant species within a 5 km radius of the study area: Magenta Lilly Pilly (*Syzygium paniculatum*). A "likelihood of occurrence" assessment determined that habitat for this species does not occur within the subject site (**Appendix 3**).

An EPBC Protected Matters Search returned a list of seven threatened plant species predicted to occur within the locality of the subject site. A "likelihood of occurrence" assessment determined that habitat is present within the subject site for Bluegrass *Dicanthium setosum*. This grass species occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, extending to northern Queensland.

The species is mainly associated with heavy basaltic black soils and red-brown loams with clay subsoil. It is often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. The species is often collected from disturbed open grassy woodlands on the northern tablelands, where the habitat has been variously grazed, nutrient-enriched and water-enriched (DPIE, 2020c).

The potential for impacts to Bluegrass have been assessed via an 'assessment of significance' pursuant to Section 7.3 of the BC Act in **Appendix 5**.

4.6 FAUNA HABITAT

The subject site was found to lack vegetation with a complex structure, shrubs and midstorey species were generally absent. The habitat is likely to support a low diversity of native fauna, including birds and mammal species common within agricultural landscapes. In summary, the fauna habitat assessment determined the following:

- The isolated trees within the subject site may provide marginal foraging and nesting habitat for common native bird species.
- The grasslands may provide foraging habitat for a range of native birds and terrestrial mammals such as macropods (Kangaroos and Wallabies).
- The grasslands may provide hunting habitat for native predatory birds, such as Falcons, Kestrels and Large Forest Owls.
- No hollow-bearing trees, nests, woody debris or rocky outcrops were identified within the subject site.

4.7 FAUNA SPECIES

Opportunistic fauna observations included sightings of common bird species such as the Australian Magpie and the Noisy Miner. No reptile or amphibian species were opportunistically identified during survey.

4.8 THREATENED FAUNA SPECIES

No threatened fauna species were detected within the subject site. A search of the BioNet Atlas of NSW Wildlife (DPIE, 2020a) returned a list of five threatened fauna species that have previously been recorded within 5 km of the subject site:

- Australian Brush-turkey population in the Nandewar and Brigalow Belt South Bioregions.
- Black Falcon *Falco subniger*.
- Powerful Owl *Ninox strenua*.
- Spotted-tailed Quoll *Dasyurus maculatus*.
- Grey-headed Flying-fox *Pteropus poliocephalus*.

A “likelihood of occurrence” assessment determined that the habitat is too degraded and does not contain suitable habitat to support populations of any of these species (**Appendix 3**).

4.9 KOALA HABITAT

Most of the subject site has been cleared for agricultural development. Isolated trees are not listed as a preferred Koala food tree species under Schedule 2 of the SEPP for Koala Habitat Protection (2019).

An assessment of Koala habitat within the subject site determined that no Highly Suitable Koala Habitat, or Core Koala Habitat is present. This is based on the following:

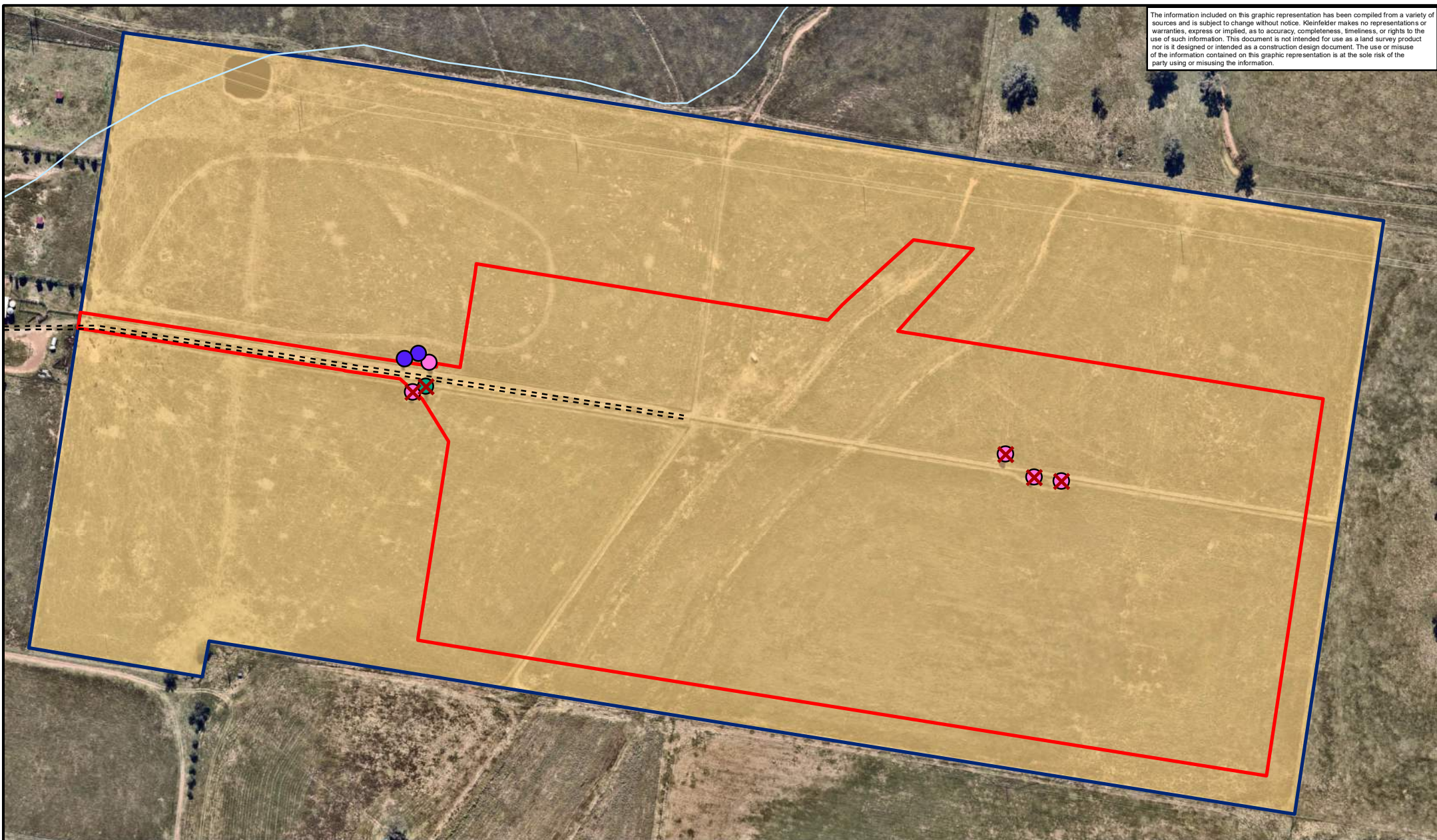
- No evidence of a resident population of Koalas was detected during the assessment (i.e. No Koala individuals, scats or scratch marks were identified).
- There are no Koala feed trees within the subject site.

4.10 EPBC ACT PROTECTED MATTERS

A ‘likelihood of occurrence’ assessment was conducted for all threatened species and migratory species returned by the EPBC Protected Matters Search (**Appendix 3**). The habitats present within the subject site were considered to be too degraded for all species, with the exception of the Fork-tailed Swift *Apus pacificus* and the White-throated Needletail *Hirundapus caudacutus*.

Both of these bird species may forage aerially over a very wide range of habitats including vegetated and non-vegetated areas. The proposed development will not remove habitat features considered to be important to these species. The extent of foraging habitat is likely to be unaffected.

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<p>Legend</p> <p> Study Area (Part Lot 4 DP 1048145)</p> <p> Subject Site</p> <p> Exotic Grassland</p> <p>— Unnamed Watercourse</p> <p>- - - Track</p> <p>X Trees to be removed</p> <p>Paddock Trees</p> <p>● <i>Angophora floribunda</i></p> <p>● <i>Casuarina cristata</i></p> <p>● <i>Eucalyptus sideroxylon</i></p>	<p>Metres</p> <p>0 10 20 40 60 80 100</p> <p></p> <p></p> <p>KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com</p>	<p>PROJECT REFERENCE: 20212647</p> <p>DATE DRAWN: 2021/05/18 14:44 Version 4</p> <p>DRAWN BY: GJoyce</p> <p>DATA SOURCE: NSW DFSI - 2020 KDC - 2020 Nearmap - 2020</p>	<p>Vegetation Mapping and Paddock Trees</p> <p>Flora and Fauna Assessment Report Warral Solar Farm Lot 4 DP 1048145 329 Country Road, Warral NSW</p>	<p>FIGURE:</p> <p>5</p>
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5. DISCUSSION

5.1 IMPACT ASSESSMENT

5.1.1 Removal of Native Vegetation

Given the lack of native vegetation within the subject site, removal of native vegetation will be mainly limited to the removal of five isolated trees in the western and eastern portions of the subject site. Three tree species were detected: *Eucalyptus sideroxylon* (Mugga Ironbark), *Angophora floribunda* (Rough-barked Apple) and *Casuarina cristata* (Bela). The location of each of the trees is presented in **Figure 5**.

All trees were identified as young (i.e. < 15 years old) and lacked hollows. Due to the position and age of the trees, all are likely to have been planted (see justification presented previously in **Section 4.3**). The trees to be removed are considered to have minimal value as a resource for local fauna species. The trees do not form part of an Endangered Ecological Community (EEC). Removal of the trees is likely to have a negligible impact of the biodiversity values within the site.

The Study Area exhibits historical and ongoing land use consistent with category 1- exempt land under Section 60H of the *Local Land Services Act 2013* (LLS Act). The grasslands are predominantly exotic; therefore, negligible amounts of native groundcover will be removed for the proposed development.

5.1.2 Impacts to Fauna

Potential indirect impacts of the proposed development on resident fauna populations include the following:

- Noise and lighting during the construction phase may cause minor disturbance to resident fauna within the locality and disrupt their natural behaviour.
- Pollution such as chemical spills from construction machinery may have adverse effects on the water quality of downstream aquatic habitat.
- Ground disturbance by machinery during the construction phase may create dust and facilitate the movement of sediment. Sedimentation could adversely affect the water quality within the constructed dam and aquatic habitat.

Management measures are presented in **Section 5.2** to reduce the potential for these impacts.

5.1.3 Impacts to Threatened Species

No threatened species were identified during the assessment. A “likelihood of occurrence” assessment determined that habitat occurs within the subject site for Bluegrass *Dicanthium setosum*. In accordance with Section 7.3 of the BC Act, an ‘assessment of significance’ determined that the proposed development is unlikely to have a significant impact on this species.

5.1.4 Impacts to Threatened Ecological Communities

No TECs were identified within the subject site.

5.1.5 Impacts to Aquatic Habitat

The proposed development has been designed to avoid directly impacting the mapped waterways within the study area. Potential indirect impacts include the following:

- The excavation of soil within the subject site during the construction phase has the potential to facilitate erosion and sediment movement. Runoff from the subject site has the potential to introduce nutrients and other toxins to aquatic habitats.
- The introduction of chemicals such as fuels for vehicles and machinery during the construction phase has the potential to cause pollution to downstream aquatic habitat.

Recommendations to reduce the potential for adverse environmental impacts to aquatic habitat are presented in **Section 5.2**.

5.1.6 Cumulative Impacts

Cumulative impacts arise from the interaction of individual elements associated with the proposed development and the additive effects of other external projects. The South Tamworth Solar Farm project is proposed to be developed within Lot 211 DP 1069964, which occurs within 1km to the north of the Study Area. A Biodiversity Development Assessment Report (BDAR) was prepared for the project (Kleinfelder 2021). Entry into the Biodiversity Offset Scheme (BOS) was required for this due to exceedance of vegetation clearing thresholds (i.e. mainly due to impacts to native grassland vegetation). The grasslands were determined to be

in a low condition state (i.e. low vegetation integrity) and offsets were required for the removal of small areas of woodland vegetation only. The BDAR determined that due to the lack of habitat values within the site, impacts to biodiversity and the environment were negligible.

Given the minor scale of environmental impacts at the South Tamworth site, cumulative impacts with the current project are also likely to be negligible. No other known projects within the locality are known to have relevance to this project that could exacerbate cumulative impacts.

5.2 IMPACT AMELIORATION

5.2.1 Avoidance Measures

Impacts on biodiversity values have been addressed through an iterative design process to avoid areas of higher biodiversity value within the subject site. The design of the solar panel array will ensure that few trees and native vegetation will be removed within the study area.

5.2.2 Erosion Control

Mitigation measures to reduce soil erosion and pollutant run-off during construction activities should include:

- Regular inspection of erosion and sediment control measures, particularly following rainfall events to ensure their ongoing functionality.
- The immediate removal offsite of any excavated materials.
- Avoid stockpiling of materials adjacent to native vegetation, but instead use areas that are already cleared/ disturbed.
- Undertake maintenance of silt fences and other mitigation measures to isolate runoff.

5.2.3 Dust Control

Specific measures to minimise the generation of dust and associated impacts on adjacent natural environments should include:

- Setting maximum speed limits for all traffic within the subject site to limit dust generation.
- Use of a water tanker to spray unpaved access tracks during the construction phase where required.

- Application of dust suppressants or covers on soil stockpiles.

5.2.4 Chemical Spills

Specific measures to minimise the potential for chemical spills and associated impacts on adjacent natural environments should include the following:

- All chemicals must be kept in clearly marked bunded areas.
- Regularly inspect vehicles and mechanical plant for leakage of fuel or oil.
- No re-fuelling of vehicles, washing of vehicles or maintenance of vehicles and plant to be undertaken within 20 m of natural drainage lines and / or water features.

5.2.5 Weed Management

The following recommendations are to be implemented during construction and operation to minimise the impact of weeds within the subject site:

- All vehicles should be cleaned prior to entering the site to prevent the introduction of new weed species.
- The site should be monitored during and after construction to ensure that Priority Weeds for the region and Weeds of National Significance are not introduced.

5.2.6 Offset Provisions

As described previously in **Section 2.2.2**, entry into the Biodiversity Offsets Scheme (BOS) is not required for the proposed development.

5.3 CONCLUSION

The proposed development will mainly affect areas of exotic grassland (agricultural land) and will require the removal of five isolated trees within the subject site. These trees are not considered to be important habitat for the long-term survival of threatened species within the locality and do not contain hollows or nests.

The Study Area exhibits historical and ongoing land use consistent with category 1- exempt land under Section 60H of the *Local Land Services Act 2013* (LLS Act). The proposed development is unlikely to cause a significant impact to any threatened species, populations

or ecological communities listed under the NSW BC Act. Entry into the NSW BOS is not triggered by the proposed development.

No EPBC listed species, ecological communities, migratory species or important habitat for such entities was identified within the subject site. The assessment determined that impacts to MNES are unlikely; therefore, an EPBC referral to the Commonwealth Minister for the Environment is not recommended.

Avoidance and mitigation measures have been presented to reduce potential impacts to biodiversity values within the subject site and the environment.

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APPENDIX 1: SITE PHOTOGRAPHS



Plate 1: Exotic grassland within the subject site



Plate 2: Isolated paddock trees (*Eucalyptus sideroxylon*)

APPENDIX 2: FLORA SPECIES LIST

Table 1: Flora list

Growth Form	Plant Species	Plot 1		Plot 2	
		Cov.	Ab.	Cov.	Ab.
Exotic Grass	<i>Avena sativa</i>	70	10000	1	100
Exotic Grass	<i>Bromus catharticus</i>	1	10		
Exotic Grass	<i>Eleusine indica</i>			0.1	10
Exotic Grass	<i>Hordeum leporinum</i>			1	100
Exotic Grass	<i>Lolium rigidum</i>	20	10000	50	10,000
Exotic Grass	<i>Nassella nessiana</i>	0.1	20		
Exotic Herb	<i>Brassica rapa</i>	1	100		
Exotic Herb	<i>Petrorhagia dubia</i>	0.1	20		
Exotic Herb	<i>Taraxacum officinale</i>			0.1	10
Exotic Herb	<i>Verbena rigida</i>			0.1	20
Exotic Herb	<i>Carthamus lanatus</i>	5	500		
Exotic Herb	<i>Centaurea solstitialis</i>	0.1	20		
Exotic Herb	<i>Centaureum erythraea</i>			0.1	5
Exotic Herb	<i>Cichorium intybus</i>			0.1	10
Exotic Herb	<i>Conyza bonariensis</i>	0.1	5		
Exotic Herb	<i>Cyclosporum leptophyllum</i>	1	10		
Exotic Herb	<i>Datura stramonium</i>			0.1	1
Exotic Herb	<i>Echium plantagineum</i>	0.1	20		
Exotic Herb	<i>Echium vulgare</i>			5	500
Exotic Herb	<i>Foeniculum vulgare</i>			0.1	1
Exotic Herb	<i>Gamochaeta americana</i>	1	10		
Exotic Herb	<i>Gomphrena celisoides</i>			0.1	10
Exotic Herb	<i>Lactuca serriola</i>	0.1	5		
Exotic Herb	<i>Lepidium africanum</i>	1	10	2	500
Exotic Herb	<i>Malva parviflora</i>			0.1	5
Exotic Herb	<i>Medicago sativa</i>	0.5	20		
Exotic herb	<i>Plantago lanceolata</i>	0.1	20		
Exotic Herb	<i>Rapistrum rugosum</i>			0.1	50
Exotic Herb	<i>Rumex crispus</i>			0.1	10
Exotic Herb	<i>Sonchus oleraceus</i>	0.1	10		
Exotic Herb	<i>Trifolium dubium</i>	0.1	20		
Exotic Herb	<i>Trifolium repens</i>	0.1	10		
Exotic Herb	<i>Trifolium arvense</i>	0.5	50	0.1	5
Exotic Herb	<i>Xanthium spinosum</i>			0.1	1

Growth Form	Plant Species	Plot 1		Plot 2	
		Cov.	Ab.	Cov.	Ab.
Native Chenopod	<i>Einadia trigonos</i>			0.1	10
Native Chenopod	<i>Sclerolaena muricata</i>			0.1	20
Native Forb	<i>Calotis lappulacea</i>			0.1	50
Native Forb	<i>Euchiton involucratus</i>	0.1	5		
Native Forb	<i>Polymeria longifolia</i>	0.1	50		
Native Forb	<i>Sida corrugata</i>	2	500	5	10,000
Native Forb	<i>Vittadinia cuneata</i>	0.1	2	0.1	5
Native Forb	<i>Wahlenbergia communis</i>	0.1	2		
Native Grass	<i>Anthosachne scabra</i>			0.1	10
Native Grass	<i>Austrostipa aristiglumis</i>	0.1	20	5	1000
Native Grass	<i>Chloris truncata</i>			0.1	20
Native Grass	<i>Cynodon dactylon</i>			0.1	50
Native Grass	<i>Dicanthium sericeum</i>	0.1	50		
Native Grass	<i>Rytidosperma sp.</i>			0.1	50
Native Herb	<i>Erodium crinitum</i>			0.1	20
Native Sedge	<i>Carex inversa</i>			0.1	20

Notes: High Threat exotics (HTE) are classified in accordance with the DPIE HTE List. Growth forms were classified in accordance with the DPIE growth forms data.

APPENDIX 3: THREATENED SPECIES 'LIKELIHOOD OF OCCURRENCE'

Table 2: Likelihood of occurrence

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
Flora								
1.	<i>Cadellia pentastylis</i> <i>Ooline</i>	V	V	-	PMST	Forms a closed or open canopy mixing with eucalypt and cypress pine species. There appears to be a strong correlation between the presence of <i>Ooline</i> and low- to medium-nutrient soils of sandy clay or clayey consistencies, with a typical soil profile having a sandy loam surface layer, grading from a light clay to a medium clay with depth. A readily identifiable species that is detectable at all times of year. Was not detected within the subject site during the assessment. This site does not contain suitable habitat for this species.	Nil	Nil
2.	<i>Callistemon pungens</i>	-	V	-	PMST	In NSW the species occurs from near Inverell to the eastern escarpment in New England National Park. It also occurs in the northern tablelands of south-eastern Queensland, mainly in the Stanthorpe area. Habitats range from riparian areas dominated by <i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i> to woodland and rocky shrubland. It is often found in rocky watercourses, usually with sandy granite (occasionally basalt) creek beds. A readily identifiable species that is detectable at all times of year. Was not detected within the subject site during the assessment. This site does not contain suitable habitat for this species.	Nil	Nil

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
3.	<i>Dichanthium setosum</i> Bluegrass	V	V	-	PMST	<p>Bluegrass occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, extending to northern Queensland. It is associated with heavy basaltic black soils and red-brown loams with clay subsoil.</p> <p>It is often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. (Often collected from disturbed open grassy woodlands on the northern tablelands, where the habitat has been variously grazed, nutrient-enriched and water-enriched).</p> <p>Was not detected within the subject site during the assessment; however, potential habitat is present.</p>	Moderate	Low
4.	<i>Euphrasia arguta</i>	CE	CE	-	PMST	<p>Historic records of the species noted the following habitats: 'in the open forest country around Bathurst in sub humid places', 'on the grassy country near Bathurst', and 'in meadows near rivers.</p> <p>Plants from the Nundle area have been reported from eucalypt forest with a mixed grass and shrub understorey; here, plants were most dense in an open disturbed area and along the roadside, indicating the species had regenerated following disturbance.</p> <p>Was not detected within the subject site during the assessment. This site does not contain suitable habitat for this species.</p>	Nil	Nil
5.	<i>Prasophyllum</i> sp. Wybong Leek-orchid	-	CE	-	PMST	<p>Endemic to NSW, it is known from near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell, Tenterfield, Currabubula and the Pilliga area. Most populations are small, although the Wybong population contains by far the largest number of individuals.</p> <p>This species is not known in the Glenn Innes-Guyra Basalts Sub-region. This species was not detected within the subject site during the assessment.</p>	Low	Low

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
6.	<i>Syzygium paniculatum</i> Magenta Lillypilly	E	V	1	BioNet	On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities. The subject site is comprised of agricultural lands that contain few native trees. The habitat is considered unsuitable for this species. Species not detected during survey.	Nil	Nil
7.	<i>Thesium australe</i> Austral Toadflax, Toadflax	V	V	-	PMST	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast often found in association with Kangaroo Grass (<i>Themeda triandra</i>). This species is a root parasite which takes water and some nutrient from other plants, especially Kangaroo Grass. The majority of the subject site has been grazed by cattle. No areas were found to be dominated by native grass species such as Kangaroo Grass. The species was not detected within the site during the assessment. The site is considered to be too degraded to support a population of this species.	Low	Low
8.	<i>Tylophora linearis</i>	V	E	-	PMST	Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of <i>Eucalyptus fibrosa</i> , <i>Eucalyptus sideroxylon</i> , <i>Eucalyptus albens</i> , <i>Callitris endlicheri</i> , <i>Callitris glaucophylla</i> and <i>Allocasuarina luehmannii</i> . The majority of the subject site has been grazed by cattle. The species was not detected within the site during the assessment. The site is considered to be too degraded to support a population of this species.	Low	Low
Amphibians								

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
1.	<i>Litoria booroolongensis</i> Booroolong Frog, Yellow-spotted Bell Frog	E	E	-	PMST	Live along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. Adults occur on or near cobble banks and other rock structures within stream margins. Shelter under rocks or amongst vegetation near the ground on the stream edge. No suitable aquatic habitat present within the subject site.	Nil	Nil
Birds								
1.	<i>Alectura lathamii</i> Australian Brush-turkey population in the Nandewar and Brigalow Belt South Bioregions	E	-	1	BioNet	Usually prefers dry rainforest that is found within the Semi-evergreen Vine Thicket Birds build nesting mounds in areas of dense vegetation. This provides ample litter for the mound building and decomposition process, as well as shade to reduce moisture loss from the mound Tall trees such as eucalypts are used for nocturnal and diurnal roosting (15 - 20m above the ground). Unsuitable habitat within the subject site.	Nil	Nil
2.	<i>Anthochaera phrygia</i> Regent Honeyeater	CE	CE	-	PMST	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. The subject site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.	Low	Low
3.	<i>Botaurus poiciloptilus</i> Australasian Bittern	E	E	-	PMST	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (<i>Typha spp.</i>) and spikerushes (<i>Eleocharis spp.</i>). No suitable aquatic habitat is present within the subject site.	Nil	Nil

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
4.	<i>Calidris ferruginea</i> Curlew Sandpiper	E	CE	-	PMST	It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland. No suitable estuarine habitat is present within the subject site.	Nil	Nil
5.	<i>Erythrotriorchis radiatus</i> Red Goshawk	CE	V	-	PMST	Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers. No suitable habitat is present within the subject site.	Nil	Nil
6.	<i>Falco subniger</i> Black Falcon	V	-	2	Bionet PMST	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be preferable to the Brown Falcon. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres (Marchant & Higgins 1993). The Black Falcon occurs as solitary individuals, in pairs, or in family groups of parents and offspring. The subject site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.	Low	Low

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
7.	<i>Falco hypoleucos</i> Grey Falcon	E	-	-	PMST	<p>The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey.</p> <p>No suitable habitat is present within the subject site. May aerially forage over the subject site.</p>	Low - Moderate	Low
8.	<i>Ninox strenua</i> Powerful Owl	V	-	1	BioNet	<p>The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation.</p> <p>The subject site is comprised of agricultural lands that contain few native trees. There are no hollow bearing trees. Powerful owl may use the study area to forage for terrestrial mammals.</p>	Low - Moderate	Low
9.	<i>Grantiella picta</i> Painted Honeyeater	V	V		PMST	<p>Inhabits Boree/ Weeping Myall (<i>Acacia pendula</i>), Brigalow (<i>A. harpophylla</i>) and Box-Gum Woodlands and Box-Ironbark Forests. This species is a specialist feeder on the fruits of mistletoes growing on woodland Eucalypts and Acacias. Prefers mistletoes of the genus <i>Amyema</i>.</p> <p>The subject site is comprised of agricultural lands that contain few native trees. No mistletoe was identified. The habitat is considered to be too degraded to support this species.</p>	Low	Low

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
10.	<i>Lathamus discolor</i> Swift Parrot	E	CE		PMST	<p>Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes.</p> <p>In the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations.</p> <p>Favoured feed trees include winter flowering species such as Swamp Mahogany <i>Eucalyptus robusta</i>, Spotted Gum <i>Corymbia maculata</i>, Red Bloodwood <i>C. gummifera</i>, Forest Red Gum <i>E. tereticornis</i>, Mugga Ironbark <i>E. sideroxylon</i>, and White Box <i>E. albens</i>.</p> <p>The subject site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.</p>	Low	Low
11.	<i>Rostratula australis</i> Australian Painted Snipe	E	E		PMST	<p>Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.</p> <p>No suitable aquatic habitat is present within the subject site.</p>	Nil	Nil
Mammals								
1.	<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	V	V		PMST	<p>Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (<i>Petrochelidon ariel</i>), frequenting low to mid-elevation dry open forest and woodland close to these features.</p> <p>No cave habitat is present within the subject site.</p>	Nil	Nil

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
2.	<i>Dasyurus maculatus</i> (SE mainland population) Spot-tailed Quoll	V	E	4	Bionet PMST	<p>This species has been recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.</p> <p>Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites.</p> <p>The subject site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.</p>	Nil	Nil
3.	<i>Nyctophilus corbeni</i> Corben's Long-eared Bat	V	v		PMST	<p>Inhabits a variety of vegetation types, including Mallee, Bulloke <i>Allocasuarina leuhmanni</i> and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland.</p> <p>The subject site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.</p>	Low	Low
4.	<i>Phascolarctos cinereus</i> (combined populations of Qld, NSW and the ACT) Koala	V	V		PMST	<p>In NSW, Koalas occur along the coast, extending west to the Darling Riverine Plains and Mulga Lands bioregions in the north of the state; to the Cobar Peneplain bioregion in the centre of the state; and to the Riverina and eastern most parts of the Murray-Darling Depression bioregions in the south.</p> <p>The koala is found in a variety of forest types with suitable feed tree species.</p> <p>No Koalas or Koala feed trees were identified within the subject site.</p>	Low	Low

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
5.	<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	V	V	12	Bionet PMST	Occurs across a wide range of habitat types along the eastern seaboard of Australia, depending on food availability. Fruit from myrtaceous trees and rainforest trees form the major components of their diet. Potential marginal foraging habitat is present; however, no camps were detected. The habitat is not considered to be important to this species.	Low	Low
Reptiles								
1.	<i>Aprasia parapulchella</i> Pink-tailed Worm Lizard	V	V	-	PMST	Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (<i>Themeda australis</i>). Sites are typically well-drained, with rocky outcrops or scattered, partially buried rocks. The subject site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.	Nil	Nil
2.	<i>Uvidicolus sphyrrurus</i> Border Thick-tailed Gecko	V	V	-	PMST	Found only on the tablelands and slopes of northern NSW and southern Queensland, reaching south to Tamworth and west to Moree. Most common in the granite country of the New England Tablelands. This species favors forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter. Occupied sites often have a dense tree canopy that helps create a sparse understory. The subject site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.	Nil	Nil
Migratory Species								
1.	<i>Apus pacificus</i> Fork-tailed Swift	-	M	-	PMST	Forages aerially over a very wide range of habitats includes both vegetated and non- vegetated areas. Potential aerial foraging habitat above the subject site.	Moderate	Low

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
2.	<i>Hirundapus caudacutus</i> White-throated Needletail	-	M	-	PMST	Forages in high open spaces over varied habitat types. Potential aerial foraging habitat above subject site.	Moderate	Low
3.	<i>Motacilla flava</i> Yellow Wagtail	-	M	-	PMST	Typically inhabits inundated fields, saltmarsh and wetlands and occasionally coastal areas. No suitable habitat within the subject site.	Nil	Low
4.	<i>Myiagra cyanoleuca</i> Satin Flycatcher	-	M	-	PMST	Found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests. No suitable habitat within the subject site.	Nil	Low
5.	<i>Rhipidura rufifrons</i> Rufous Fantail	-	M	-	PMST	Found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground. No suitable habitat within the subject site.	Nil	Low

APPENDIX 4: EPBC ACT PROTECTED MATTERS SEARCH REPORT



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 24/11/20 10:19:26

[Summary](#)

[Details](#)

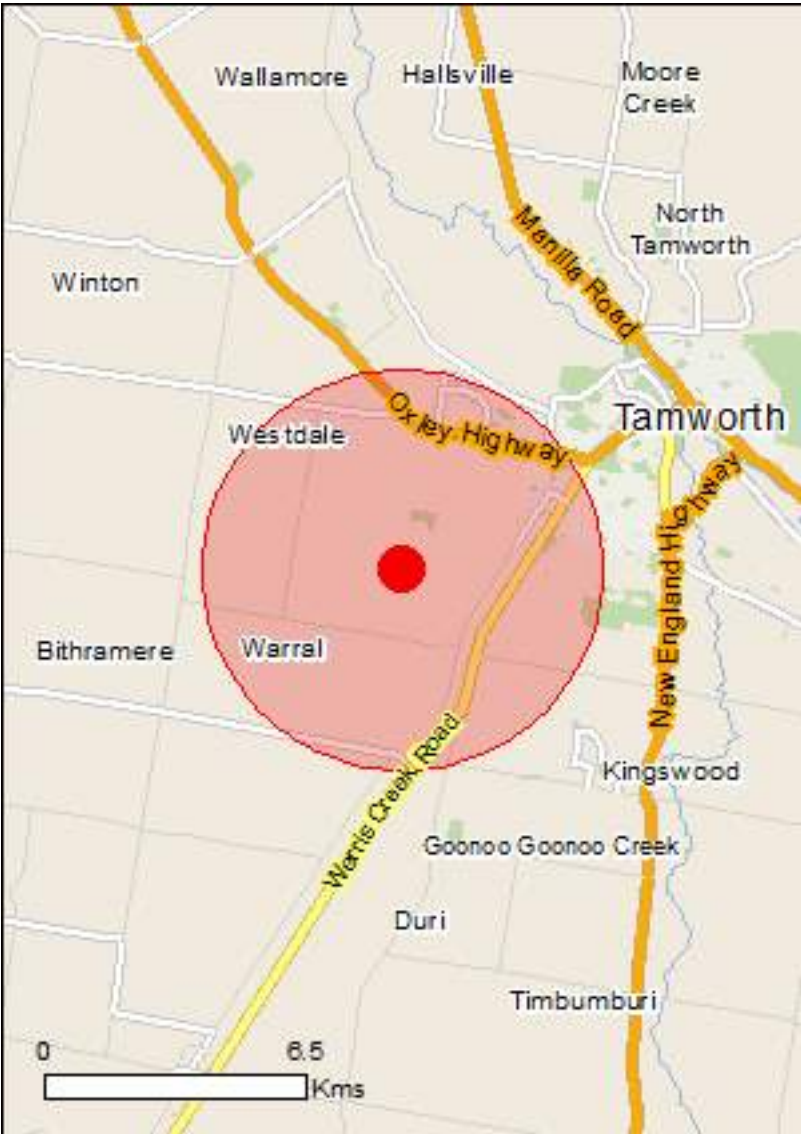
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

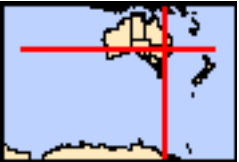
[Acknowledgements](#)



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[Buffer: 5.0Km](#)



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	24
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	4
Commonwealth Heritage Places:	None
Listed Marine Species:	17
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	28
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)		[Resource Information]
Name	Proximity	
Banrock station wetland complex	1000 - 1100km	
Riverland	900 - 1000km upstream	
The coorong, and lakes alexandrina and albert wetland	1100 - 1200km	

Listed Threatened Ecological Communities	[Resource Information]
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For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community likely to occur within area
New England Peppermint (Eucalyptus nova-anglica)	Critically Endangered	Community may occur within area
Grassy Woodlands	Endangered	Community may occur within area
Weeping Myall Woodlands		
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species	[Resource Information]
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Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat may occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur

Name	Status	Type of Presence
Rostratula australis Australian Painted Snipe [77037]	Endangered	within area Species or species habitat likely to occur within area
Frogs		
Litoria booroolongensis Booroolong Frog [1844]	Endangered	Species or species habitat may occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat may occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Plants		
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area
Callistemon pungens [55581]	Vulnerable	Species or species habitat may occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Euphrasia arguta [4325]	Critically Endangered	Species or species habitat likely to occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area
Tylophora linearis [55231]	Endangered	Species or species habitat may occur within area
Reptiles		
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat may occur within area
Uvidicolus sphyrurus Border Thick-tailed Gecko, Granite Belt Thick-tailed Gecko [84578]	Vulnerable	Species or species habitat likely to occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat likely to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land		[Resource Information]
The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.		
Name		
Commonwealth Land - Australian Postal Commission		
Commonwealth Land - Australian Telecommunications Commission		
Commonwealth Land - Commonwealth Trading Bank of Australia		
Commonwealth Land - Defence Housing Authority		
Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name		Threatened
Type of Presence		
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Extra Information

Invasive Species

[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat may occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area

Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-31.12216 150.86411

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
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- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
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- [-Australian National Herbarium, Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
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- [-CSIRO](#)
- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

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APPENDIX 5: ASSESSMENT OF SIGNIFICANCE (PURSUANT TO SECTION 7.3 OF THE BC ACT)

Factors of Assessment - *Biodiversity Conservation Act 2016*

The five factors considered in the test of significance under s.7.3 of BC Act are shown in the table below. The tests of significance for all threatened species, populations and ecological communities considered likely to occur within the study area are provided in the proceeding sub-sections.

Table 3: Factors addressed in the assessment of significance

Factor	Species	Population	Ecological Community
in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.	X		
in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction			X
in relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality	X		X
whether the proposed development or activity is likely to have an adverse effect any declared area of outstanding biodiversity value (either directly or indirectly).	NA	NA	NA
whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of, a key threatening process.	X	X	X

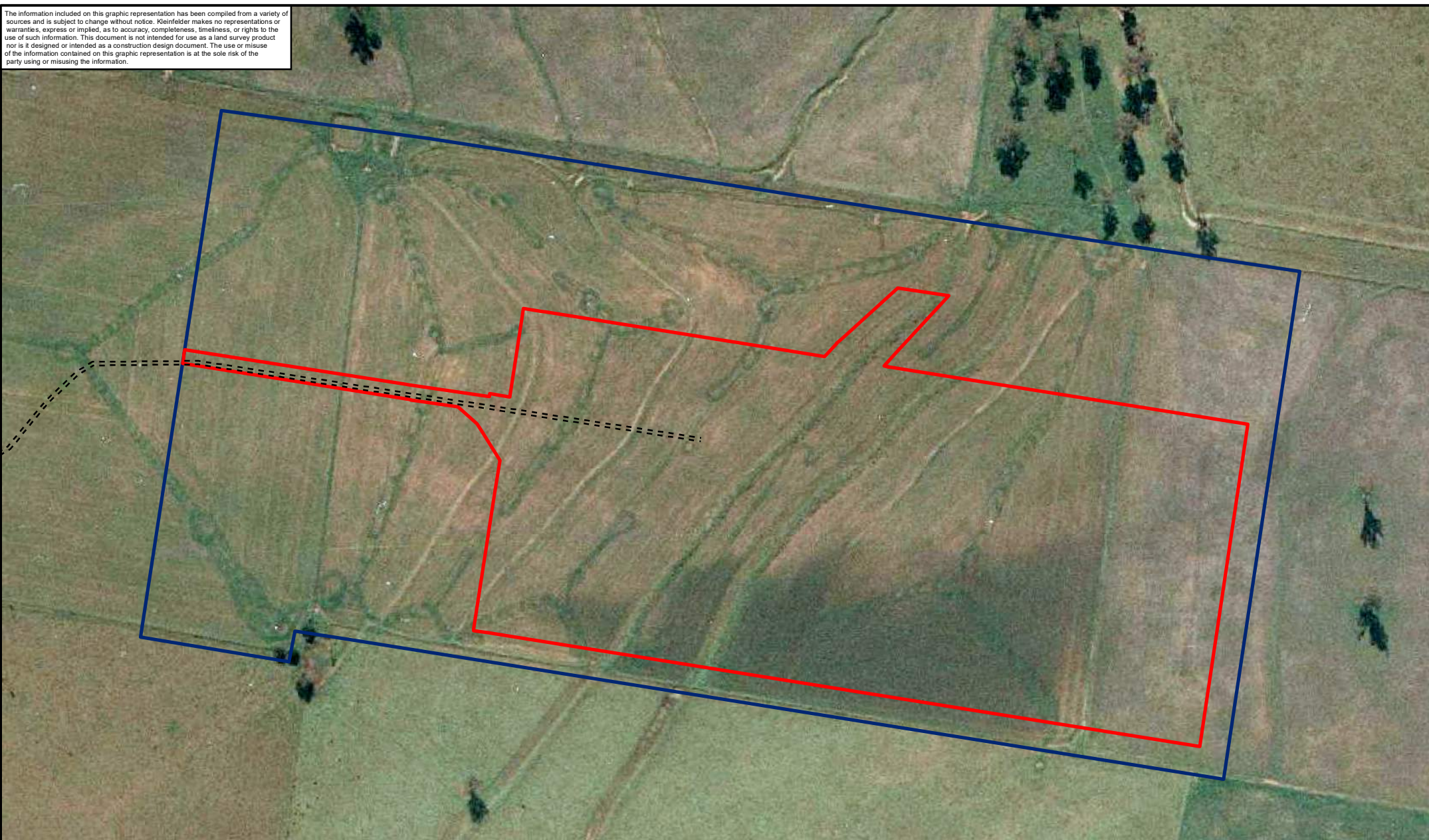
Threatened Flora

Table 4: Bluegrass *Dicanthium setosum*

Factors	Assessment of Significance
(a) Effect on life cycle	<p>Bluegrass <i>Dicanthium setosum</i> was not detected within the subject site during the assessment; however, records of the species occur in the locality and suitable habitat has been identified within the subject site.</p> <p>The proposed development will require ground disturbance that would result in the removal of some groundcover vegetation; however, most of the grasslands will be retained in their current state.</p> <p>Given that no areas of the subject site were found to contain Bluegrass and the majority of the habitat for the species will be retained, it is unlikely that the proposed development will adversely affect the lifecycle of the species, such that a local population would be at risk of extinction.</p>
(c) (i) Habitat Removal	The majority of the habitat for the species will be retained within the subject site following the proposed development.
(c) (ii) Habitat Fragmentation	The groundcover habitat to be removed is comprised of exotic/native agricultural grassland. No areas of native grassland were identified; therefore, the proposed development will not cause further habitat fragmentation for the species within the locality.
(c) (iii) Habitat importance	The habitat to be removed is comprised of exotic/native grassland and is not considered important to the species. Removal of this habitat is unlikely to put a local population at risk of extinction.
(d) Effect on biodiversity value	The proposed development does not occur within an Area of Outstanding Biodiversity Value (AOBV).
(e) KTP	<p>The following KTPs are listed in order of their relevance to the EEC and the proposed development:</p> <ul style="list-style-type: none"> • Removal of native vegetation • Loss of Hollow-bearing Trees • Removal of dead wood and dead trees • Invasion of native plant communities by exotic perennial grasses • Invasion of native plant communities by African Olive <i>Olea europaea</i> subsp. <i>cuspidata</i> (Wall. ex G. Don) Cif. • Infection of native plants by <i>Phytophthora cinnamomi</i> <p>Given that the subject site is already a highly modified environment with few natural ecological features, the proposed development is likely to facilitate the above listed KTPs to a minor extent. Impacts are likely to be negligible.</p>
Conclusion	As the proposed development will not impact an area containing a known occurrence of Bluegrass and the majority of the habitat for the species will be retained. The proposed development is considered unlikely to have a significant impact on this species in the locality.

APPENDIX 6: AERIAL IMAGERY

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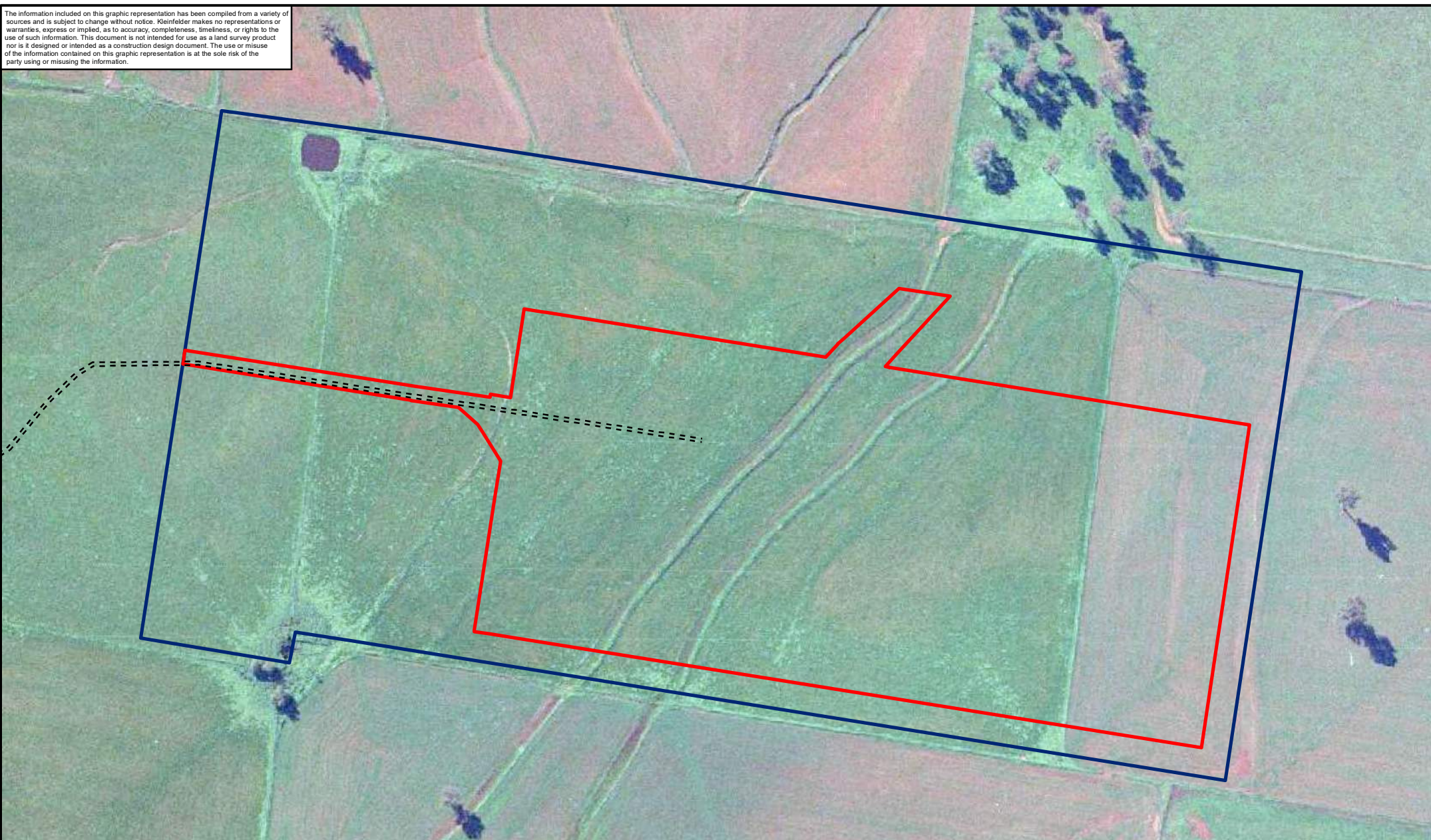
Legend <div style="display: flex; align-items: center;"> <div style="border: 2px solid blue; width: 20px; height: 10px; margin-right: 5px;"></div> Study Area (Part Lot 4 DP 1048145) </div> <div style="display: flex; align-items: center;"> <div style="border: 2px solid red; width: 20px; height: 10px; margin-right: 5px;"></div> Subject Site </div> <div style="display: flex; align-items: center;"> <div style="border-top: 2px dashed black; width: 20px; height: 1px; margin-right: 5px;"></div> Track </div>	<div style="text-align: center;"> <p>Metres</p> <p>0 25 50 100 150 200</p> </div>	<div style="display: flex; justify-content: space-between;"> <div>PROJECT REFERENCE: 20212647</div> <div>DATE DRAWN: 2021/05/18 12:07 Version 1</div> </div>	<div style="text-align: center;"> <p>Historic Imagery</p> <p>1989 (NSW Spatial Services)</p> </div>	<div style="text-align: center;"> <p>FIGURE:</p> <p>6</p> </div>
		<div style="display: flex; justify-content: space-between;"> <div>DRAWN BY: GJoyce</div> <div>DATA SOURCE: NSW Spatial Services - 2021 KDC - 2020</div> </div>		



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Flora and Fauna Assessment Report
 Warral Solar Farm
 Lot 4 DP 1048145
 329 Country Road, Warral NSW

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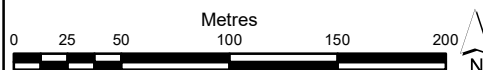


Legend

 Study Area (Part Lot 4 DP 1048145)

 Subject Site

--- Track



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PROJECT REFERENCE: 20212647

DATE DRAWN: 2021/05/18 12:08 Version 1

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2021
KDC - 2020

Historic Imagery 1998 (NSW Spatial Services)

Flora and Fauna Assessment Report
Warral Solar Farm
Lot 4 DP 1048145
329 Country Road, Warral NSW

FIGURE:

7

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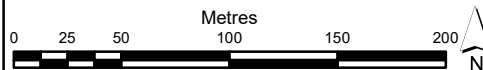


Legend

 Study Area (Part Lot 4 DP 1048145)

 Subject Site

--- Track



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PROJECT REFERENCE: 20212647

DATE DRAWN: 2021/05/18 12:11 Version 1

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2021
KDC - 2020

Historic Imagery 2014 (Nearmap)

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Warral Solar Farm
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FIGURE:

9

APPENDIX 7: LICENSES AND PERMITS

Kleinfelder employees involved in the current study are licensed or approved under the *National Parks and Wildlife Act 1974* (License Number: SL100730, Expiry: 31 March 2021) and the *Animal Research Act 1985* to harm/trap/release protected native fauna and to pick for identification purposes native flora and to undertake fauna surveys.



23 November 2020

Patrick Quinlan
Client Director/Associate
KDC
Suite 2B, 125 Bull Street,
NEWCASTLE WEST NSW 2302

Dear Patrick,

Re: Preliminary Aboriginal archaeological advice for Lot 4 of DP1048145, 329 Country Road, Warral, NSW for Providence Asset Group

This letter aims to provide Providence Asset Group preliminary Aboriginal archaeological advice for Lot 4 of DP1048145, 329 Country Road, Warral, NSW. This letter summarises the preliminary results from the site inspection and includes recommendations for further management of Aboriginal cultural heritage values.

Summary of Site Inspection

There are no previously recorded sites in the project area based on Aboriginal heritage searches and background research of previous archaeological investigations to date. One artefact scatter, "WSF001", was recorded in the project area during the site inspection on the graded track between paddocks. No other Aboriginal objects or sites were observed in the project area, partly due to lack of visibility across most of the overgrown paddocks. Visibility in the area was generally very poor due to thick pasture vegetation coverage (0 - 10%). Areas of exposure were rare (<5%), though within exposure there was good visibility between 80 - 100%.

The two paddocks comprising the southern half of the project area contained loamy red clay soils with frequent angular shale cobbles and occasional angular coarse gravels. The gravels showed evidence of continuous trampling by cattle and horses. The two paddocks without cattle and comprising the northern half, on the other hand, was entirely overgrown with tall pasture grasses, Patersons Curse and exotic weeds. The entire project area has been impacted by European farming practices; it has been cleared of most mature trees and a number of trenches for utilities such as fibre optic trenches were observed.

Cultural Comments

During the survey, Mr Fermor commented that where any grading or slope profiling works were occurring in the project area that he would like a Tamworth LALC sites officer to be given the opportunity to inspect any excavated material up to 200mm depth. Furthermore, an Indigenous employment program should be considered by Providence Asset Group to provide opportunities to the local Indigenous community during the works stage. Mr Fermor commented that the access track for the project should be rerouted to avoid the site.

Recommendations

Due to the land use history and high level of disturbance observed during the site survey (where visibility allowed) the project area was predicted to have low potential for intact sub-surface archaeological deposits to occur. A1 topsoils appear to have been displaced by erosion or removed entirely throughout the project area by plowing, cultivation and cattle grazing. Nevertheless, the presence of the newly recorded artefact scatter in a highly disturbed context suggests that areas of cultural sensitivity may be extant in the project area. This find suggests that there is high risk of Aboriginal objects still surviving

in highly disturbed and modified landscape contexts. The ability to accurately assess the potential for archaeological deposits in such overgrown paddocks, however, has been compromised. The following recommendations are made for the project:

- Avoidance of the newly recorded artefact scatter, WSF001 and rerouting of the access track between paddocks if possible;
- Completion of an AHIMS site recording form for the artefact scatter and any associated deposits and submission to the AHIMS database to comply with Section 91 of the National Parks and Wildlife Act, in consultation with the Tamworth Local Aboriginal Land Council; and
- Consultation with the Tamworth Local Aboriginal Land Council on the outcomes of this preliminary advice and formal comment on cultural heritage values and the results of the site inspection; and
- Commencing preparation of an Aboriginal Cultural Heritage Assessment and Archaeological Assessment (ACHA/AA) to assist with further archaeological testing/salvage under an Aboriginal Heritage Impact Permit (AHIP) application.

We are happy to discuss any aspect of this summary and look forward to planning ahead with you for the next stage of this project.

Yours sincerely



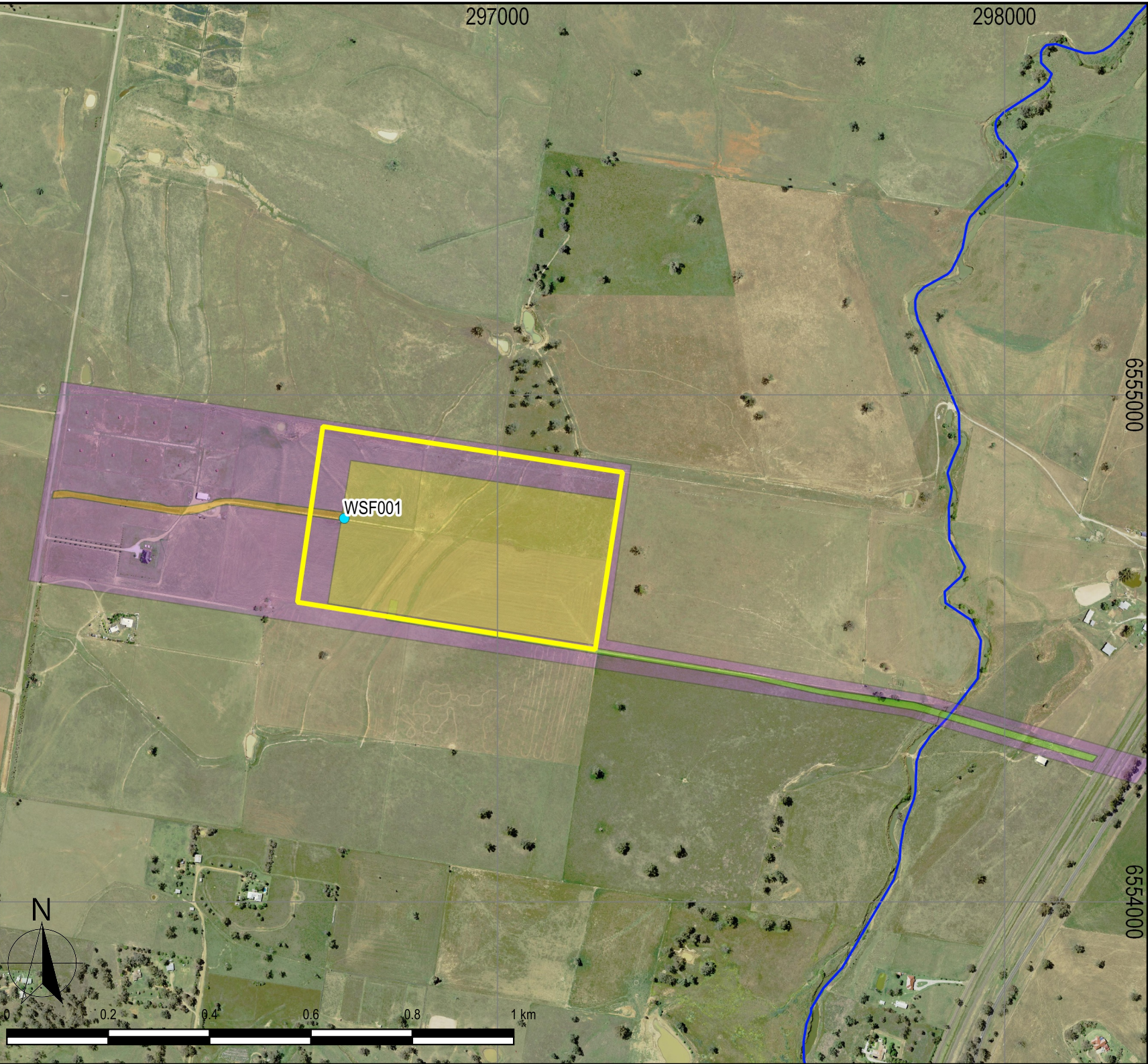
Dr Mary-Jean Sutton
Principal Archaeologist/Company Director



Warral Sites Recored

Legend

- Major Towns & Cities
- Warral HSA
- Warral Recorded Sites
- Timbumburi Creek
- Proposed Works
 - Priority DD Assessment
 - Proposed Grid Connection
 - Proposed Lease Area
 - Proposed Site Access



Source: NSW Spatial Services, AHIMS, KDC, 1968, A Handbook of Australian Soils, Projection: GDA94

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Noise Assessment

Warral Solar Farm
Tamworth, NSW



Document Information

Noise Assessment

Warral Solar Farm

Tamworth, NSW

Prepared for: Providence Asset Group

704/99 Bathurst Street

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DOCUMENT ID	STATUS	DATE	PREPARED	SIGNED	REVIEWED	SIGNED
MAC201186-02RP1	Final	14 December 2020	Rod Linnett		Oliver Muller	

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APPENDIX A – GLOSSARY OF TERMS		

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Providence Asset Group (PAG) to prepare a Noise Assessment (NA) for the proposed Warral Solar Farm near Tamworth, NSW (the 'project'). This report presents the methodology and findings of the NA for the construction and operation of the project.

1.1 Purpose and Objectives

A NA is required as part of the environmental assessment to be submitted to Tamworth Regional Council (TRC) as part of the Development Application (DA). The purpose of the NA is to quantify potential environmental noise emissions associated with the construction and operation of the project. Where impacts are identified, the assessment includes recommendations for potential noise mitigation and management measures.

1.2 Scope of the Assessment

The NA includes the following key tasks:

- review construction and operating activities to identify key noise generating plant, equipment, machinery or activities proposed to be undertaken as part of the project;
- identify the closest and/or potentially most affected receivers situated within the area of influence to the project;
- determine project-specific construction Noise Management Levels (NMLs), and operational noise criteria;
- undertake 3D noise modelling to predict levels that may occur as a result of the construction and operation of the project at the closest and/or potentially most affected receivers;
- provide a comparison of predicted noise levels against relevant construction and operational criteria;
- assess the potential noise impacts associated with construction and operational aspects of the project
- assess the potential noise impacts associated with road traffic noise during construction; and
- provide feasible and reasonable noise mitigation and management measures, and monitoring options, where criteria may be exceeded.

The assessment has been undertaken in accordance with the following documents:

- NSW Department of Environment and Climate Change (DECCW) – NSW Interim Construction Noise Guideline (ICNG), 2009;
- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI) 2017;
- NSW Department of Environment, Climate Change and Water (DECCW) – NSW Road Noise Policy (RNP), 2011;
- Australian Standard AS 1055:2018 - Acoustics - Description and measurement of environmental noise - General Procedures; and
- International Standard ISO 9613:1993 - Acoustics - Attenuation of sound during propagation outdoors.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

2 Project Description

2.1 Background

PAG propose to construct and operate a 5 Megawatt (MW) solar farm using photovoltaic (PV) technology at 329 Country Road, Warral NSW, NSW approximately 4km south west of Tamworth, NSW.

2.2 Description of Proposed Construction Works

The project includes installation of groups of north facing PV modules on mounting structures of 1.3m to 1.5m in height. Approximately 12,000 PV panels will be installed using a single axis tracking system, tilting along the north-south axis. The PV mounting structure would comprise steel posts driven into the ground using a small pile driver. Additional support structures would be attached to the piles, which would then support the PV panels.

Where cabling of each PV array/module to inverters is required to be underground, earthworks will primarily involve trenching. Other minor earthworks would be completed for the preparation of the site and in most cases a concrete slab would be required to support the ancillary infrastructure. Most of the infrastructure would be pre-fabricated off-site, delivered and assembled on-site.

It is anticipated that the solar farm would be constructed in stages, with two to three stages in construction at any one time over a six month period during standard construction hours.

All vehicles would access the project via Country Road during construction and operational phases.

During construction, traffic generated by the project would include employee and delivery vehicles. During the peak construction period, the daily traffic volume is expected to be up to four heavy vehicles (semi-trailers or B-doubles) per hour and 20 light commercial vehicles or equivalent for worker transport during the morning and afternoon peaks.

2.3 Description of Proposed Operation

PV infrastructure on site will comprise of groups of PV panels installed in rows running north to south. The PV modules will be on a single axis tracker system which will follow the sun and move in an east to west direction. Electrical cabling would be attached beneath the modules and would connect the individual PV modules to each other. Inverters will be located centrally and connected by underground cables. The project will be contained solely within the site as shown in **Figure 1**.

The project would operate 24 hours a day, 7 days a week, with no permanent staff on site. During operation, the PV panels would generate electricity which would be fed into the power grid via the adjacent existing powerline. Key noise emissions from the operation of the project are associated with the inverter and transformer(s). It is noted that emissions from these sources are anticipated to be acoustically insignificant compared to ambient background noise levels at assessed receivers.

When required, maintenance activities will occur during standard working hours (except for emergencies) and are expected to include:

- panel cleaning;
- repairs or replacement of infrastructure, as required; and
- land management including mowing to control vegetation as required.

Typical noise sources associated with maintenance activities would include light vehicle movements on site and maintenance of equipment.

2.3.1 Receiver Review

Using aerial photography, geospatial information and other project design information, MAC has identified the following potentially sensitive receivers that may be affected by noise from operation or construction activities and project related road traffic. **Table 1** presents a summary of receiver identification, type, address and coordinates. These are reproduced visually in **Figure 1**.

Table 1 Receiver Locations

Receiver	Description	Receiver Type	Coordinates (GDA94/MGA56)	
			Easting	Northing
C01	RFS Fire Control Centre (Future)	Commercial	296408	6556372
R01	347 Country Road	Rural Residential	296240	6554531
R02	40 Heiligmans Lane	Rural Residential	295830	6554452
R03	312 Country Road	Rural Residential	295692	6554983
R04	Oxley Lane	Rural Residential	295858	6555471
R05	269 Oxley Lane	Rural Residential	295210	6555326
R06	265 Oxley Lane	Rural Residential	295044	6555618
R07	216 Country Road	Rural Residential	296117	6555848
R08	194 Country Road	Rural Residential	296104	6556178
R09	New Winton ROAD	Rural Residential	296274	6556626
R10	115 Country Road	Rural Residential	296663	6556575
R11	236 Green St	Rural Residential	297266	6556278
R12	30 Heiligmans Lane	Rural Residential	296518	6554013
R13	32-34 Heiligmans Lane	Rural Residential	296327	6553871
R14	36-38 Heiligmans Lane	Rural Residential	296062	6553827
R15	391 Country Road	Rural Residential	296085	6554043
R16	80-118 Heiligmans Lane	Rural Residential	295390	6554271
R17	120-158 Heiligmans Lane	Rural Residential	294954	6554360
R18	341 Oxley Lane	Rural Residential	295311	6554808
R19	26-28 Heiligmans Lane	Rural Residential	296513	6553545
R20	22-24 Heiligmans Lane	Rural Residential	296703	6553463
R21	18 Heiligmans Lane	Rural Residential	296832	6553378
R22	14-16 Heiligmans Lane	Rural Residential	297148	6553324
R23	8 Heiligmans Lane	Rural Residential	297280	6553497
R24	492 Warral Road	Rural Residential	297637	6553354
R25	486 Warral Road	Rural Residential	297660	6553422
R26	480 Warral Road	Rural Residential	297708	6553534
R27	462 Warral Road	Rural Residential	297745	6553695
R28	442 Warral Road	Rural Residential	297821	6553838
R29	360 Warral Road	Rural Residential	298200	6554562
R30	Warral Road	Rural Residential	298460	6554885
R31	300 Warral Road	Rural Residential	297629	6555205
XPR1	329 Country Road (PR)	Project Related	296302	6554686

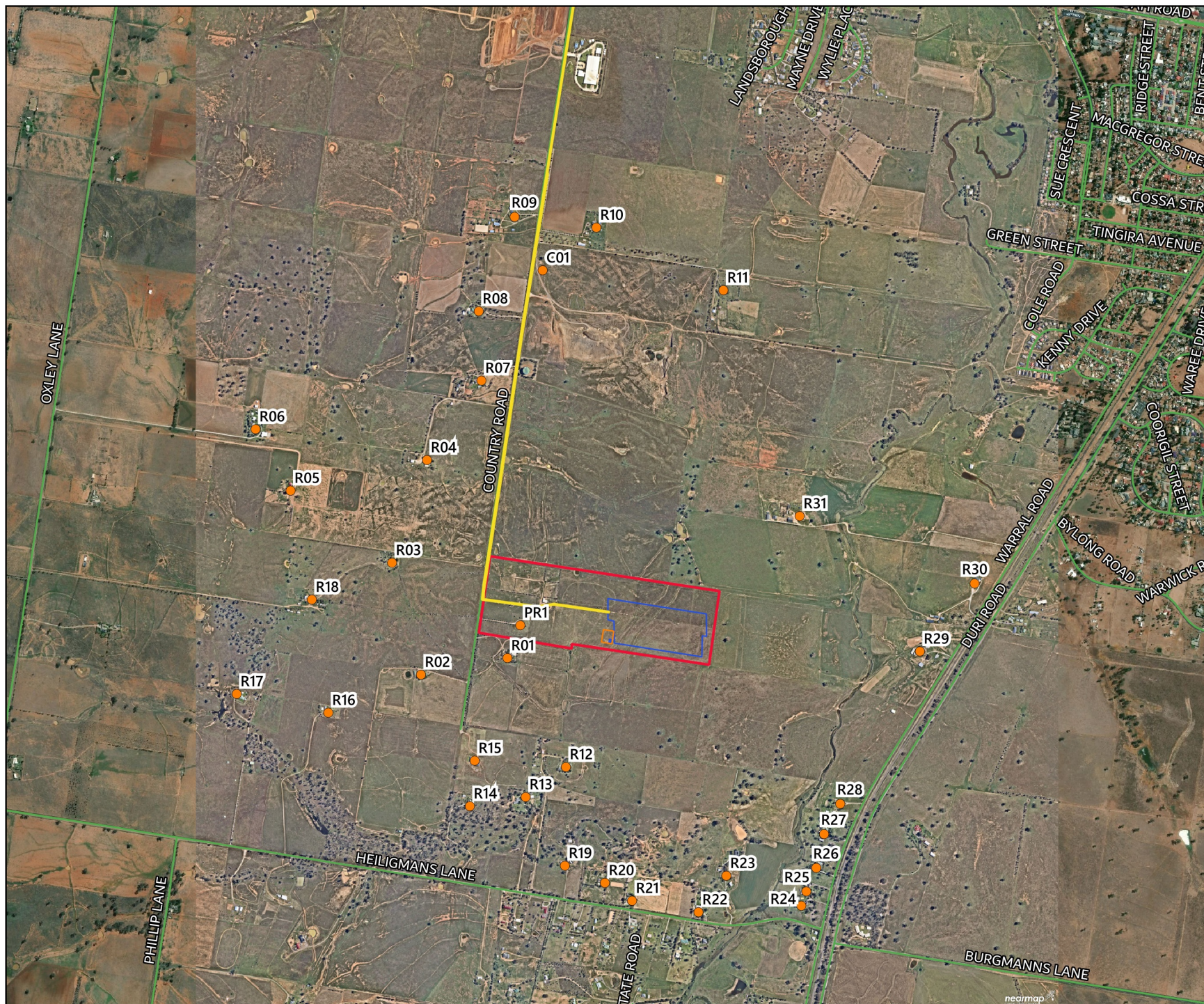


FIGURE 1
Project Layout
MAC201186-02
Warral Solar Farm

KEY

- Receivers
 - Access Route
 - Panel Array
 - Project Boundary
- 0 200 400 600 800 1000 m



3 Noise Policy and Guidelines

3.1 Interim Construction Noise Guideline

The ICNG sets out procedures to identify and address the impacts of construction noise on residences and other sensitive land uses. This section provides a summary of noise objectives that are applicable to the assessment. The ICNG provides two methodologies for the assessment of construction noise emissions:

- Quantitative, which is suited to major construction projects with typical durations of more than three weeks; and
- Qualitative, which is suited to short term infrastructure maintenance (< three weeks).

The qualitative assessment methodology is a more simplified approach that relies on noise management strategies. This study has adopted a quantitative assessment approach which is summarised in **Figure 2**. The quantitative approach includes identification of potentially affected receivers, derivation of the construction noise management levels, quantification of potential noise impact at receivers via predictive modelling and, provides management and mitigation recommendations.

3.1.1 Standard Hours for Construction

Table 2 summaries the ICNG recommended standard hours for construction works

Table 2 Recommended Standard Hours for Construction	
Daytime	Construction Hours
Monday to Friday	7am to 6pm
Saturdays	8am to 1pm
Sundays or Public Holidays	No construction

These recommended hours do not apply in the event of direction from police, or other relevant authorities, for safety reasons or where required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm.

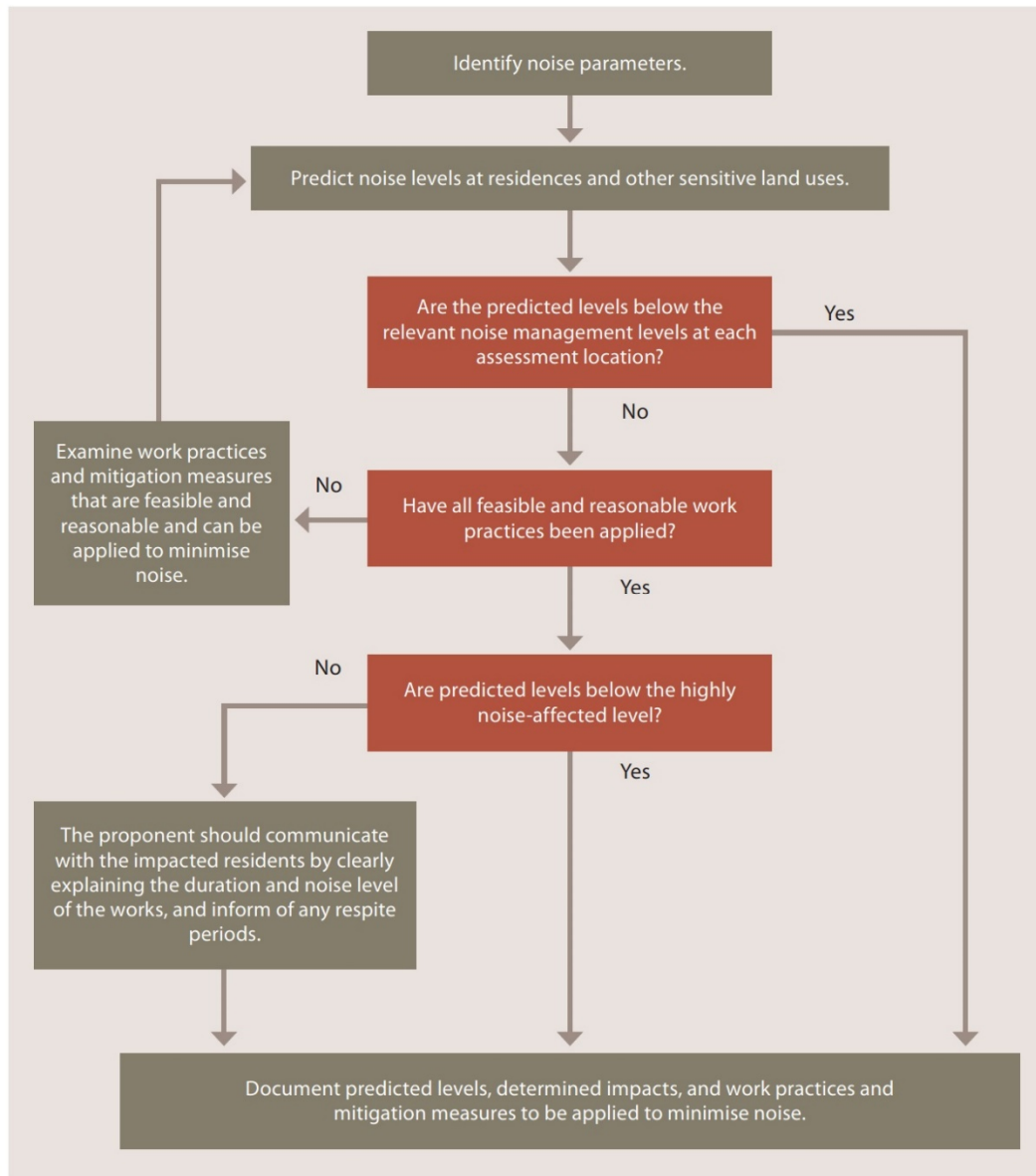
Construction activities are anticipated to be undertaken during standard construction hours.

3.1.2 Out of Hours Construction

Works conducted outside of recommended standard hours are considered out of hours work (OOH). The ICNG suggests that any request to vary the hours of construction activities as identified above shall be:

- considered on a case by case basis or activity-specific basis;
- accompanied by details of the nature and need for activities to be undertaken during the varied construction hours; and
- accompanied by written evidence that activities undertaken during the varied construction hours are strongly justified; appropriate consultation with potentially affected receivers and notification of the relevant regulatory authorities has occurred; and all practicable and reasonable mitigation measures will be put in place.

Figure 2 Quantitative Assessment Processes for Assessing and Managing Construction Noise



Source: Department of Environment and Climate Change, 2009.

3.1.3 Construction Noise Management Levels

Section 4 of the ICNG (DECC, 2009) details the quantitative assessment method involving predicting noise levels and comparing them with the Noise Management Level (NML) and are important indicators of the potential level of construction noise impact. **Table 3** reproduces the ICNG Noise Management Level (NML) for residential receivers. The NML is determined by adding 10dB (standard hours) or 5dB (OOH) to the Rating Background Level (RBL) for each specific assessment period.

Table 3 Noise Management Levels

Time of Day	Management Level		How to Apply
	LAeq(15min) ¹		
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays.	Noise affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq(15min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of work to be carried out, the expected noise levels and duration, as well as contact details.	
	Highly noise affected 75dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account times identified by the community when they are less sensitive to noise (such as before and after school for work near schools, or mid-morning or mid-afternoon for work near residences; and if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.	
Outside recommended standard hours.	Noise affected RBL + 5dB	A strong justification would typically be required for work outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dBA above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2.	

Note 1: The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the construction noise management levels for noise assessment purposes and is the median of the ABL's.

3.1.4 Construction Sleep Disturbance

Section 4.3 of the ICNG (DECC, 2009) states that a sleep disturbance assessment is required where construction activities are planned to occur for more than two consecutive nights. Given that construction activities are anticipated to occur during standard construction hours, sleep disturbance has not been considered in this assessment.

3.2 Noise Policy for Industry

The EPA released the Noise Policy for Industry (NPI) in October 2017 which provides a process for establishing noise criteria for consents and licenses enabling the EPA to regulate noise emissions from scheduled premises under the Protection of the Environment Operations Act 1997.

The objectives of the NPI are to:

- provide noise criteria that is used to assess the change in both short term and long-term noise levels;
- provide a clear and consistent framework for assessing environmental noise impacts from industrial premises and industrial development proposals;
- promote the use of best-practice noise mitigation measures that are feasible and reasonable where potential impacts have been identified; and
- support a process to guide the determination of achievable noise limits for planning approvals and/or licences, considering the matters that must be considered under the relevant legislation (such as the economic and social benefits and impacts of industrial development).

The policy sets out a process for industrial noise management involving the following key steps:

1. Determine the Project Noise Trigger Levels (PNTLs) (ie criteria) for a development. These are the levels (criteria), above which noise management measures are required to be considered. They are derived by considering two factors: shorter-term intrusiveness due to changes in the noise environment; and maintaining the noise amenity of an area.
2. Predict or measure the noise levels produced by the development with regard to the presence of annoying noise characteristics and meteorological effects such as temperature inversions and wind.
3. Compare the predicted or measured noise level with the PNTL, assessing impacts and the need for noise mitigation and management measures.
4. Consider residual noise impacts - that is, where noise levels exceed the PNTLs after the application of feasible and reasonable noise mitigation measures. This may involve balancing economic, social and environmental costs and benefits from the proposed development against the noise impacts, including consultation with the affected community where impacts are expected to be significant.

5. Set statutory compliance levels that reflect the best achievable and agreed noise limits for the development.
6. Monitor and report environmental noise levels from the development.

3.2.1 Project Noise Trigger Levels (PNTL)

The policy sets out the procedure to determine the PNTLs relevant to an industrial development. The PNTL is the lower (ie, the more stringent) of the **Project Intrusiveness Noise Level (PINL)** and **Project Amenity Noise Level (PANL)** determined in accordance with Section 2.3 and Section 2.4 of the NPI.

3.2.2 Rating Background Level (RBL)

The Rating Background Level (RBL) is a determined parameter from noise monitoring and is used for assessment purposes. As per the NPI, the RBL is an overall single figure background level representing each assessment period (day, evening and night) over the noise monitoring period.

3.2.3 Project Intrusiveness Noise Level (PINL)

The PINL ($LA_{eq}(15min)$) is the RBL + 5dB and seeks to limit the degree of change a new noise source introduces to an existing environment. Hence, when assessing intrusiveness, background noise levels need to be measured.

3.2.4 Project Amenity Noise Level (PANL)

The PANL is relevant to a specific land use or locality. To limit continuing increases in intrusiveness levels, the ambient noise level within an area from all combined industrial sources should remain below the recommended amenity noise levels specified in Table 2.2 (of the NPI). The NPI defines two categories of amenity noise levels:

- **Amenity Noise Levels (ANL)** – are determined considering all current and future industrial noise within a receiver area; and
- **Project Amenity Noise Level (PANL)** – is the recommended level for a receiver area, specifically focusing the project being assessed.

Additionally, Section 2.4 of the NPI states: “to ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows”:

PANL for new industrial developments = recommended **ANL** minus 5dBA.

The following exceptions apply when deriving the PANL:

- areas with high traffic noise levels;
- proposed developments in major industrial clusters;
- existing industrial noise and cumulative industrial noise effects; and
- greenfield sites.

Where relevant this assessment has considered influences of traffic with respect to amenity noise levels (ie areas where existing traffic noise levels are 10dB greater than the recommended amenity noise level).

The recommended amenity noise levels as per Table 2.2 of the NPI are reproduced in **Table 4**.

Table 4 Amenity Criteria

Receiver Type	Noise Amenity Area	Time of day	Recommended amenity noise level dB LAeq(period)
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks.	See column 4	See column 4	5dB above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School Classroom	All	Noisiest 1-hour period when in use	35 (internal) 45 (external)
Hospital ward			
- internal	All	Noisiest 1-hour	35
- external	All	Noisiest 1-hour	50
Place of worship			
- internal	All	When in use	40
Passive Recreation	All	When in use	50
Active Recreation	All	When in use	55
Commercial premises	All	When in use	65
Industrial	All	When in use	70

Notes: The recommended amenity noise levels refer only to noise from industrial noise sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor levels except where otherwise stated.

Types of receivers are defined as rural residential; suburban residential; urban residential; industrial interface; commercial; industrial – see Table 2.3 and Section 2.7 of the NPI.

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

3.2.5 Maximum Noise Assessment Trigger Levels

The potential for sleep disturbance from maximum noise level events from a project during the night-time period needs to be considered. The NPI considers sleep disturbance to be both awakenings and disturbance to sleep stages.

Where night-time noise levels from a development/premises at a residential location exceed the following criteria, a detailed maximum noise level event assessment should be undertaken:

- LAeq(15min) 40dB or the prevailing RBL plus 5dBA, whichever is the greater, and/or
- LAmax 52dB or the prevailing RBL plus 15dBA, whichever is the greater.

A detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

Other factors that may be important in assessing the impacts on sleep disturbance include:

- how often the events would occur;
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the development;
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods); and
- current understanding of effects of maximum noise level events at night.

3.3 Road Noise Policy

The road traffic noise criteria are provided in the Department of Environment, Climate Change and Water NSW (DECCW), Road Noise Policy (RNP), 2011. The policy sets out noise criteria applicable to different road classifications for the purpose of quantifying traffic noise impacts. Road noise criteria relevant to this assessment are presented in detail in **Section 4.5**.

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4 Noise Assessment Criteria

Background noise monitoring has not been conducted for this project and hence, the minimum applicable Rating Background Levels (RBL) of 35dBA for the daytime period and 30dBA for the evening and night time periods have been adopted in accordance with NPI methodology.

4.1 Construction Noise Criteria

The relevant Noise Management Levels (NMLs) for standard construction hours are presented in **Table 5**.

Table 5 Construction Noise Management Levels			
Receiver Type	Assessment Period	Adopted RBL dB LA90	NML dB LAeq(15min)
Urban Residential	Standard Hours	35	45 (RBL+10dBA)
Suburban Residential	Standard Hours	35	45 (RBL+10dBA)
Rural Residential	Standard Hours	35	45 (RBL+10dBA)
Educational	When in use	N/A	45 (internal) 60 (external) ¹
Hospital Wards	When in use	N/A	45 (internal) 60 (external) ¹
Place of Worship	When in use	N/A	45 (internal) 60 (external) ¹
Active Recreation Areas	When in use	N/A	65 (external)
Passive Recreation Areas	When in use	N/A	60 (external)
Industrial Premises	When in use	N/A	75 (external)
Community Centres	When in use	N/A	Refer to AS2107 for maximum internal levels and specific use
Commercial Premises	When in use	N/A	70 (external)

Note 1: External level based on 15dB loss through partially open window.

4.2 Construction Vibration

Department of Environment and Conservation (DEC) 2006, *Assessing Vibration: A Technical Guideline* (the 'Guideline') provides guidance on determining effects of vibration on buildings occupants. The guideline does not address vibration induced damage to structures, blast induced vibration effects or structure borne noise effects.

The Construction Noise & Vibration Strategy (CNVS, V4.1 Transport for NSW, 2019) sets out safe working distances to achieve the human response criteria for vibration. The key vibration generating source proposed to be used is small pile driver used to drive the piles into the ground on which the PV mounting structures are mounted and vibratory roller for road construction. The CNVS sets a safe working distance of 50m for a hammer piling rig and 100m for a large vibratory roller to achieve the residential human response criteria for continuous vibration. Therefore, as the nearest non project related receivers to the project are greater than 100m from the project boundary, human exposure to vibration is anticipated to be minimal. Furthermore, where the human response criteria are satisfied, the structural or cosmetic criteria for sensitive receivers will be achieved. Therefore, vibration impacts are not considered to be a significant issue and have not been considered further in this assessment.

4.3 Operational Noise Criteria

4.3.1 Project Intrusiveness Noise Levels

The PINLs for the project are presented in **Table 6** and have been determined based on the RBLs +5dBA.

Table 6 Project Intrusiveness Noise Levels			
Receiver	Period ¹	Adopted RBL dB LA90(period)	PINL dB LAeq(15min)
All Residential Receivers	Day	35	40
	Evening	30	35
	Night	30	35

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.3.2 Project Amenity Noise Levels

The PANL for residential receivers and other receiver types (ie non-residential) potentially affected by the project are presented in **Table 7**.

Table 7 Amenity Noise Levels and Project Amenity Noise Levels					
Receiver Type	Noise Amenity Area	Assessment Period ¹	Recommended ANL dB LAeq(period)	ANL dB LAeq(period) ²	PANL dB LAeq(15min) ³
Residential	Rural	Day	50	45	48
		Evening	45	40	43
		Night	40	35	38
Residential	Suburban	Day	55	50	53
		Evening	45	40	43
		Night	40	35	38
Residential	Urban	Day	60	55	58
		Evening	50	45	48
		Night	45	40	43
Hotels Motels	Rural/Urban/ Suburban	Day	ANL +5dB	ANL +5dB	ANL +5dB
		Evening	ANL +5dB	ANL +5dB	ANL +5dB
		Night	ANL +5dB	ANL +5dB	ANL +5dB
Educational		When in use	35 (internal 1 hr)	30 (internal 1 hr)	33 (internal 1 hr) 48 (external 1 hr) ⁴
Hospital Wards		When in use	35 (internal 1 hr)	30 (internal 1 hr)	33 (internal 1 hr)
			50 (external 1 hr)	45 (external 1 hr)	48 (external 1 hr)
Place of worship		When in use	40 (internal)	35 (internal 1 hr)	38 (internal 1 hr)
					53 (external 1 hr) ⁴
Passive Recreation		When in use	50	45	48
Active Recreation		When in use	55	50	53
Commercial		When in use	65	60	63
Industrial		When in use	70	65	68
Industrial Interface		When in use	ANL +5dB	ANL +5dB	ANL +5dB

Note 1: Monday – Saturday, Day 7am to 6pm; Evening 6pm to 10pm; Night 10pm to 7am. On Sundays and Public Holidays, Day 8am to 6pm; Evening 6pm to 10pm; Night 10pm to 8am.

Note 2: Project Amenity Noise Level equals the Amenity Noise Level as there is no other industry in the area.

Note 3: Includes a +3dB adjustment to the amenity period level to convert to a 15-minute assessment period as per Section 2.2 of the NPI.

Note 4: External level based on 15dB loss through partially open window.

4.3.3 Project Noise Trigger Levels

The PNTLs are the lower of either the PINLs or the PANLs. **Table 8** presents the derivation of the PNTLs in accordance with the methodologies outlined in the NPI. For this assessment the night time PNTL of 35dB LAeq(15min) is the limiting criteria for residential receivers.

Table 8 Project Noise Trigger Levels				
Catchment	Assessment Period ¹	PINL dB LAeq(15min)	PANL dB LAeq(15min)	PNTL dB LAeq(15min)
Residential Receivers (Rural)	Day	40	53	40
	Evening	35	48	35
	Night	35	43	35
Commercial	When in use	--	63	63

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.4 Maximum Noise Assessment Trigger Levels

The maximum noise trigger levels shown in **Table 9** are based on night time RBLs and trigger levels as per Section 2.5 of the NPI. The trigger levels will be applied to transient noise events that have the potential to cause sleep disturbance.

Table 9 Maximum Noise Trigger Level	
L1 Rural Residential Receivers	
52dB LAmax or RBL + 15dB	
Trigger	52
RBL 30+15dB	45
Highest	52

Note: Monday to Saturday; Night 10pm to 7am. On Sundays and Public Holidays Night 10pm to 8am.

Note: NPI identifies that maximum of the two values is to be adopted which is shown in bold font.

4.5 Road Traffic Noise Criteria

The road traffic noise criteria are provided in the RNP. For this assessment, the 'sub arterial road' category for Country Road has been adopted. It is acknowledged that the functional classification of Country Road is a 'Collector Road' in accordance with the Roads and Maritime Noise Criteria Guideline (April 2015). However, the Road Noise Policy does not provide separate noise criteria for Collector Roads but applies the sub-arterial category to all roads that are not classified as local roads. The relevant road traffic noise criteria are provided in the RNP and are presented in **Table 10** for residential receivers.

Table 10 Road Traffic Noise Assessment Criteria

Road category	Type of project/development	Assessment Criteria – dBA	
		Day (7am to 10pm)	Night (10pm to 7am)
Freeways/arterial/ sub-arterial Roads	Existing residences affected by additional traffic on freeways/arterial/sub- arterial roads generated by land use developments	60dB LAeq(15hr)	55dB LAeq(9hr)
Local roads	Existing residences affected by additional traffic on local roads generated by land use developments	55dB LAeq(1hr)	50dB LAeq(1hr)
School Classrooms	Proposed road projects and traffic generating developments	40dB LAeq(1hr) (internal) when in use	N/A
Hospital Wards		35dB LAeq(1hr) (internal)	35dB LAeq(1hr) (internal)
Places of Worship		40dB LAeq(1hr) (internal)	40dB LAeq(1hr) (internal)
Open Space (active use)		60dB LAeq(1hr)	N/A
Open Space (passive use)		55dB LAeq(1hr)	N/A
Isolated residences in commercial or industrial zones		Refer to AS2107 for internal levels	
Mixed Use development		Each component to be considered separately	
Childcare Facilities		Sleeping rooms 35dB LAeq(1hr) (internal) Indoor play areas 40dB LAeq(1hr) (internal) Outdoor play areas 55dB LAeq(1hr) (external)	

Additionally, the RNP states where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2dBA, which is generally accepted as the threshold of perceptibility to a change in noise level.

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5 Modelling Methodology

A computer model was developed to quantify project noise emissions to neighbouring receivers for typical construction activities and operations. DGMR (iNoise, Version 2020.0) noise modelling software was used to quantify noise emissions from typical construction activities and operations. iNoise is a new intuitive and quality assured software for industrial noise calculations in the environment. 3D noise modelling is considered industry best practice for assessing noise emissions from projects.

The model incorporated a three-dimensional digital terrain map giving all relevant topographic information used in the modelling process. Additionally, the model uses relevant noise source data, ground type, attenuation from barrier or buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers. Where relevant, modifying factors in accordance with Fact Sheet C of the NPI have been applied to calculations.

The model calculation method used to predict noise levels was in accordance with ISO 9613-1 'Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere' and ISO 9613-2 'Acoustics - Attenuation of sound during propagation outdoors. Part 2: General method of calculation' including corrections for meteorological conditions using CONCAWE¹. The ISO 9613 standard from 1996 is the most used noise prediction method worldwide. Many countries refer to ISO 9613 in their noise legislation. However, the ISO 9613 standard does not contain guidelines for quality assured software implementation, which leads to differences between applications in calculated results. In 2015 this changed with the release of ISO/TR 17534-3. This quality standard gives clear recommendations for interpreting the ISO 9613 method. iNoise fully supports these recommendations. The models and results for the 19 test cases are included in the software.

5.1 Construction Assessment Methodology

Construction activities are proposed to be progressive (trenching, piling and assembly) and will occur at several locations simultaneously. Noise emissions were modelled for the following four scenarios:

- earthworks for internal roads and compound construction including the stripping of topsoil and unsuitable soil and the placement and compaction of road base for internal roads;
- earthworks involving trenching for cabling;
- piling of panel supports; and
- assembly of the panels.

¹ Report no. 4/18, "the propagation of noise from petroleum and petrochemical complexes to neighbouring communities", Prepared by C.J. Manning, M.Sc., M.I.O.A. Acoustic Technology Limited (Ref.AT 931), CONCAWE, Den Haag May 1981

It is envisaged that all four construction scenarios have the potential to occur simultaneously at up to two key locations across the site. Noise emission data and assumptions used in this assessment are summarised in **Table 11**. All significant noise generating construction activities will be limited to standard construction hours. Where low intensity construction activities are required to be undertaken outside standard construction hours, such as cabling, minor assembly, use of hand tools etc, they will be managed such that they are not audible at any residential receivers.

Table 11 Construction Equipment Sound Power Levels, Lw dBA (re 10⁻¹² W)

Noise Source/Item	Utilisation %	Quantity	Lw/Item	Total Lw
Trenching & Earthworks				
Backhoe	80	1	104	103
Light vehicle	25	2	76	73
Total – Trenching & Earthworks				105
Piling				
Piling Rig (hydraulic)	80	1	113	112
Tele-handler	75	1	106	105
Light vehicle	25	2	76	73
Total – Piling				113
Assembly				
Mobile Crane/HIAB	75	1	104	103
Tele-handler	75	1	106	105
Light vehicle	25	2	76	73
Hand tools/Power tools	50	1	102	99
Welder	50	1	105	102
Total – Assembly				109
Transport (on site)				
Heavy vehicle	40	1	104	101
Tele-handler	50	1	106	103
Total – Transport				105

5.2 Operational Assessment Methodology

For this assessment, noise predictions were modelled for a typical worst-case operational scenario over a 15-minute assessment period based on the assumptions and sound power levels in **Table 12**. Plant noise emission data used in modelling for this assessment were obtained from manufacturers data or the MAC database. Where relevant, modifying factors in accordance with Section 3.3 and Fact Sheet D of the NPI have been applied to calculations.

Table 12 Operational Equipment Sound Power Levels, Lw dBA (re 10⁻¹² W)

Noise Source/Item	Activity	Quantity	Lw/Item	Total Lw
PV Panel Tracking Motor ^{1,2}	All tracking motors in operation 1 minute per 15-minute period	142	78	83
2.5MW Inverter ²	Constant	2	81	84
5MVA Transformer ²	Constant	1	77	77

Note 1: Tracking motor is situated underneath the PV panel, -5dB attenuation applied to account for shielding provided by the panel.

Note 2: Modifying factor penalty of +5dB added for low frequency and +5dB added for tonality.

5.2.1 Meteorological Analysis

Noise emissions can be influenced by prevailing weather conditions. Light stable winds (<3m/s) and temperature inversions have the potential to increase noise at a receiver.

Fact Sheet D of the NPI provides two options when considering meteorological effects:

- adopt the noise enhancing conditions for all assessment periods without an assessment of how often the conditions occur – a conservative approach that considers a source to receiver winds for all receivers and F class temperature inversions with wind speeds up to 2m/s at night; or
- determine the significance of noise enhancing conditions. This requires assessing the significance of temperature inversions (F and G Class stability categories) for the night time period and the significance of light winds up to 3m/s for all assessment periods during stability categories other than E, F or G.

Standard meteorological conditions and noise-enhancing meteorological conditions as defined in Table D1 of the NPI are reproduced in **Table 13**.

Table 13 Standard and Noise-Enhancing Meteorological Conditions

Meteorological Conditions	Meteorological Parameters
Standard Meteorological Conditions	Day/evening/night: stability categories A–D with wind speed up to 0.5m/s at 10m AGL.
Noise Enhancing Meteorological Conditions	Daytime/evening: stability categories A–D with light winds (up to 3 m/s at 10m AGL). Night-time: stability categories A–D with light winds (up to 3m/s at 10m AGL) and/or stability category F with winds up to 2m/s at 10 m AGL.

A detailed analysis of the significance of noise enhancing conditions has not been undertaken and hence, the (worst case) NPI noise enhancing meteorological conditions have been applied to the noise modelling assessment are presented in **Table 14**.

Table 14 Modelled Meteorological Parameters

Assessment Condition ¹	Temperature	Wind Speed ² / Direction	Relative Humidity	Stability Class ²
Day	20°C	3m/s all directions	50%	D
Evening	10°C	3m/s all directions	50%	D
Night	10°C	2m/s all directions	50%	F

Note 1: Day 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening 6pm to 10pm; Night - the remaining periods.

Note 2: Implemented using CONCAWE meteorological corrections.

5.3 Road Traffic Noise Assessment Methodology

Due to the low traffic volume generated by the project over a typical day during the construction phase, road traffic noise calculation methods such as Calculation of Road Traffic Noise (CRTN - ISBN 0 11 550847 3) by Department of Transport (UK) 1988 or Traffic Noise Model (TNM) by the United States Department of Transport, Federal Highway Administration are not considered appropriate as they are primarily intended to calculate noise emissions from motorways and highways. Whilst each method has a low volume correction, the project traffic volume is out of the scope of these methods. Therefore, road traffic noise has been modelled using iNoise modelling software using ISO 9613-1 and ISO 9613-2 calculation methods, representing the road traffic as “moving sources” along the transport route using the parameters presented in **Table 15**.

Table 15 Road Traffic Noise Modelling Parameters

Noise Source/Item	Lw dBA re 10 ⁻¹² W	Movements/hr	Speed, km/h	Source Height, m ¹
Heavy vehicle (rigid, semi trailer or b-double)	104	8	50	1.5
Light Vehicle	96	20	50	0.75

Note 1: Height above ground level.

6 Noise Assessment Results

6.1 Construction Noise Assessment

Noise levels were predicted at all identified receivers at 1.5m above ground level for typical construction activities for standard construction hours. **Table 16** summarises the predicted noise level range and maximum predicted noise level for each of the construction scenarios (trenching, piling and assembly) at identified receivers. Noise levels are expected to satisfy the NMLs at all receivers.

Table 16 Predicted Construction Noise Levels

Receiver ID	Description/Address	Predicted Noise Level Range dB LAeq(15min) ¹	Highest Predicted Noise Level dB LAeq(15min)	NML Standard Hours dB LAeq(15min)	Compliance Achieved
C01	RFS Fire Control Centre (Future)	<30-43	43	70	✓
R01	347 Country Road	30-44	44	45	✓
R02	40 Heiligmans Lane	<30-38	38	45	✓
R03	312 Country Road	<30-39	39	45	✓
R04	Oxley Lane	30-39	39	45	✓
R05	269 Oxley Lane	<30-32	32	45	✓
R06	265 Oxley Lane	<30-30	30	45	✓
R07	216 Country Road	<30-37	37	45	✓
R08	194 Country Road	<30-34	34	45	✓
R09	New Winton Road	<30-37	37	45	✓
R10	115 Country Road	<30-31	31	45	✓
R11	236 Green St	<30-33	33	45	✓
R12	30 Heiligmans Lane	<30-45	45	45	✓
R13	32-34 Heiligmans Lane	<30-39	39	45	✓
R14	36-38 Heiligmans Lane	<30-37	37	45	✓
R15	391 Country Road	<30-40	40	45	✓
R16	80-118 Heiligmans Lane	<30-33	33	45	✓
R17	120-158 Heiligmans Lane	<30-30	30	45	✓
R18	341 Oxley Lane	<30-33	33	45	✓
R19	26-28 Heiligmans Lane	<30-37	37	45	✓
R20	22-24 Heiligmans Lane	<30-38	38	45	✓
R21	18 Heiligmans Lane	<30-39	39	45	✓

Table 16 Predicted Construction Noise Levels

Receiver ID	Description/Address	Predicted Noise	Highest Predicted	NML Standard	Compliance Achieved
		Level Range dB LAeq(15min) ¹	Noise Level dB LAeq(15min)	Hours dB LAeq(15min)	
R22	14-16 Heiligmans Lane	<30-38	38	45	✓
R23	8 Heiligmans Lane	<30-40	40	45	✓
R24	492 Warral Road	<30-37	37	45	✓
R25	486 Warral Road	<30-37	37	45	✓
R26	480 Warral Road	<30-38	38	45	✓
R27	462 Warral Road	<30-39	39	45	✓
R28	442 Warral Road	<30-40	40	45	✓
R29	360 Warral Road	<30-40	40	45	✓
R30	Warral Road	<30-37	37	45	✓
R31	300 Warral Road	<30-45	45	45	✓

Note 1: Noise levels from construction activities vary due to their position across the project site with respect to surrounding receivers.

6.2 Operational Noise Assessment

Noise levels were predicted at all identified receivers at 1.5m above ground level for all operational sources and are presented in **Table 17**. Noise levels are expected to satisfy the PNTLs at all receivers

Table 17 Predicted Operational Noise Levels

Receiver ID	Description/Address	Predicted Noise Level	PNTL dB LAeq(15min)	Compliance Achieved
		dB LAeq(15min)	Day/Eve/Night ¹	
C01	RFS Fire Control Centre (Future)	<30	63	✓
R01	347 Country Road	<30	40/35/35	✓
R02	40 Heiligmans Lane	<30	40/35/35	✓
R03	312 Country Road	<30	40/35/35	✓
R04	Oxley Lane	<30	40/35/35	✓
R05	269 Oxley Lane	<30	40/35/35	✓
R06	265 Oxley Lane	<30	40/35/35	✓
R07	216 Country Road	<30	40/35/35	✓
R08	194 Country Road	<30	40/35/35	✓
R09	New Winton Road	<30	40/35/35	✓
R10	115 Country Road	<30	40/35/35	✓
R11	236 Green St	<30	40/35/35	✓
R12	30 Heiligmans Lane	<30	40/35/35	✓
R13	32-34 Heiligmans Lane	<30	40/35/35	✓

Table 17 Predicted Operational Noise Levels

Receiver ID	Description/Address	Predicted Noise Level	PNTL dB LAeq(15min)	Compliance
		dB LAeq(15min)	Day/Eve/Night ¹	
R14	36-38 Heiligmans Lane	<30	40/35/35	✓
R15	391 Country Road	<30	40/35/35	✓
R16	80-118 Heiligmans Lane	<30	40/35/35	✓
R17	120-158 Heiligmans Lane	<30	40/35/35	✓
R18	341 Oxley Lane	<30	40/35/35	✓
R19	26-28 Heiligmans Lane	<30	40/35/35	✓
R20	22-24 Heiligmans Lane	<30	40/35/35	✓
R21	18 Heiligmans Lane	<30	40/35/35	✓
R22	14-16 Heiligmans Lane	<30	40/35/35	✓
R23	8 Heiligmans Lane	<30	40/35/35	✓
R24	492 Warral Road	<30	40/35/35	✓
R25	486 Warral Road	<30	40/35/35	✓
R26	480 Warral Road	<30	40/35/35	✓
R27	462 Warral Road	<30	40/35/35	✓
R28	442 Warral Road	<30	40/35/35	✓
R29	360 Warral Road	<30	40/35/35	✓
R30	Warral Road	<30	40/35/35	✓
R31	300 Warral Road	<30	40/35/35	✓

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

6.3 Maximum Noise Level Assessment

A detailed maximum noise level assessment is not required as predicted noise levels for night time operations do not exceed the maximum noise level screening criterion of 40dB LAeq(15min) and there are no operational noise sources that generate significant maximum noise events.

6.4 Road Traffic Noise Assessment

The major transport route for all vehicles to access the project site is via Country Road from the Oxley Highway. During construction, traffic generated by the project includes employee/subcontractor and delivery vehicles. The traffic volume over a typical day for standard construction hours is expected to be up to four heavy vehicles (semi-trailers or B-doubles) per hour and 20 light commercial vehicles or equivalent mini buses for worker transport during the morning and afternoon peak hour periods.

Predicted noise levels from project related construction traffic at the closest receiver on Country Road, 110m from the road centre has been completed using the methodology described in **Section 5.3** and the parameters presented in **Table 15**. The results presented in **Table 18** show the calculated $LA_{eq}(1hr)$ noise level and the adjusted $LA_{eq}(15hr)$ noise level to align with RNP assessment periods.

Table 18 Predicted Construction Road Traffic Noise Levels

Road Name	Offset Distance to Receiver	Predicted Noise Level		RTN Criteria	Compliance Achieved
Country Road	110m	37dB $LA_{eq}(1hr)$	36dB $LA_{eq}(15hr)$	60dB $LA_{eq}(15hr)$	Yes

Results demonstrate that project construction traffic noise levels would comply with the relevant RNP criteria.

Existing road traffic flows on the Oxley Highway are approximately 3,144 vehicles per day (TfNSW Traffic Volume Viewer, Station ID 6168, 2020). The project proposes to add an additional 40 light vehicles and up to six heavy vehicles per day (four times the average of 100 heavy vehicles over a six month construction period) as a possible daily worst case scenario. Based on a total of 46 vehicle movements occurring during the daytime period, the project would increase traffic noise levels by less than 0.1dB based on a simple calculation relating to the percentage change in traffic flows, ie $10 \times \log(\text{future flow/existing flow})$.

Therefore, it is concluded that project related road traffic noise levels would satisfy the relevant RNP criteria at any residential receiver along the proposed transport routes and not increase existing noise levels by more than 2dB.

7 Discussion and Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Assessment for the proposed Warral Solar Farm at Warral near Tamworth, NSW.

The results of the Noise Assessment demonstrate that emissions from the project would satisfy the relevant construction NMLs and operational PNTLs at all identified receivers.

Furthermore, sleep disturbance is not anticipated, as there are no operational noise sources that generate significant maximum noise events and noise emissions from the project are predicted to satisfy the EPA maximum noise criteria.

Road noise emissions associated with the project are anticipated to satisfy the relevant RNP criteria at all receivers along the proposed transportation route.

A qualitative assessment of potential vibration impacts has been completed. Due to the nature of the works proposed and distances to potential vibration sensitive receivers, vibration impacts from the project would be negligible.

Based on the Noise Assessment results, there are no noise related issues which would prevent approval of the proposed project.

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Appendix A – Glossary of Terms

A number of technical terms have been used in this report and are explained in **Table A1**.

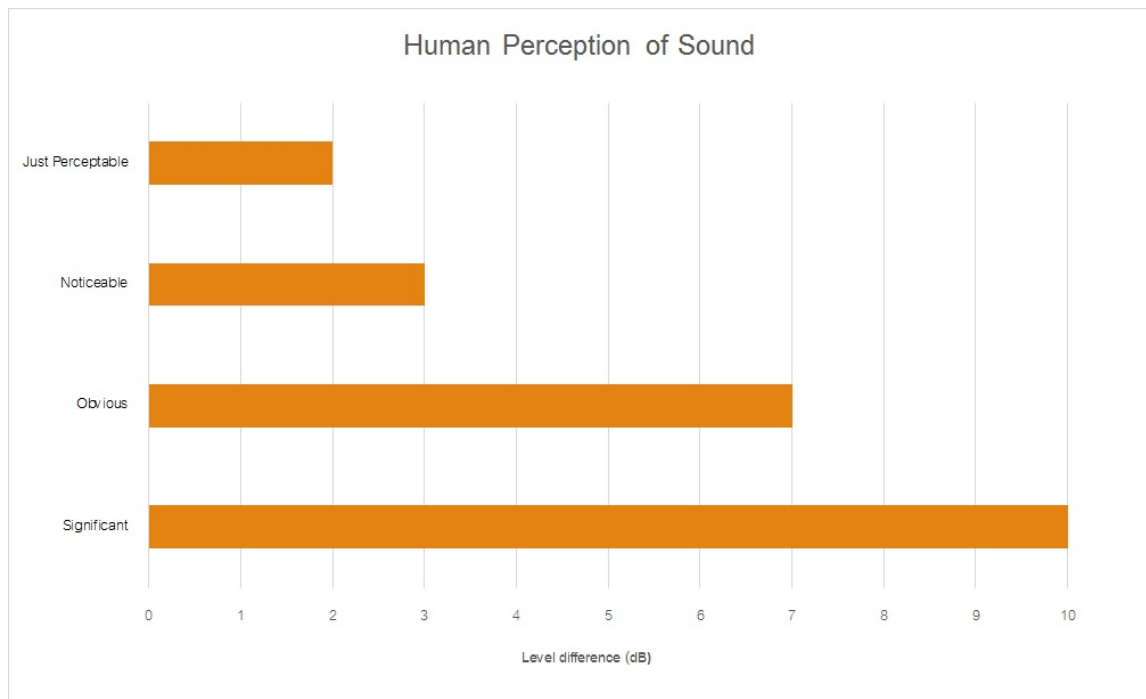
Table A1 Glossary of Acoustical Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
Ambient Noise	The total noise associated with a given environment. Typically, a composite of sounds from all sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to sound.
Background Noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is usually represented by the LA90 descriptor
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Z-weighted or decibels Linear (unweighted).
Extraneous Noise	Sound resulting from activities that are not typical of the area.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A sound level which is exceeded 10% of the time.
LA90	Commonly referred to as the background noise, this is the level exceeded 90% of the time.
LAeq	Represents the average noise energy or equivalent sound pressure level over a given period.
LAmx	The maximum sound pressure level received at the microphone during a measuring interval.
Masking	The phenomenon of one sound interfering with the perception of another sound. For example, the interference of traffic noise with use of a public telephone on a busy street.
RBL	The Rating Background Level (RBL) as defined in the NPI, is an overall single figure representing the background level for each assessment period over the whole monitoring period. The RBL, as defined is the median of ABL values over the whole monitoring period.
Sound power level (Lw or SWL)	This is a measure of the total power radiated by a source in the form of sound and is given by $10 \cdot \log_{10} (W/W_0)$. Where W is the sound power in watts to the reference level of 10^{-12} watts.
Sound pressure level (Lp or SPL)	the level of sound pressure; as measured at a distance by a standard sound level meter. This differs from Lw in that it is the sound level at a receiver position as opposed to the sound 'intensity' of the source.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA

Source	Typical Sound Pressure Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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10/12/2020

Project Number: 200522

STORMWATER MANAGEMENT REPORT

at

WARRAL SOLAR FARM | COUNTRY ROAD WARRAL NSW

for

PROVIDENCE ASSET GROUP

Project No. 200522

Revision: C – Reissued for DA

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1. Introduction

DRB Consulting Engineers (DRB) were engaged by Providence Asset Group, to undertake a Stormwater Management Plan for the proposed Warral Solar Farm, located at LOT 4 DP 1048145 Country Road, Warral, NSW.

This report will provide commentary on the impact the proposed development will have on the existing site with regard to stormwater quantity.

It should be noted that, this report has been prepared to a level suitable for Development Application only.

This report should be read in conjunction with the Concept Stormwater Management plans 200522/CIV01-02.

2. Site Description & Proposed Development

The site is located at Country Road, Warral. The site is located on the eastern side of Country Road and is identified as Lot 4 DP 1048145.

The proposed Warral Solar Farm will be located in the Eastern portion of the site, known as the Investigation Area (IA).

At the time of this investigation, the IA was a vacant rural parcel of land approximately 13.37 Ha in area. The IA had a good grass coverage and sloped from the west to the northeast at slopes of approximately 2.5 – 3.5%.

The IA had an existing watercourse located to the north of the site. During rainfall events, surface runoff from the IA would be captured by existing swales and conveyed towards the existing watercourse with the remainder of the IA sheet flowing across the site to the east towards Timbumburi creek.

Figure 1 below shows the existing site and investigation area.



Figure 1 – Existing Site Boundaries

The proposed Solar Farm layout can be seen in Figure 2 below.

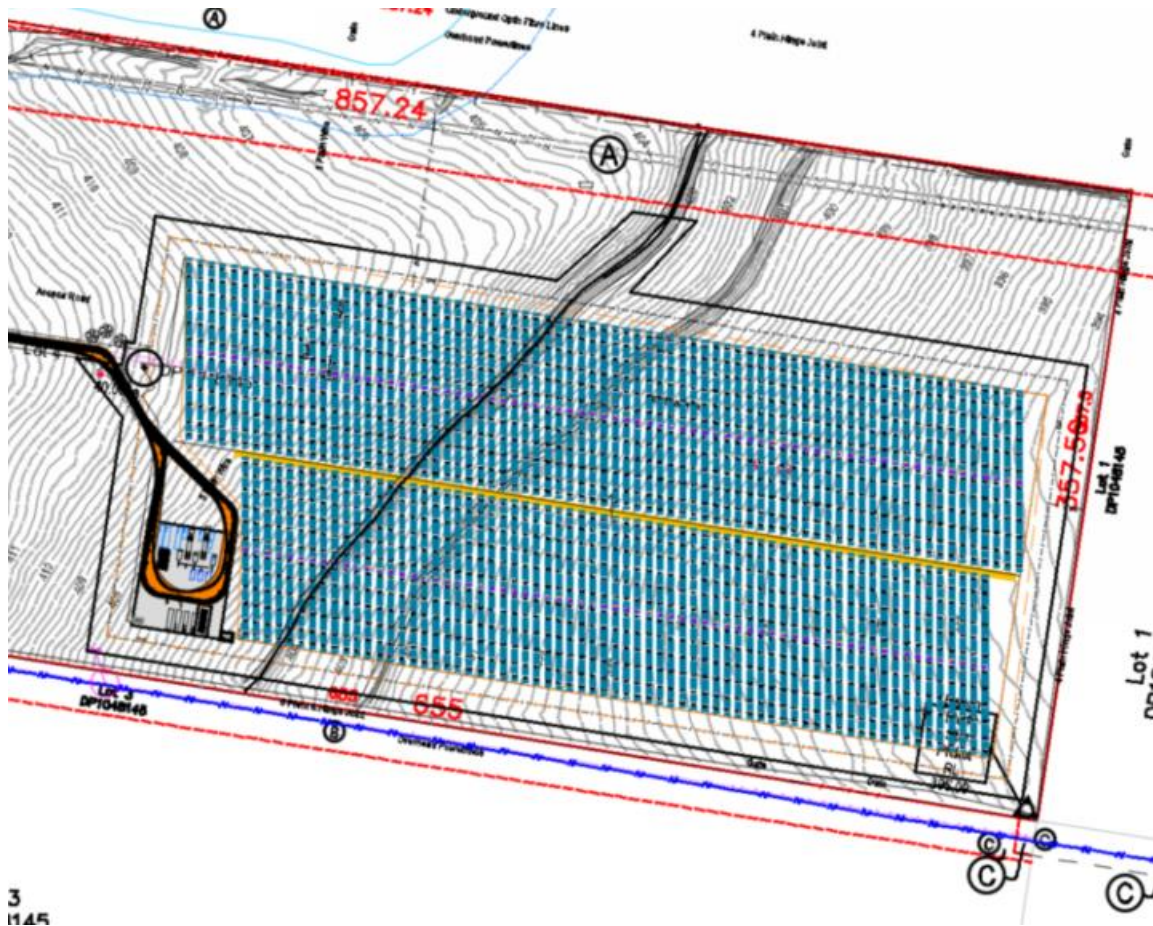


Figure 2 – Proposed Solar Farm

3. Council Requirements

A review of Tamworth Regional Council's Development Plan and Engineering Guidelines identified that the site is subject to the requirement for Onsite Stormwater Detention.

- *The proposed development must detain stormwater runoff to ensure Post-Development flow rates are reduced to Pre-Development flow rates for all storm events up to and including the 1 in 100 year storm event.*

Furthermore, the site must discharge legally without causing nuisance flows onto neighbouring properties.

4. Water Quantity Analysis (Onsite Stormwater Detention)

4.1. Overview

The proposed development area has been split into two separate catchments for the assessment of Stormwater Quantity; the Photovoltaic Array and the Gravel / Hardstand catchments. Figure 3 below shows the proposed catchment boundaries.

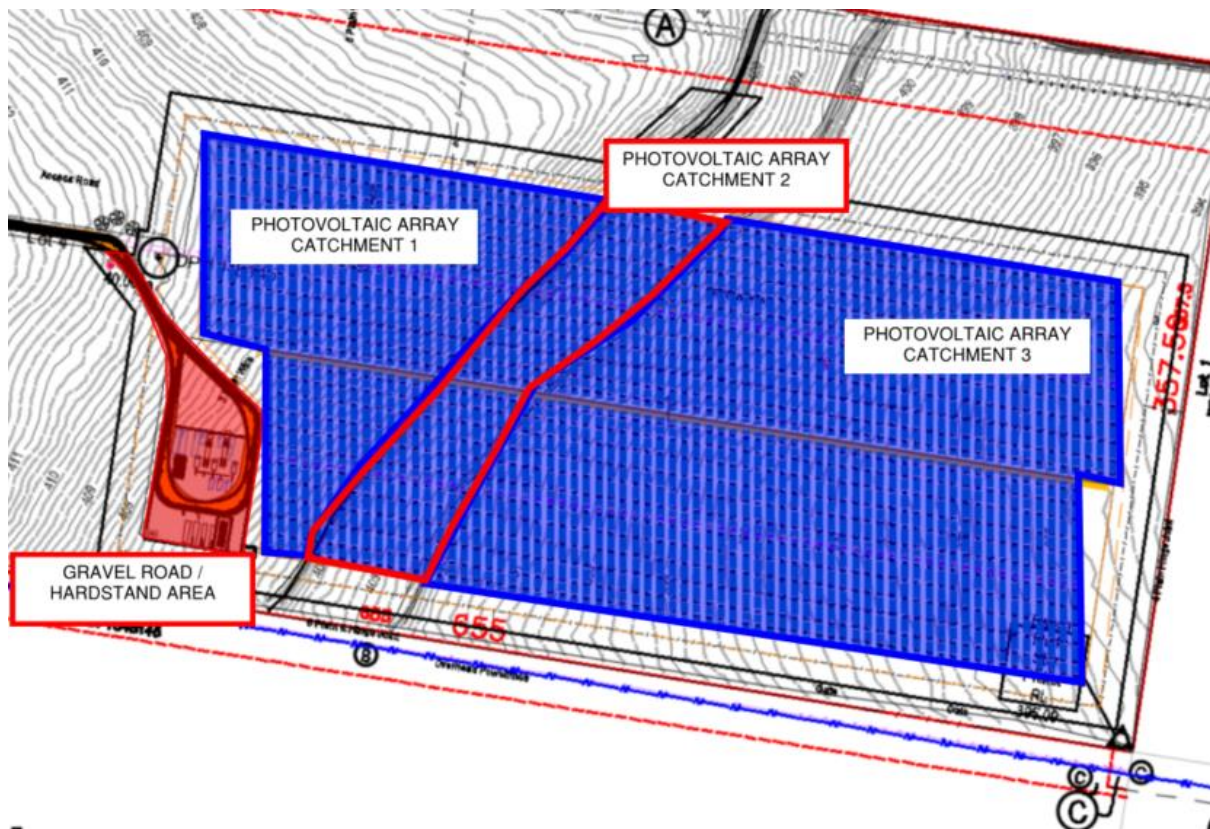


Figure 3 – Proposed Catchment Boundaries

4.2. Photovoltaic Array

The Photovoltaic Array will consist of 142 x Ground Mounted Single Axis Trackers. The array structure will be steel pile supported and will have approximately 600mm clearance above the existing ground surface.

4.2.1. Pre-Development Peak Flows

The catchment characteristics for the Pre-Development catchment area can be seen in Table 1 below:

Construction Stage	Parameter	
Catchment 1 Pre-Development	Sub-Catchment Area	22,874.50 m ²
	Percentage Impervious	0 %
	Flowpath Length	127.70 m
	Flowpath Slope	0.52 %
	Retardance Coefficient 'n'	0.075
Catchment 2 Pre-Development	Sub-Catchment Area	11,316.61 m ²
	Percentage Impervious	0 %
	Flowpath Length	57.20 m
	Flowpath Slope	3.5 %
	Retardance Coefficient 'n'	0.075
Catchment 3 Pre-Development	Sub-Catchment Area	57,900.20 m ²
	Percentage Impervious	0 %
	Flowpath Length	369.00 m
	Flowpath Slope	2.1 %
	Retardance Coefficient 'n'	0.075

Table 1 – Existing Catchment Parameters

A DRAINs model was developed to determine the pre-development peak flow rates. The DRAINs model used the *ARR 2019 Initial loss - Continuing loss (IL-CL) hydrological model* and 2016 IFD data. The Hydrological model parameters were determined using the ARR data hub and can be seen in Figure 4 below.

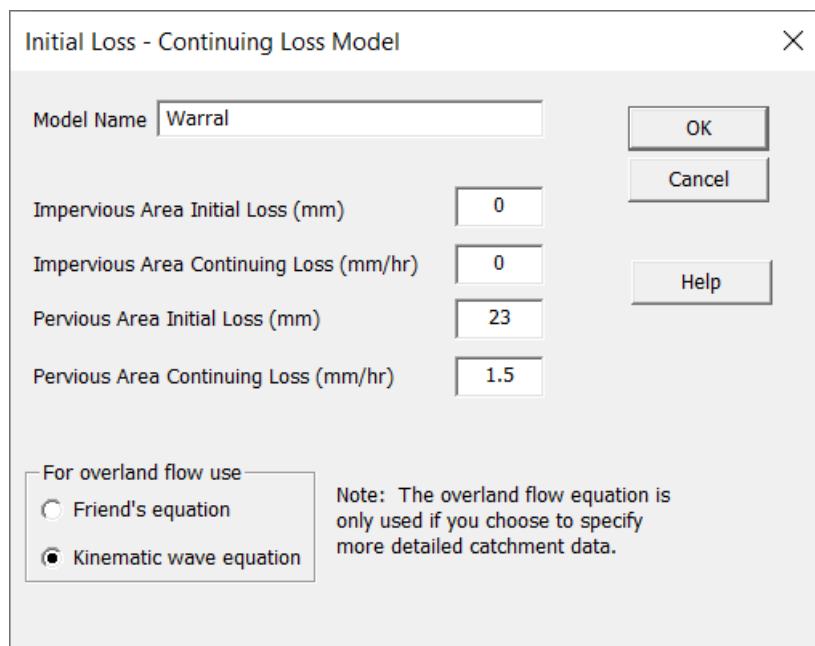


Figure 4 – Hydrological Model Parameters

The model was developed for the 1 EY (Exceedances per year), 10% AEP (Annual Exceedance Probability) and 1% AEP events and analysed the following storm durations.

5 minutes	45 minutes	9 hours
10 minutes	1 hour	12 hours
15 minutes	2 hours	18 hours
20 minutes	3 hours	24 hours
25 minutes	4.5 hours	
30 minutes	6 hours	

The Results of the DRAINS model can be seen below in Table 2.

Construction Stage	Storm Event (Exceedance Probability / Annual Exceedance Probability)	Peak Flow
Catchment 1 Pre-Developed	1EY	0.197 m ³ /s
	10% AEP	0.539 m ³ /s
	1% AEP	1.050 m ³ /s
Catchment 1 Pre-Developed	1EY	0.123 m ³ /s
	10% AEP	0.326 m ³ /s
	1% AEP	0.564 m ³ /s
Catchment 1 Pre-Developed	1EY	0.266 m ³ /s
	10% AEP	0.760 m ³ /s
	1% AEP	1.610 m ³ /s

Table 2 – Pre-Development Peak Flow

4.2.2. Post-Development Peak Flows

The Post-Development site conditions can be summarised below:

- (i) The proposed arrays will be at varying angles, however, in a worst-case runoff scenario, it is assumed the arrays are horizontal to the existing ground surface level.
- (ii) Runoff from the proposed arrays will fall immediately on to the untouched natural ground surface.
- (iii) The pervious area under the arrays will not receive direct rainfall, however, it will be available for both initial and continuing loss for the runoff of the array immediately upslope.

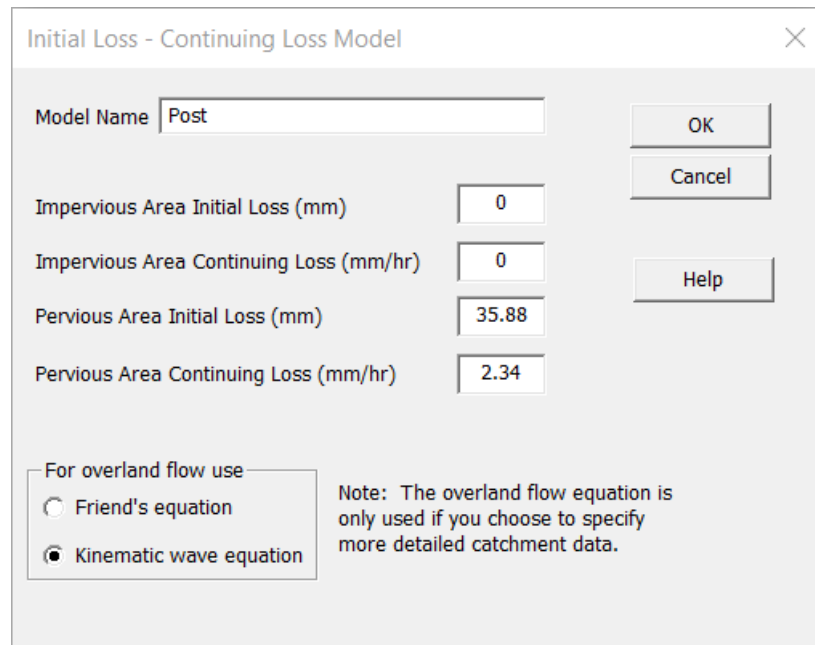
The catchment characteristics for the Post-Development catchment area can be seen in Table 3 below:

Construction Stage	Parameter	
Catchment 1 Post-Development	Sub-Catchment Area	22,874.50 m ²
	Percentage Impervious	36.10 %
	Flowpath Length	127.70 m
	Flowpath Slope	0.52 %
	Retardance Coefficient 'n'	0.075
Catchment 2 Post-Development	Sub-Catchment Area	11,316.61 m ²
	Percentage Impervious	36.10 %
	Flowpath Length	57.20 m
	Flowpath Slope	3.5 %
	Retardance Coefficient 'n'	0.075
Catchment 3 Post-Development	Sub-Catchment Area	57,900.20 m ²
	Percentage Impervious	36.10 %
	Flowpath Length	369.00 m
	Flowpath Slope	2.1 %
	Retardance Coefficient 'n'	0.075

Table 3 – Proposed Development Catchment Parameters

To replicate the proposed site conditions and consider the available pervious areas located underneath the proposed arrays, the Pervious Area Initial and Continuing Loss was factored up by 1.56. This allowed the total pervious area to be included in the assessment.

The Hydrological model parameters used in the Post-Development model can be seen in Figure 5 below.



Initial Loss - Continuing Loss Model

Model Name: Post

Impervious Area Initial Loss (mm): 0

Impervious Area Continuing Loss (mm/hr): 0

Pervious Area Initial Loss (mm): 35.88

Pervious Area Continuing Loss (mm/hr): 2.34

For overland flow use:

☐ Friend's equation

☒ Kinematic wave equation

Note: The overland flow equation is only used if you choose to specify more detailed catchment data.

OK, Cancel, Help

Figure 5 – Hydrological Model Parameters

The Results of the DRAINS model can be seen below in Table 4.

Construction Stage	Storm Event (Exceedance Probability / Annual Exceedance Probability)	Pre-Development Peak Flow	Post-Development Peak Flow	Difference
Catchment 1	1EY	0.197 m ³ /s	0.121 m ³ /s	- 0.76 m ³ /s
Post-Development	10% AEP	0.539 m ³ /s	0.416 m ³ /s	- 0.123 m ³ /s
	1% AEP	1.050 m ³ /s	0.855 m ³ /s	- 0.195 m ³ /s
Catchment 2	1EY	0.123 m ³ /s	0.078 m ³ /s	- 0.045 m ³ /s
Post-Development	10% AEP	0.326 m ³ /s	0.246 m ³ /s	- 0.080 m ³ /s
	1% AEP	0.564 m ³ /s	0.501 m ³ /s	- 0.063 m ³ /s
Catchment 3	1EY	0.266 m ³ /s	0.191 m ³ /s	- 0.075 m ³ /s
Post-Development	10% AEP	0.760 m ³ /s	0.585 m ³ /s	- 0.175 m ³ /s
	1% AEP	1.610 m ³ /s	1.240 m ³ /s	- 0.370 m ³ /s

Table 4 – Post-Development Peak Flow

4.2.3. Conclusion

By discharging the runoff from proposed Photovoltaic Array's directly to the existing ground surface and maintaining the existing natural surface levels and travel paths the proposed development area catchment limited the increase to peak runoff to negligible values, and reduced the peak runoff during the 1% AEP.

4.3. Gravel / Hardstand Area

The Gravel / Hardstand Area includes the proposed roads, gravel laydown area and temporary buildings located within the Investigation Area.

It is proposed that runoff from this area will generally follow the existing contours, with the existing swales to capture the runoff and convey these flows to a new above ground onsite stormwater detention basin. The basin will then reduce flows to the pre-development levels.

4.3.1. Pre-Development Peak Flows

The catchment characteristics for the Pre-Development catchment area can be seen in Table 5 below:

Catchment	Parameter	
Pre-Developed	Sub-Catchment Area	46,266.4 m ²
	Percentage Impervious	0 %
	Flowpath Length	92.5 m
	Flowpath Slope	3.89 %
	Retardance Coefficient 'n'	0.075

Table 5 – Existing Catchment Parameters

A DRAINs model was developed to determine the pre-development peak flow rates. The DRAINs model used the *ARR 2019 Initial loss - Continuing loss (IL-CL) hydrological model* and 2016 IFD data. The Hydrological model parameters were determined using the ARR data hub (see Figure 4 above) and was developed for the 1 EY (Exceedances per year), 10% AEP (Annual Exceedance Probability) and 1% AEP events.

The Results of the DRAINs model can be seen below in Table 6.

Catchment	Storm Event (Exceedance Probability / Annual Exceedance Probability)	Combined Peak Flow
Pre-Developed	1EY	0.423 m ³ /s
	10% AEP	1.180 m ³ /s
	1% AEP	2.230 m ³ /s

Table 6 – Pre-Development Peak Flow

4.3.2. Post-Development Peak Flows

The Post-Development site conditions can be summarised below:

- (i) The proposed gravel roads and hardstand areas will be assumed to be impervious.
- (ii) A retardance coefficient of 0.013 was adopted for both the proposed gravel road and hardstand area.
- (iii) The runoff from the impervious area was then treated as sheet flow along the natural ground surface and conveyed to the proposed above ground onsite stormwater detention basin via the existing swale.

The catchment characteristics for the Post-Development catchment area can be seen in Table 7 below:

Catchment	Parameter	
Hardstand / Proposed Gravel Road	Sub-Catchment Area	3,942.3 m ²
	Percentage Impervious	100 %
	Flowpath Length	80.5 m
	Flowpath Slope	3.6 %
	Retardance Coefficient 'n'	0.013
Pervious	Sub-Catchment Area	42,324.1 m ²
	Percentage Impervious	0 %
	Flowpath Length	92.5 m
	Flowpath Slope	3.89 %
	Retardance Coefficient 'n'	0.075

Table 7 – Proposed Development Catchment Parameters

The Gravel / Hardstand Catchment drained directly into an above ground Onsite Stormwater Detention Basin. The Basin characteristics can be seen in Table 7 below.

OSD Basin	
Basin Invert	403.24m AHD
Basin – Top of Bank	403.70m AHD
Base of Weir Width	0.0 m
Base of Weir Level	403.24m AHD
Top of Weir Width	8.0 m
Top of Weir Level	403.70 AHD
Basin Volume	78.21 m ³

Table 7 – Proposed OSD Basin Characteristics

The Results of the DRAINS model can be seen below in Table 8.

Storm Event	Pre-Dev. Peak Flow	Post-Dev. Peak Flow	Post-Dev. Peak Flow - Mitigated	Difference	Top Water Level
1EY	0.423 m ³ /s	0.471 m ³ /s	0.331 m ³ /s	- 0.092 m ³ /s	403.44m AHD
10% AEP	1.180 m ³ /s	1.234 m ³ /s	0.827 m ³ /s	- 0.353 m ³ /s	403.50m AHD
1% AEP	2.230 m ³ /s	2.278 m ³ /s	1.910 m ³ /s	- 0.320 m ³ /s	403.69m AHD

Table 8 – Post-Development Peak Flow

4.3.3. Conclusion

By discharging the runoff from proposed Gravel / Hardstand Area through the proposed OSD basin, the Post-development peak flows for the entire Investigation Area are reduced back to the Pre-development peak flow values.

5. Conclusion

The stormwater drainage strategy for the proposed Warral Solar Farm at Country Road, Warral can be summarised as:

- (i) All impervious runoff from the proposed Photovoltaic Arrays will discharge to the existing ground surface where the natural flow regime will be maintained.
- (ii) Runoff from the proposed gravel/hardstand area catchment will be conveyed via sheet flow and the existing swale to the proposed above ground onsite stormwater detention basin.
- (iii) Discharge from the above ground onsite stormwater detention basin will be limited to the pre-development flow rates.
- (iv) By utilizing the existing swales, discharge from the site will replicate the existing site conditions, ie there will be no nuisance flows.

Provided the above stormwater drainage philosophy is adopted for the site, the proposed Warral Solar Farm will limit the Post-Development peak flows to Pre-Development flow rates for the 1 EY, 10% AEP and 1% AEP events.

Should you require any further advice or clarification of any of the above, please do not hesitate to contact us.

Yours faithfully

DRB CONSULTING ENGINEERS PTY LIMITED



Mathew McNamara

BEng (Civil) Hons MIE Aust



TRAFFIC IMPACT ASSESSMENT

**SOLAR PHOTOVOLTAIC (PV) POWER GENERATING FARM
& ASSOCIATED SUPPORTIVE INFRASTRUCTURE**

**PART LOT 4 DP 1048145
329 COUNTRY ROAD, WARRAL**

PREPARED FOR: PROVIDENCE ASSET GROUP

DECEMBER 2020

20/191

**TRAFFIC IMPACT ASSESSMENT
PROVIDENCE ASSET GROUP****SOLAR PHOTVOLTAIC (PV) POWER FARM
PART LOT 4 IN DP 1048145
329 COUNTRY ROAD, WARRAL**

Intersect Traffic Pty Ltd (ABN: 43 112 606 952)

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This document has been prepared, checked and released in accordance with the Quality Control Standards established by Intersect Traffic Pty Ltd.

Issue	Date	Description	By
A	16/11/20	Draft	JG
B	17/11/20	Edit	JG
C	15/12/20	Final Proof	JG
D	15/12/20	Approved	JG

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This document has been authorised by


Date 15th December 2020**Disclaimer**

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1.0 INTRODUCTION

Intersect Traffic Pty Ltd (Intersect Traffic) has been engaged by Providence Asset Group to prepare a traffic impact assessment report for a proposed Solar Photovoltaic (PV) Power Farm (up to 5MW) on part of Lot 4 DP 1048145 – 329 Country Road, Warral.

The proposed development involves installation of solar panel banks, off-load area, inverter and AC combiner area, HV switchboard area, MV power station area, direct connection to a suitable existing power line to the south of the site, on-site car parking and temporary construction office. Vehicular access to the site will be via an extension to an existing internal road with turnaround area off Country Road. The development concept plans are shown in **Attachment A**.

This report is required to support a development application to Tamworth Regional Council and allow the Council to assess the proposal in respect of its impact on the local and state road network.

This report presents the findings of the traffic and parking assessment and includes the following:

1. An outline of the existing situation near the site.
2. Assessment of the additional traffic generated by the proposal, identifies a preferred delivery route and the additional traffic's impact on the local road network.
3. Review of the adequacy of the proposed vehicular access to the site.
4. Review of the suitability and provision of on-site car parking through assessment against Council and Australian Standards requirements.
5. Presentation of conclusions and recommendations.

2.0 SITE DESCRIPTION

The subject site is shown in **Figure 1** below. It is located on the western side of Country Road, Warral approximately 3.2 km south of the Oxley Highway, 5 km's south-east of Tamworth Airport and approximately 6.5 kilometres south-west of the Tamworth CBD. The site currently contains rural pasture used for agricultural purpose.

The property has the formal title of Part Lot 4 in DP 1048145, 329 Country Road, Warral and the development area for the proposal is approximately 13.4 hectares. The site is currently zoned RU4 – Primary Production Small Lots pursuant to the Tamworth Regional LEP (2010).

The existing vehicular access to the site is currently provided off Country Road via two constructed rural access crossing to an existing farm shed and a dwelling approximately 3.29 km's and 3.34 km's south of the Oxley Highway respectively. Deliveries to the site will use the identified delivery road shown on **Figure 1** being via the Oxley Highway and New England Highway from the south from Sydney and Newcastle. Noting Country Road is not a designated B-Double route, Council will need to provide special permission for B-Doubles to deliver materials to the site. It is considered that Country Road is suitable for use by B-Double vehicles. **Photograph 1** below shows the existing development site from Country Road at the northern access to the site while **Photograph 2** shows the existing southern vehicular access to the site. It is proposed to use the existing northern access road within the site to access the solar farm with an extension of the access road and turnaround that will be used for the construction and operation of the solar farm.

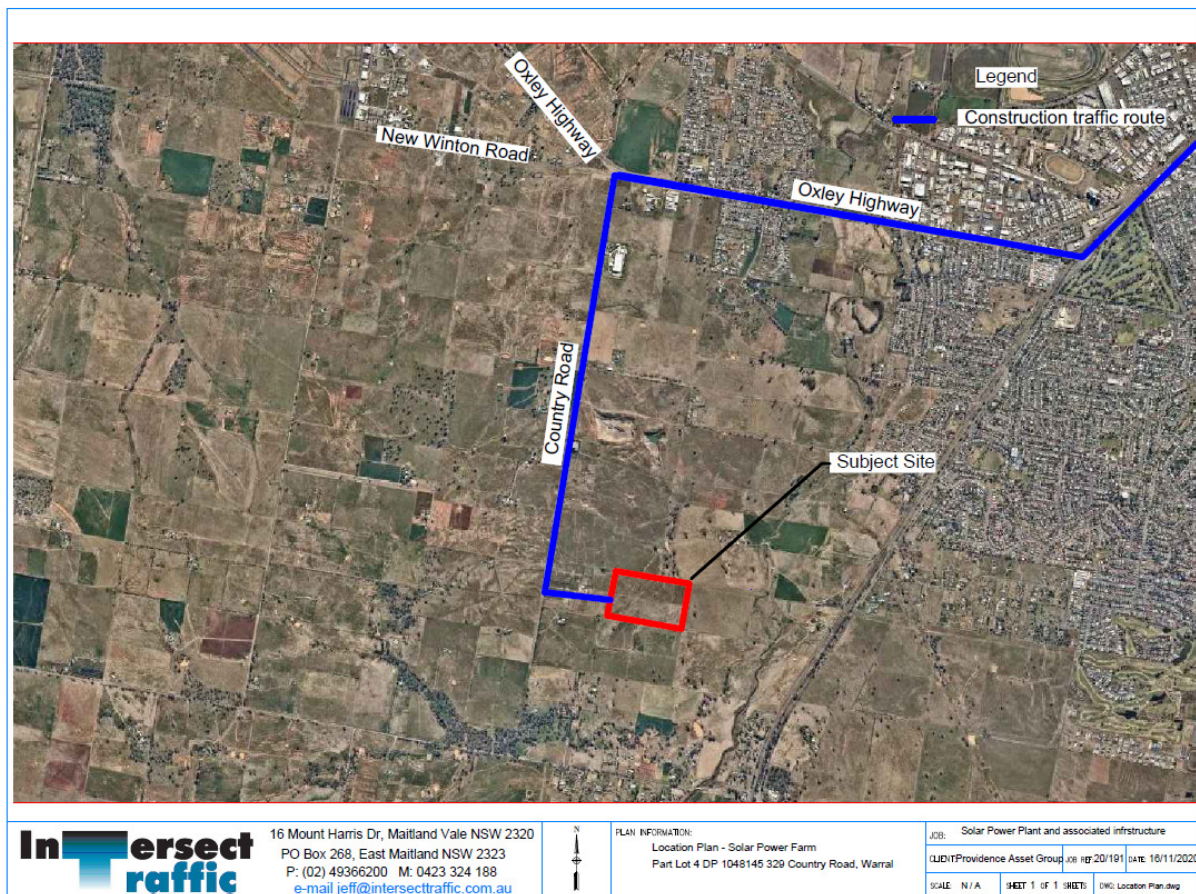


Figure 1 – Site Location



Photograph 1 – Development site and northern access to shed



Photograph 2 – Existing vehicular access to dwelling on the site.

3.0 EXISTING ROAD NETWORK

3.1 Oxley Highway

The Oxley Highway is a classified state highway (A39) with its primary function to connect the mid-north coast of NSW (Port Macquarie, Wauchope) to the New England area (Walcha, Tamworth, Gunnedah) to the Central West of NSW (Coonabarabran, Gilgandra and Warren). As such it is an arterial road and major NSW transport route from inland NSW to the NSW coastal area. As a sealed rural arterial road the Oxley Highway is under the care and control of NSW Roads and Maritime Services (RMS) or Transport for NSW (TfNSW) as they are now known.

Near Westdale the Oxley Highway is a two-lane two-way sealed rural road with an 8-metre wide sealed carriageway consisting of 3.5 metre wide travel lanes and 0.5 metre wide sealed shoulders. Additional turning lanes are provided at major intersections along its length, including at the Country Road intersection. Near the site the speed zoning is 70 km/h however a variable speed school zone exists immediately east of Country Road along the Westdale Public School frontage. This reduces the speed zoning to 40 km/h during peak drop off and pick up times for students. At the time of inspection the Oxley Highway was observed to be in good condition as shown in **Photograph 3** below.



Photograph 3 – Oxley Highway, Westdale.

3.2 Country Road

Country Road is a local rural road with its primary function to provide vehicular access to properties along its length though it also performs a collector road function in distributing the local traffic to the arterial road network at the Oxley Highway. As a local road it is under the care and control of Tamworth Regional Council and a 70 km/h speed zoning would also apply to Country Road. Note Country Road is not a designated B-Double route.

Country Road is a two lane two sealed and unsealed road with a sealed pavement width of 7 metres with variable width gravel road shoulders and table drains. This allows two lanes of traffic flow, one in each direction but provides little parking or pull over areas along its length. It currently services an industrial food processing facility and a quarry therefore already has a higher than normal percentage of heavy vehicle traffic. Country Road is only centreline and edge line marked near its intersection with the Oxley Highway. At the time of inspection the sealed pavement of Country Road was in excellent condition as shown in **Photograph 4** below.

Approximately 1.9 km south of the Oxley Highway (just past the Quarry access) Country Road becomes an unsealed road with a carriageway width of approximately 6 metres. This allows two way flow on the road however again there is little in the way of shoulders and pull off areas along this section of road. At the time of inspection the unsealed section of the road near the development site was found to be in good condition as shown in **Photograph 5** below.



Photograph 4 – Country Road, Westdale near Oxley Highway.



Photograph 5 – Unsealed section of Country Road near site access

4.0 ALTERNATE TRANSPORT MODES

Tamworth Buslines runs public transport (bus) services within Tamworth including Route 437 to Westdale as shown in the route map extract in **Figure 2**. These run approximately hourly on Monday to Friday between 8 am and 6 pm as well as providing 4 AM and 1 PM service on Saturdays. The morning and afternoon services run slightly different routes. This service provides access to the Tamworth CBD with connections to bus services for all other Tamworth service routes. The nearest bus stop is within Westdale at the intersection of the Oxley Highway and Mayne Drive some 3.1 km north-east of the site. This service would not be convenient for construction employees associated with the development.

As a rural area there are no pedestrian footpaths or on / off road cycleways within the local road network. Near the site pedestrians are generally required to utilise the grass verges and road shoulders / pavement while cyclists are required to utilise the road shoulders or share the travel lanes with other vehicles.

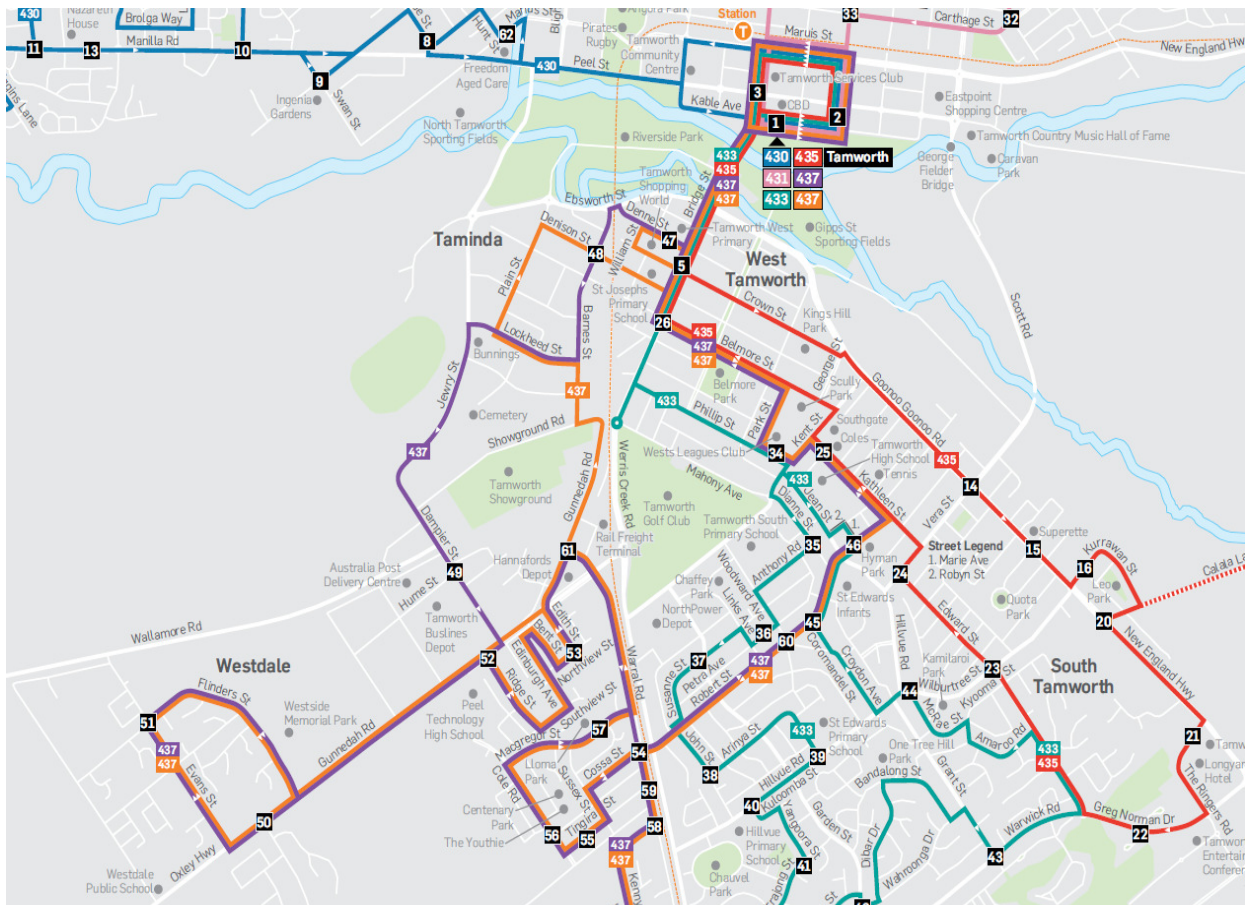


Figure 2 – Tamworth Buslines – Bus Route Map extract

5.0 DEVELOPMENT PROPOSAL

The proposed development involves the construction of a Solar Photovoltaic (PV) Power Farm on the site. The development concept plans are shown in **Attachment A** with the specific works involved in the expansion listed below:

- ◆ Installation of temporary construction office and amenities.
- ◆ Installation of Solar Panel arrays.
- ◆ Earthworks for construction lay-down area, hardstand areas and internal roads.
- ◆ Installation of inverters, transformers and switchgear.
- ◆ Extension of an existing unsealed access road to the property (northern access) from Country Road to the construction site.
- ◆ Construction of security fence and entrance gate; and
- ◆ Drainage and landscaping to Tamworth Regional Council requirements.

The development will require a team of 30 construction employees for a period of up to 6 months working 7 am to 5 pm Monday to Friday and 8 am – 1 pm on Saturdays. The majority of traffic movements associated with the development will occur during the construction of the solar power farm. Traffic movements generated by the operation of the development would include a single staff light vehicle movement associated with maintenance inspections as required and specific maintenance work which would be short term and infrequent. Deliveries during construction works would be expected to be within rigid and articulated vehicles. More detail on construction traffic is provided later in this report.

6.0 TRAFFIC IMPACTS

6.1 – Traffic Generation and Trip Distribution

The RMS publication “*RTA’s Guide to Traffic Generating Developments (2002)*” provides advice on the traffic generating potential of different land uses. However this document does not cover Solar Farms therefore determining traffic generation is reliant on advice from the applicant regarding construction and operation of the development.

From an operational perspective traffic generation is expected to be minimal with only regular daily maintenance inspections carried out when necessary. Therefore based on 1 visit per day per week a peak hour traffic generation of 2 vehicle trips per hour (vtpH) has been assumed for this assessment. There may be times when specific maintenance tasks have to be undertaken but these will be infrequent, short-term and undertaken under a construction traffic management plan for the work. Construction traffic estimates for the development are as follows based on the information provided in **Attachment C**.

- ◆ Construction employees on-site – Maximum 30 transported in up to 10 light vehicles per day arriving between 6 am and 7 am and departing between 5 pm and 6 pm.
- ◆ Deliveries – Mainly heavy rigid vehicles and articulated vehicles (AV). Maximum – 8 per day but average of 5 per day between 10 am and 4 pm. Whilst these are likely to mostly arrive outside the peak hour traffic generation periods associated with the arrival and departure of employees, logistically there could be occurrences when due to circumstances out of the control of the contractor, a delivery arrives during the peak hour periods.
- ◆ Other vehicles – Some earthworks plant may be required on-site as well as concrete agitators and road base material deliveries during construction of the access. It would be expected a maximum frequency of 3 deliveries within a peak hour is assumed.
- ◆ Construction period – up to 6 months

Based on this advice the likely peak hour traffic generation which will occur in the AM peak coinciding with employees arriving on site and in the PM peak coinciding with employees leaving the site is calculated below. It is also noted deliveries involve 2 trips with an inbound trip and an outbound trip.

AM peak = 10 inbound employees + 3 x 2 roadworks and other plant + 1 x 2 deliveries = 18 vtpH (14 inbound and 4 outbound).

PM peak = 10 outbound employees + 3 x 2 roadworks and other plant + 1 x 2 deliveries = 18 vtpH (14 outbound and 4 inbound).

It is expected that the distribution of trips will be all east towards Tamworth with deliveries being via the New England Highway from the south originating from either Newcastle or Sydney. In accessing the site the likely transportation route as envisaged is shown on the location plan (**Figure 1**) in this report.

Existing traffic volumes in the area were recorded by Intersect Traffic at the Oxley Highway / Country Road intersection during the likely peak AM and PM traffic periods (road network) i.e. 8 am – 9 am and 3.00 pm – 4.00 pm on Tuesday 17th March 2020 and Wednesday 18th March 2020 respectively. These periods were chosen following interrogation of Transport for NSW (TfNSW) data in the area on its Traffic Volume Viewer application. Northern Transport Planning and Engineering also installed a traffic classifier on the Oxley Highway immediately east of Country Road from Tuesday 10th March 2020 until Monday 16th March 2020. The data sheets for these counts are provided in **Attachment B**.

These traffic counts determined that the relevant peak hour two-way mid-block traffic volumes on the state and local road network in the AM and PM periods during this period were.

- ◆ Oxley Highway east of Country Road - 473 vtp/h in the AM peak and 728 vtp/h in the PM peak. These are taken from the traffic classifier counts.
- ◆ Oxley Highway west of Country Road – 387 vtp/h in the AM peak and 507 vtp/h in the PM peak.
- ◆ Country Road south of the Oxley Highway – 27 vtp/h in the AM peak and 25 vtp/h in the PM peak.

It was noted that the traffic classifier count recorded mid-block traffic volumes on the Oxley Highway east of Country Road 20 % higher in the AM peak and 27% higher in the PM peak than the manual intersection count. This indicates a large variation in daily peak hour traffic and to account for this the manual intersection count data has been increased by 20 % (AM) and 27 % (PM) for the other two legs of the intersection. Therefore the peak AM and PM traffic volumes for the road network adopted in this assessment are as follows.

- ◆ Oxley Highway east of Country Road - 473 vtp/h in the AM peak and 728 vtp/h in the PM peak.
- ◆ Oxley Highway west of Country Road – 460 vtp/h in the AM peak and 640 vtp/h in the PM peak.
- ◆ Country Road south of the Oxley Highway – 33 vtp/h in the AM peak and 32 vtp/h in the PM peak.

Given the construction will be completed within a 6 month period and the peak operational traffic volume from the site is only 2 vtp/h there is no need to do a 2030 (10 year horizon period) assessment of this development.

6.2 – Road Capacity

Table 4.3 of the RMS publication “*RTA’s Guide to Traffic Generating Developments*” provides some guidance on likely mid-block capacity of two-lane two-way urban roads. This table is reproduced below as **Table 1**:

Table 1 – Urban Road Mid-Block Capacity Table

Table 4.3
Typical mid-block capacities for urban roads with interrupted flow

Type of Road	One-Way Mid-block Lane Capacity (pcu/hr)	
Median or inner lane:	Divided Road	1,000
	Undivided Road	900
Outer or kerb lane:	With Adjacent Parking Lane	900
	Clearway Conditions	900
	Occasional Parked Cars	600
4 lane undivided:	Occasional Parked Cars	1,500
	Clearway Conditions	1,800
4 lane divided:	Clearway Conditions	1,900

Source: - RTA’s Guide to Traffic Generating Developments (2002)

This table indicates the one-way mid-block capacity of a single travel lane on an undivided urban road is 900 vtp/h therefore the two-way mid-block capacity of a two-way urban road is twice this value i.e. 1,800 vtp/h. Therefore the technical two-way mid-block capacity of the local and state road network is 1,800 vtp/h.

However when considering the local road network i.e. Country Road it is more appropriate to apply the environmental capacity guidelines set by NSW RMS in Figure 4.6 of its “*RTA’s Guide to Traffic Generating Developments*” document given the standard of construction of these roads and their

primary function of providing access to properties / dwellings along their length. This figure is reproduced below as **Table 2**.

Table 2 – Environmental Road Capacity Table

Table 4.6
Environmental capacity performance standards on residential streets

Road class	Road type	Maximum Speed (km/hr)	Maximum peak hour volume (veh/hr)
Local	Access way	25	100
	Street	40	200 environmental goal
			300 maximum
Collector	Street	50	300 environmental goal
			500 maximum

Note: Maximum speed relates to the appropriate design maximum speeds in new residential developments. In existing areas maximum speed relates to 85th percentile speed.

Source: - RTA's Guide to Traffic Generating Developments (2002)

As a local street Country Road should have traffic volumes less than 300 vtpd to maintain an acceptable level of residential amenity within these roads.

Therefore the road capacity thresholds adopted in this assessment are as follows.

- ◆ Oxley Highway – 1,800 vtpd.
- ◆ Country Road – 300 vtpd.

As the two-way mid-block peak hour traffic data and traffic generation figures reported in **Section 6.1** in the AM and PM peak hour traffic volumes on the local and state road network during construction of the Solar Farm are still expected to be well below the existing capacity thresholds determined above then the local and state road network has sufficient spare two-way capacity to cater for the construction and operation of the Solar Farm. The addition of up to 18 vtpd will not cause the capacity thresholds determined above to be reached therefore it can be concluded that the proposed development will not adversely impact on the local and state road network mid-block efficiency.

Note in undertaking this assessment it is assumed that there is some chance the other proposed Solar Farm by Providence Asset Group on Country Road near the existing quarry will be constructed concurrently with this project. Therefore the cumulative traffic impacts from the construction of both projects (up to 36 vtpd during construction) and the operational cumulative impact of 2 vtpd still does not result in the capacity thresholds for the local road network to be reached and is again insignificant given the minor increase in traffic and the levels of spare capacity existing in the existing road network.

6.3 – Intersection Capacity

The main intersection impacted by the construction of the development is the Oxley Highway / Country Road priority controlled give way T-intersection. To determine the impact of the development on this intersection it has been modelled using the SIDRA INTERSECTION 8 software. SIDRA INTERSECTION is a micro-analytical program which identifies "Level of Service" (LoS) criteria for intersection analysis which range from LoS A to LoS F. Assessment is then based on the LoS requirements of the TfNSW shown below in **Table 3**:

Table 3 – TfNSW Intersection performance criteria.

Table 4.2
Level of service criteria for intersections

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Signs
A	< 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays Roundabouts require other control mode	At capacity, requires other control mode

Source: - RTA's Guide to Traffic Generating Developments (2002).

In undertaking this assessment the following assumptions were made.

- ◆ The intersection is to remain as currently constructed as an AUR/AUL rural type intersection.
- ◆ Traffic data used was sourced by Intersect Traffic in March 2020 with a sensitivity analysis of up to 125 % undertaken to account for the variations in daily traffic peaks identified in the traffic counts.
- ◆ Construction traffic used the traffic route identified in **Figure 1** with only 4 outbound trips in the AM peak which is mirrored in the PM peak: and
- ◆ As the construction period is only 6 months future traffic modelling (i.e.2030) is not required.
- ◆ Assumes both solar farms proposed by Providence Asset Group is constructed together.

The results of the modelling are summarised for the 'all vehicles' case with worst delay and level of service within **Table 4** below while the full Sidra movement summary tables are provided in **Attachment D**.

Table 4 – Oxley Highway / Country Road, Westdale intersection – Sidra Results Summary

Model	Deg. Satn (v/c)	Worst Average Delay (s)	Worst Level of Service	95 % back of queue length (cars)
2020 AM	0.100	9.1	A	0.1
2020 PM	0.160	10.9	A	0.1
2020 AM + construction traffic	0.100	9.4	A	0.2
2020 PM + construction traffic	0.160	11.4	A	0.3
2020 AM + construction traffic - sensitivity	0.124	10.9	A	0.2
2020 PM + construction traffic - sensitivity	0.198	14.0	A	0.4

The modelling shows that even with the additional construction and operational traffic from the Solar Farms the intersection continues to operate satisfactorily in 2020 with the degree of saturation, average delays and level of service well within the acceptable guidelines set by TfNSW. Based on these results it would also be reasonable to conclude the construction traffic would not adversely impact on intersections on the wider road network given the high level of intersection

control i.e. roundabouts and traffic signals that exist at the major intersections of the transportation route along the New England Highway and Oxley Highway.

Overall it can be concluded that the proposed Solar Farm at the site will not adversely impact on the efficiency and effectiveness of the local and state road network.

6.4 Access Assessment

In terms of width, the access to the development providing access to a user class 1 (long term) car parking facility with less than 25 car spaces fronting a local road is required to be a category 1 access (Table 3.1 of the Standard). Table 3.2 of the Standard then specifies a category 1 access facility as a combined entry / exit between 3.0 to 5.5 metres wide. However the proposed entrance width at the combined entry / exit access at Country Road will need to be a minimum 12.5 metres wide to cater for the swept turning paths for delivery vehicles during the construction stage and satisfy the requirements of Australian Standard *AS2890.1-2004 Parking Facilities – Part 1 Off-street car parking* and Australian Standard *AS2890.2-2002 Parking Facilities – Part 2 Off-street commercial vehicle facilities*.

Sight distance at the proposed access off Country Road was observed to be in excess of 150 metres in each direction therefore complies with the requirements of Figure 3.2 of Australian Standard *AS2890.1-2004 Parking Facilities – Part 1 Off-street car parking* (97 metres desirable for 70 km/h) as well as Austroads *Guide to Road Design – Part 4A – Unsignalised and signalised intersections - Table 3.2* (151 metres for 70 km/h) for safe intersection sight distance.

It is therefore concluded that the proposed site access is suitably located and satisfactory for use for the Solar Farm as it complies with the requirements of Australian Standard *AS2890.1-2004 Parking Facilities – Part 1 Off-street car parking* and Australian Standard *AS2890.2-2002 Parking Facilities – Part 2 Off-street commercial vehicle facilities*.

The main issue with access for construction vehicles to the site is the suitability of the local road network to safely cater for heavy vehicle deliveries. In this regard it is noted that Country Road has a sealed pavement a minimum 7 metres wide and then an unsealed pavement 6 metres wide to the construction site, which therefore complies with Austroads Standards for Rural Roads with less than 500 vtp. It would therefore allow two heavy vehicles to pass each other at slow speed. Therefore it is considered the proposed transportation route to the site is suitable to carry heavy vehicles and thus is suitable to cater for the construction traffic from the Solar Farm construction. This is further evidenced by the existing heavy vehicle traffic on the road accessing the Baiada site, the adjoining Quarry and the rural properties along the road. However, the additional heavy vehicle loading from the construction may accelerate the deterioration in the sealed pavement along the transportation route. It is therefore recommended that a dilapidation report be prepared for the project in regard to Country Road in consultation with Tamworth Regional Council to identify unsatisfactory pavement damage caused by the construction of the Solar Farm and ensure the road network is repaired to Council's satisfaction post the construction stage of the development. This will require pre and post construction stage inspections of the road pavement along the proposed transport routes.

Overall with a suitable condition of consent included for the preparation of a dilapidation report covering Country Road and the satisfactory repair of the local road network post construction it is considered the local and state road network would be suitable to cater for the expected construction traffic associated with the development.

7.0 ON-SITE CAR PARKING

On-site car parking for the proposal is required to comply with the Industrial Development controls and Appendix A of the Tamworth Regional Council DCP (2010). Adopting the industrial development rates for this project the relevant on-site car parking provision during the operation of the Solar Farm is.

- ◆ 1 space per 75 m² or 1 space per 2 employees whichever is greater.

With only 1 employee engaged in the day to day operation of the Solar Farm the development is only required to provide 1 on-site car parking space under the DCP requirements. However it is the responsibility of the applicant to also provide sufficient on-site car parking for construction employees during the duration of the construction of the development for the development to comply with the car parking objectives of the DCP. Construction employee car parking will be provided on the hard stand area identified as the construction lay down area and this is large enough to cater for the expected storage requirements during construction as well as the provision of at least 10 on-site car parks for construction employees which is the expected traffic generation from employees to the site as well as being in excess of the Industrial land use requirements of the Tamworth Regional Council DCP (2010). With significant overflow parking areas also on site it is considered reasonable to conclude the development provides sufficient on-site car parking that complies with the objectives and controls related to car parking required within the Tamworth Regional Council DCP (2010).

The employee car parking area would need to comply with the requirements of Australian Standard AS2890.1-2004 *Parking Facilities – Part 1 Off-street car parking* with parking bay sizes 2.4 m x 5.4 m and aisle widths of 5.8 metres. There is sufficient room on-site to ensure compliance with this requirement which could be covered by a suitable condition of consent. Overall it is considered suitable on-site car parking can be provided for the development ensuring all vehicle movements to and from the site off Country Road will be undertaken in a forward direction.



8.0 ALTERNATE TRANSPORT MODES

The proposed development will not generate any increase in public transport demand during both the construction and operational phases of the development particularly given the site is not currently serviced by convenient public transport. Therefore there is no nexus for the provision of new services or improved infrastructure resulting from the development. Similarly, the development will not generate any additional pedestrian or cycle traffic during both the construction and operation phases of the development therefore no nexus exists for the provision of additional pedestrian paths or cycle ways near the site.

9.0 CONCLUSIONS

This traffic and parking assessment for the proposed Solar Photovoltaic (PV) Power Farm (up to 5MW) on part of Lot 4 DP 1048145 – 329 Country Road, Warral has determined the following:

- ◆ The development during construction will generate up to an additional 18 vehicle movements to and from the site during the weekday AM and PM peak periods but only 2 vtpd during the operation of the Solar Farm.
- ◆ The existing peak traffic volumes on the local road network are well below the two-way mid-block capacity threshold of 1,800 vtpd for the Oxley Highway (LoS C) as well as the environmental capacity of 200 vtpd for the local road network (Country Road). Traffic volumes will remain below these thresholds during the construction and operation of the development.
- ◆ The Oxley Highway / Country Road intersection will continue to operate satisfactorily during and post construction of the Solar Farm with little if any impact on the operation of the intersection resulting from the development.
- ◆ It is also reasonable to conclude the development will not adversely impact on the intersections on the wider state road network given the high levels of intersection control on the major intersections.
- ◆ Therefore, the additional construction and operational traffic generated by this development will not adversely impact on the efficiency or effectiveness of the local and state road network.
- ◆ The proposed site access is suitable for use for construction and operation of the development being compliant with Australian Standard and Austroads requirements.
- ◆ With a suitable condition of consent included for the preparation of a dilapidation report covering Country Road and the satisfactory repair of the local road network post construction it is considered the local and state road network would be suitable to cater for the expected construction traffic associated with the development.
- ◆ There is sufficient area on-site to accommodate the expected peak parking demand generated by the development during both construction and operation with the provision of an AS2890.1-2004 compliant car park within the construction laydown area for a minimum 10 spaces as well as the provision of numerous overflow parking areas on the site.
- ◆ The proposed development will not generate any increase in public transport demand therefore no nexus exists for the provision of new services or improved infrastructure resulting from the development. Similarly, the development will not generate any additional pedestrian or cycle traffic therefore no nexus exists for the provision of additional pedestrian paths or cycle ways near the site.

10.0 RECOMMENDATION

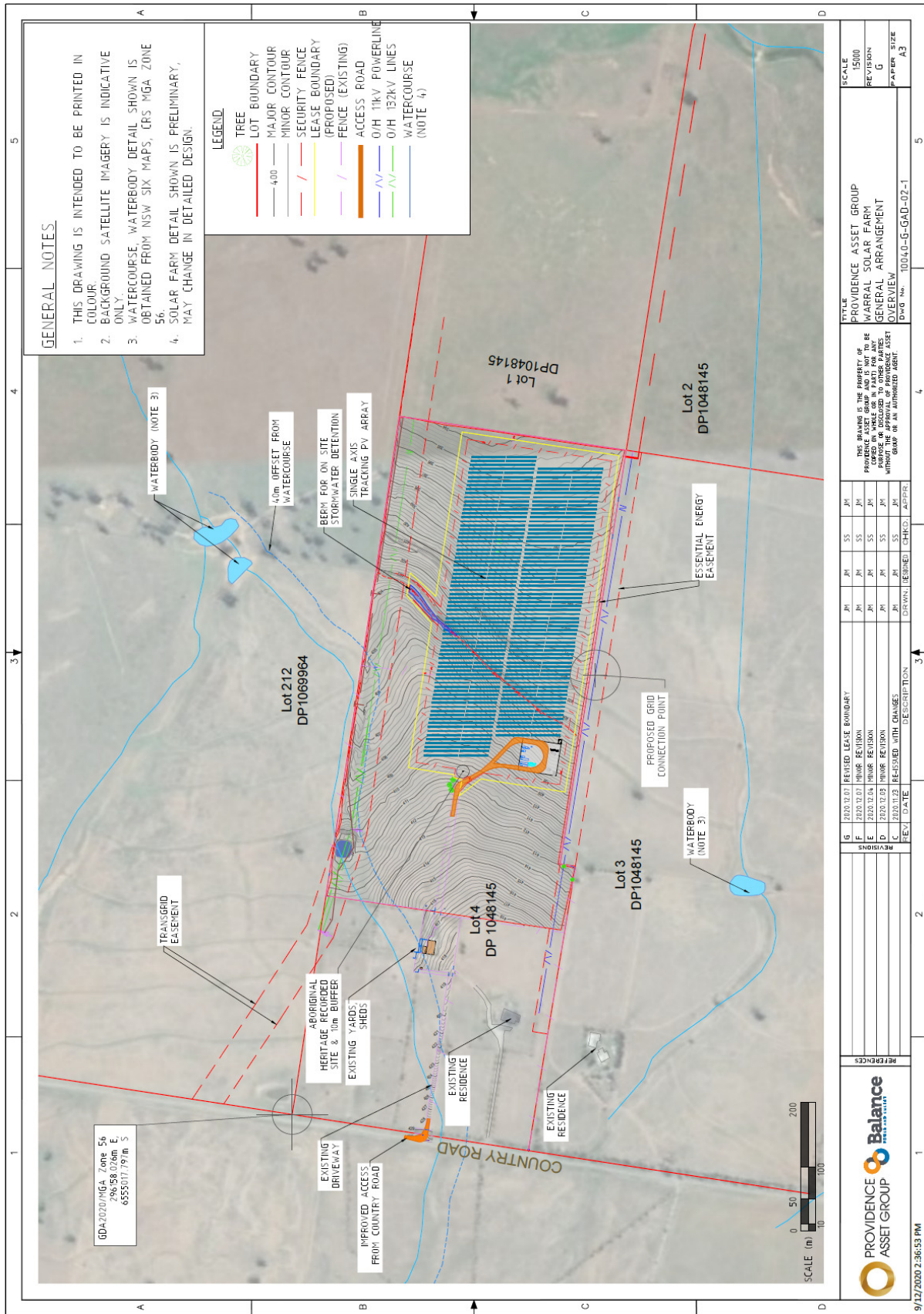
Having carried out this traffic and parking assessment for the proposed Solar Photovoltaic (PV) Power Farm (up to 5MW) on part of Lot 4 DP 1048145 – 329 Country Road, Warral it is recommended that the proposal can be supported from a traffic perspective as the development will not adversely impact on the local road network and complies with all relevant requirements of Tamworth Regional Council, Austroads, Australian Standards and TfNSW.



JR Garry BE (Civil), Masters of Traffic
Director
Intersect Traffic Pty Ltd

ATTACHMENT A

DEVELOPMENT PLANS

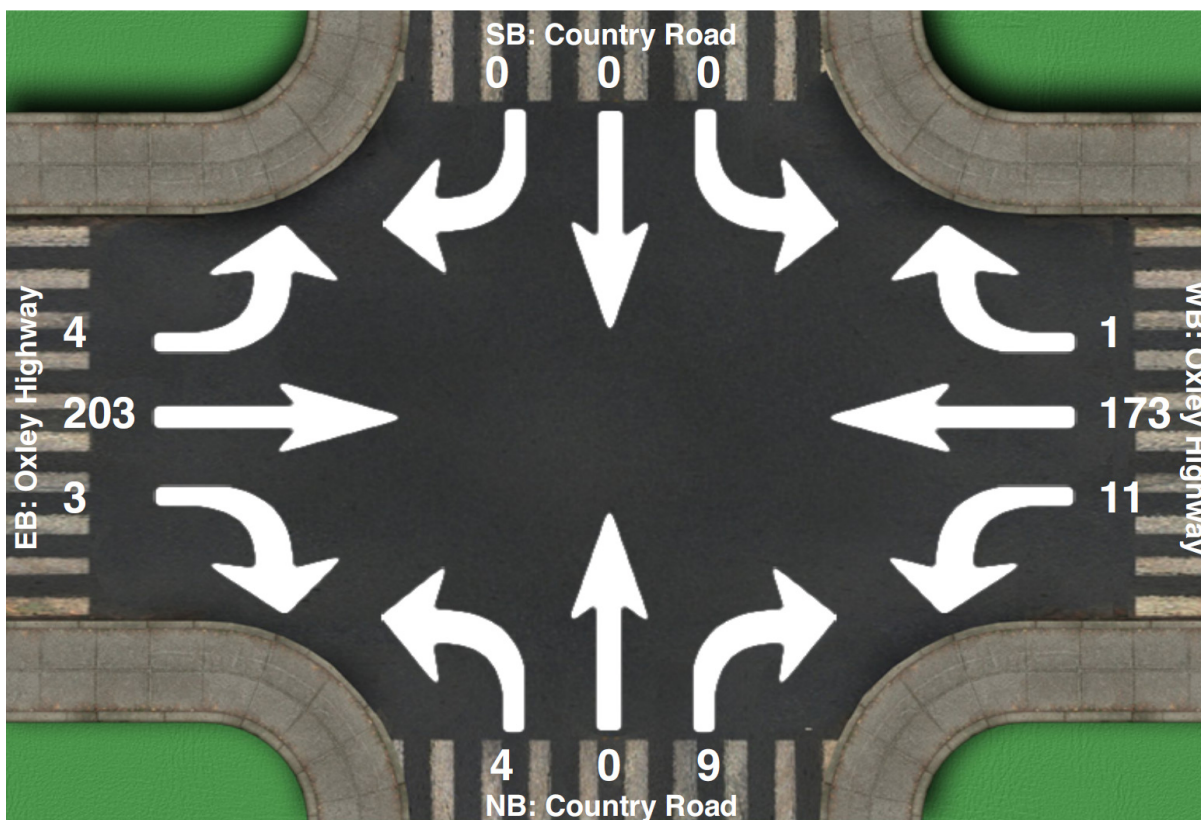


ATTACHMENT B

TRAFFIC COUNT DATA

Intersection Peak Hour

Location: Country Road at Oxley Highway, Westdale
GPS Coordinates:
Date: 2020-03-18
Day of week: Wednesday
Weather:
Analyst: Jeff



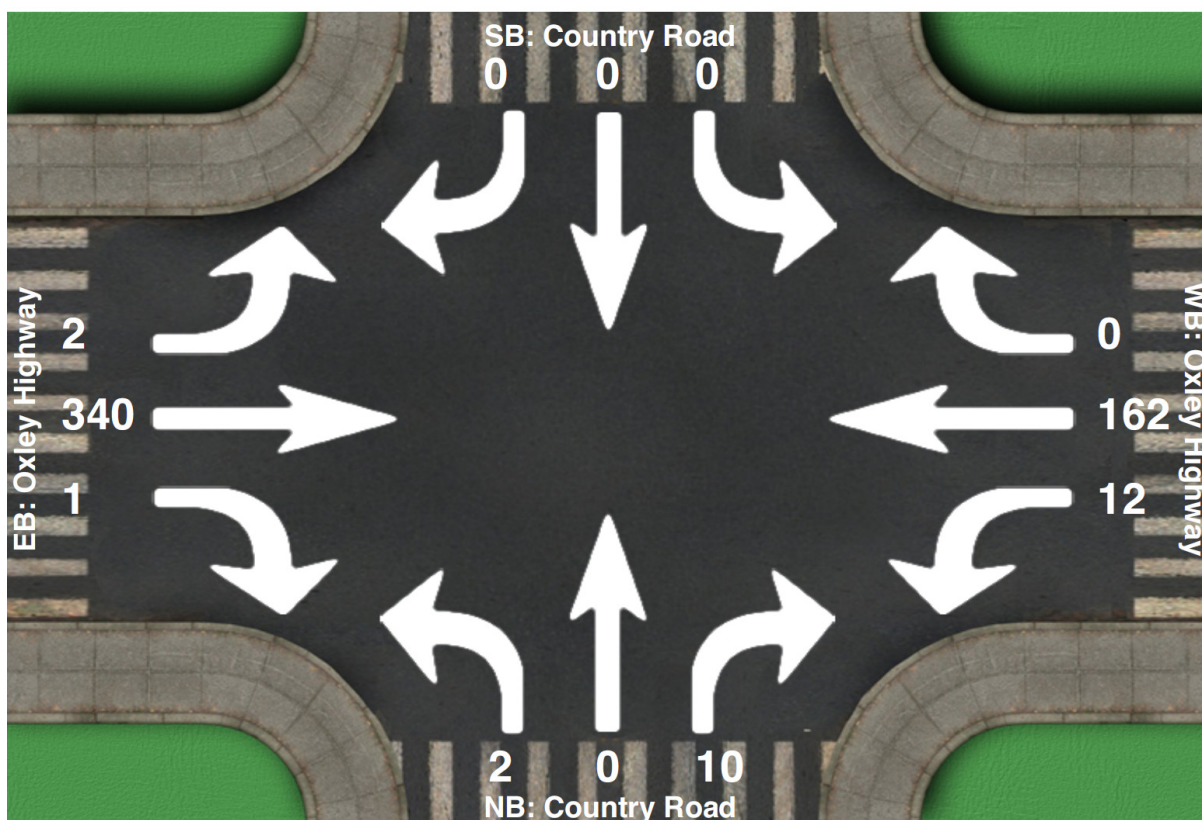
Intersection Peak Hour

08:00 - 09:00

	SouthBound			Westbound			Northbound			Eastbound			Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Vehicle Total	0	0	0	11	173	1	4	0	9	4	203	3	408
Factor	0.00	0.00	0.00	0.69	0.87	0.25	1.00	0.00	0.75	0.50	0.88	0.75	0.93
Approach Factor	0.00			0.86			0.81			0.88			

Intersection Peak Hour

Location: Country Road at Oxley Highway, Westdale
GPS Coordinates:
Date: 2020-03-17
Day of week: Tuesday
Weather:
Analyst: Jeff



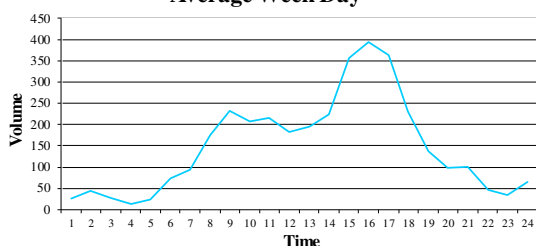
Intersection Peak Hour

15:00 - 16:00

	SouthBound			Westbound			Northbound			Eastbound			Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Vehicle Total	0	0	0	12	162	0	2	0	10	2	340	1	529
Factor	0.00	0.00	0.00	0.75	0.90	0.00	0.50	0.00	0.36	0.50	0.67	0.25	0.76
Approach Factor	0.00			0.93			0.43			0.68			

Site 2 Oxley Hwy E of Country Rd [60]
Eastbound

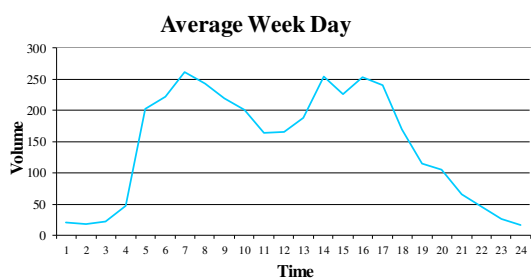
Day Time	Tue 10/03/20	Wed 11/03/2020	Thu 12/03/2020	Fri 13/03/2020	Sat 14/03/2020	Sun 15/03/2020	Mon 16/03/2020	W/Day Ave.	W/End Ave.	7 Day Ave
0:00	20	54	25	24	31	4	10	27	18	24
1:00	72	44	61	44	54	3	3	45	29	40
2:00	24	15	41	51	20	9	10	28	15	24
3:00	10	13	13	20	13	6	12	14	10	12
4:00	30	22	25	26	14	4	13	23	9	19
5:00	72	66	79	81	50	9	65	73	30	60
6:00	95	105	100	87	45	10	81	94	28	75
7:00	181	180	163	170	79	39	175	174	59	141
8:00	214	235	231	249	130	85	234	233	108	197
9:00	195	203	223	214	203	122	203	208	163	195
10:00	246	212	198	234	219	116	195	217	168	203
11:00	192	178	185	182	170	140	173	182	155	174
12:00	196	180	190	218	176	151	198	196	164	187
13:00	208	267	212	221	117	171	218	225	144	202
14:00	306	320	313	426	136	147	420	357	142	295
15:00	440	413	378	368	134	197	369	394	166	328
16:00	349	365	400	406	145	169	296	363	157	304
17:00	246	216	251	236	114	160	208	231	137	204
18:00	125	153	141	162	85	116	105	137	101	127
19:00	74	97	106	158	56	83	59	99	70	90
20:00	122	68	113	98	46	44	100	100	45	84
21:00	55	52	39	52	26	75	39	47	51	48
22:00	20	26	31	53	26	20	43	35	23	31
23:00	58	53	52	58	15	15	109	66	15	51
Total	3550	3537	3570	3838	2104	1895	3338	3567	2000	3119

Average Week Day

Summary

	from	to	
AM Peak	8:00 AM	9:00 AM	249
PM Peak	3:00 PM	4:00 PM	440
Week Day Average			3567
Weekend Day Average			2000
7 Day Average			3119

Site 2 Oxley Hwy E of Country Rd [60]
Westbound

Day Time	Tue 10/03/20	Wed 11/03/2020	Thu 12/03/2020	Fri 13/03/2020	Sat 14/03/2020	Sun 15/03/2020	Mon 16/03/2020	W/Day Ave.	W/End Ave.	7 Day Ave
0:00	19	22	27	21	17	6	13	20	12	18
1:00	21	12	22	17	13	6	19	18	10	16
2:00	27	8	29	25	4	6	20	22	5	17
3:00	46	46	50	59	12	10	36	47	11	37
4:00	190	184	194	206	38	17	240	203	28	153
5:00	243	232	225	203	72	19	210	223	46	172
6:00	276	264	291	249	62	36	231	262	49	201
7:00	263	212	237	237	99	62	270	244	81	197
8:00	208	268	186	224	130	76	210	219	103	186
9:00	207	186	227	196	162	109	193	202	136	183
10:00	145	192	145	186	149	107	155	165	128	154
11:00	165	166	158	183	141	124	161	167	133	157
12:00	199	198	195	178	186	149	170	188	168	182
13:00	209	250	240	289	168	169	287	255	169	230
14:00	227	228	215	254	164	193	212	227	179	213
15:00	280	228	252	286	169	137	221	253	153	225
16:00	258	243	248	249	123	139	205	241	131	209
17:00	184	165	166	173	98	121	164	170	110	153
18:00	94	111	121	152	86	103	96	115	95	109
19:00	102	95	117	127	51	74	87	106	63	93
20:00	55	65	77	84	24	55	48	66	40	58
21:00	65	34	41	54	34	33	34	46	34	42
22:00	14	20	28	41	22	20	28	26	21	25
23:00	18	14	15	19	13	17	19	17	15	16
Total	3515	3443	3506	3712	2037	1788	3329	3501	1913	3047


Summary

	from	to	
AM Peak	6:00 AM	7:00 AM	291
PM Peak	1:00 PM	2:00 PM	289
Week Day Average			3501
Weekend Day Average			1913
7 Day Average			3047

ATTACHMENT C

TRAFFIC GENERATION INFORMATION



Preliminary Solar Farm Vehicle Movement Guidance

27/03/2020

1 Traffic Generated by Construction Works

During the construction of the solar farm, it is estimated that approximately 50 x 40 ft containers will be transported to site. Added to these containers are waste traffic, equipment, temporary installations and workforce transport to and from site. A logistics agent will be engaged to manage the freight from the delivery port [TBC] to the solar farm site.

An estimation of the traffic created by the worksite is provided in Figure 1, below.

The vehicular traffic for the transport vehicles is based on a 3-axle rigid truck. The General Mass Limit (GML) for a 3-axle load is assumed to be 20 tonnes based on The Australian Trucking Association's 'Technical Advisory Procedure for Truck Configurations' [24]. Depending on the availability of vehicles it may be possible that a conventional B-doubles will transport equipment to site. The GML for this vehicle is 40 tonnes. In this case the vehicular traffic for the container loads will reduce by a factor of 2 for each B-double transporting equipment to site.

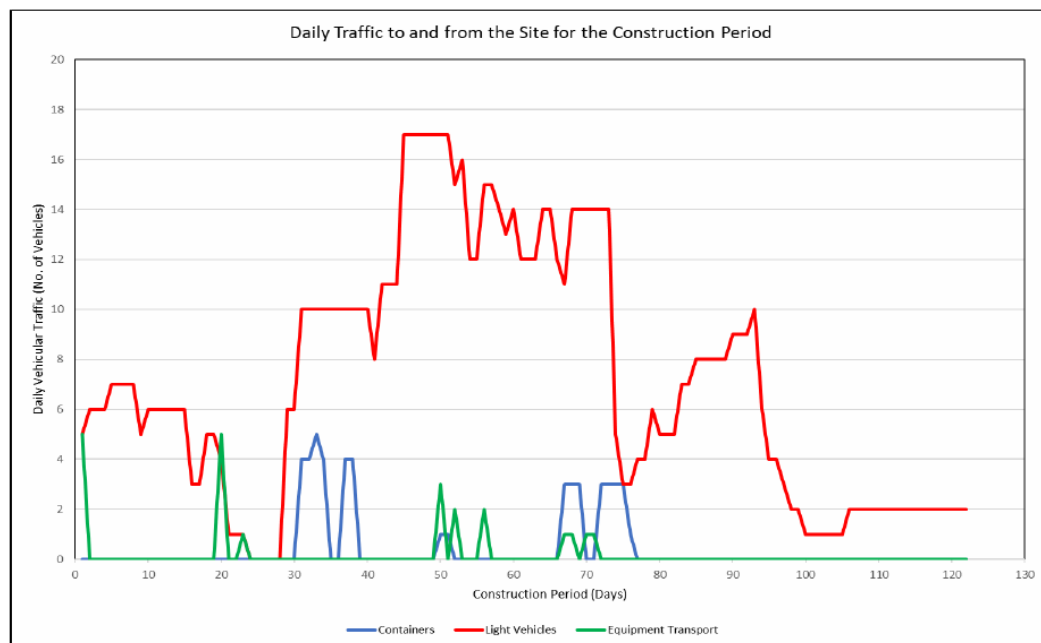


Figure 1 - Daily Traffic to and from Site for the Construction Period

At the peak of the equipment supply, the number of transport vehicles entering and leaving the solar farm site will be 4 to 5 daily for a period of just over a month into the construction period. There will be another busy week midway through the construction period where there will be approximately 3 transport vehicles entering and leaving the site daily.

All heavy transport to and from the site will predominantly be on standard working days between 8am and 4pm.



It is anticipated that there will be up to 30 personnel working on the site during the construction period that will generate the anticipated light vehicle traffic.

The light traffic will be concentrated at the beginning and the end of the day around 6-7am and 4-5pm. The container transport will be concentrated between 10am and 3pm.

2 Impact on Existing Traffic

With a maximum of eight to ten light vehicles and six to eight heavy vehicles travelling to and from the site daily, it is not anticipated that the increased traffic due to construction works will have any significant impact on the existing traffic.

3 Additional Road Signage of Existing Road

It is suggested that road signage is provided for the proposed site entrance on Manilla Road. The recommended locations of the warning signs be placed at distances of 200 metres approaching the intersection to the north and south. The warning signs will indicate that it is a construction site entrance. The entrance to the site on Mannum Road will be designed for the anticipated heavy transport loads volumes during the construction period that are detailed in Section 1. A Traffic Control Plan will be submitted to the DPTI Traffic Management Centre for approval, with all signage to be placed and maintained to the satisfaction of the Commissioner of Highways.

4 Parking

All parking for site personnel will be on site. This will be sign posted at the site entrance. Balance will not permit parking on Mannum Road and will incorporate this in the site induction.

5 O&M Traffic

Once the solar farm has been constructed and has entered the “operations and maintenance” stage the traffic onto site will consist of light vehicles, with few exceptions, at a frequency of 1 to 5 visits per fortnight.

5MW Solar Farm - Typical Vehicle Movements			
Construction - Major Equipment	Load	Quantity	Comments
Piling & Tracker Components	40' Container / Trailer	24	Doubles if permitted / practical
PV Modules	40' Container / Trailer	26	Doubles if permitted / practical
Switchgear	20' Container / Trailer	1	
Inverters	20' Container / Trailer	2	
Cranes	~50T	3	
Cables	40' Container / Trailer	2	Doubles if permitted / practical
Balance of Plant (BOP)	40' Container / Trailer	3	
Civil Plant	Float or Drop Deck	8	4ea at mob / demob
Piling Plant	Float or Drop Deck	4	2ea at mob / demob
Site Facilities	Float/Drop Deck/40' Trailer	8	4ea at mob / demob
Light trucks - 6 wheelers	local deliveries - sand, gen fteight etc	10	
Light trucks - 4 wheelers	local deliveries - sand, gen fteight etc	10	
		101	
Construction - Light Vehicles / Other	Load	Quantity	Comments
Light Vehicle - 4WD ute or similar	Personell / tools	384	Average 4 per day
Light Vehicle - ?	Workforce private vehicles	576	Average 6 per day - depends on engagement of workforce
		960	
O&M	Load	Quantity	Comments
Light Vehicle - 4WD ute or similar	fortnightly inspection	30	1 per fortnight, plus additional
Light Vehicle - 4WD ute or similar	3 monthly Inspections	8	2 visits, 4 times per year
Light Vehicle - 4WD ute or similar	Faults	4	
Light trucks - 4 wheelers	PV Module cleaning	2	Once per Year
		44	

ATTACHMENT D

SIDRA SUMMARY TABLES

MOVEMENT SUMMARY

▽ Site: 101 [2020AM]

Oxley Highway / Country Road T-intersection Westdale
 March 2020 counts
 Site Category: (None)
 Giveaway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Country Road												
1	L2	4	10.0	0.004	6.4	LOS A	0.0	0.1	0.28	0.54	0.28	52.3
3	R2	9	10.0	0.016	9.1	LOS A	0.1	0.4	0.50	0.66	0.50	50.4
Approach		14	10.0	0.016	8.3	LOS A	0.1	0.4	0.43	0.62	0.43	51.0
East: Oxley Highway												
4	L2	12	10.0	0.007	5.7	LOS A	0.0	0.0	0.00	0.57	0.00	53.2
5	T1	183	10.0	0.100	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		195	10.0	0.100	0.3	NA	0.0	0.0	0.00	0.03	0.00	59.5
West: Oxley Highway												
11	T1	218	10.0	0.099	0.0	LOS A	0.0	0.2	0.01	0.01	0.01	59.9
12	R2	3	10.0	0.099	6.6	LOS A	0.0	0.2	0.01	0.01	0.01	57.7
Approach		221	10.0	0.099	0.1	NA	0.0	0.2	0.01	0.01	0.01	59.8
All Vehicles		429	10.0	0.100	0.5	NA	0.1	0.4	0.02	0.04	0.02	59.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

▽ Site: 101 [2020PM]

Oxley Highway / Country Road T-intersection Westdale

March 2020 counts

Site Category: (None)

Giveaway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Country Road												
1	L2	2	10.0	0.002	6.3	LOS A	0.0	0.1	0.27	0.53	0.27	52.4
3	R2	11	10.0	0.022	10.9	LOS A	0.1	0.6	0.56	0.72	0.56	49.2
Approach		13	10.0	0.022	10.2	LOS A	0.1	0.6	0.51	0.69	0.51	49.7
East: Oxley Highway												
4	L2	13	10.0	0.007	5.7	LOS A	0.0	0.0	0.00	0.57	0.00	53.2
5	T1	171	10.0	0.093	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		183	10.0	0.093	0.4	NA	0.0	0.0	0.00	0.04	0.00	59.5
West: Oxley Highway												
11	T1	360	10.0	0.160	0.0	LOS A	0.0	0.1	0.00	0.00	0.00	60.0
12	R2	1	10.0	0.160	6.6	LOS A	0.0	0.1	0.00	0.00	0.00	57.8
Approach		361	10.0	0.160	0.0	NA	0.0	0.1	0.00	0.00	0.00	60.0
All Vehicles		557	10.0	0.160	0.4	NA	0.1	0.6	0.01	0.03	0.01	59.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

▽ Site: 101 [2020AM + construction traffic]

Oxley Highway / Country Road T-intersection Westdale

March 2020 counts

Site Category: (None)

Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Country Road												
1	L2	4	10.0	0.004	6.4	LOS A	0.0	0.1	0.28	0.54	0.28	52.3
3	R2	24	10.0	0.042	9.4	LOS A	0.2	1.2	0.51	0.70	0.51	50.2
Approach		28	10.0	0.042	9.0	LOS A	0.2	1.2	0.48	0.68	0.48	50.5
East: Oxley Highway												
4	L2	37	10.0	0.021	5.7	LOS A	0.0	0.0	0.00	0.57	0.00	53.2
5	T1	183	10.0	0.100	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		220	10.0	0.100	1.0	NA	0.0	0.0	0.00	0.10	0.00	58.7
West: Oxley Highway												
11	T1	218	10.0	0.099	0.0	LOS A	0.0	0.2	0.01	0.01	0.01	59.9
12	R2	3	10.0	0.099	6.8	LOS A	0.0	0.2	0.02	0.01	0.02	57.7
Approach		221	10.0	0.099	0.1	NA	0.0	0.2	0.01	0.01	0.01	59.8
All Vehicles		469	10.0	0.100	1.0	NA	0.2	1.2	0.03	0.09	0.03	58.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

▽ Site: 101 [2020AM + construction traffic sensitivity]

Oxley Highway / Country Road T-intersection Westdale

March 2020 counts

Site Category: (None)

Giveway / Yield (Two-Way)

Flow Scale Analysis (Upper Limit): Results for Flow Scale (chosen as largest for any movement) = 124.0 %

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Country Road												
1	L2	5	10.0	0.005	6.6	LOS A	0.0	0.1	0.32	0.55	0.32	52.2
3	R2	30	10.0	0.062	10.9	LOS A	0.2	1.7	0.56	0.77	0.56	49.2
Approach		35	10.0	0.062	10.3	LOS A	0.2	1.7	0.53	0.74	0.53	49.6
East: Oxley Highway												
4	L2	46	10.0	0.026	5.7	LOS A	0.0	0.0	0.00	0.57	0.00	53.2
5	T1	227	10.0	0.124	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		273	10.0	0.124	1.0	NA	0.0	0.0	0.00	0.10	0.00	58.7
West: Oxley Highway												
11	T1	270	10.0	0.122	0.0	LOS A	0.0	0.3	0.02	0.01	0.02	59.9
12	R2	4	10.0	0.122	7.1	LOS A	0.0	0.3	0.02	0.01	0.02	57.7
Approach		274	10.0	0.122	0.1	NA	0.0	0.3	0.02	0.01	0.02	59.8
All Vehicles		582	10.0	0.124	1.1	NA	0.2	1.7	0.04	0.09	0.04	58.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

▽ Site: 101 [2020PM + construction traffic]

Oxley Highway / Country Road T-intersection Westdale

March 2020 counts

Site Category: (None)

Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Country Road												
1	L2	2	10.0	0.002	6.3	LOS A	0.0	0.1	0.27	0.53	0.27	52.4
3	R2	36	10.0	0.077	11.4	LOS A	0.3	2.1	0.58	0.79	0.58	48.9
Approach		38	10.0	0.077	11.1	LOS A	0.3	2.1	0.56	0.78	0.56	49.1
East: Oxley Highway												
4	L2	27	10.0	0.016	5.7	LOS A	0.0	0.0	0.00	0.57	0.00	53.2
5	T1	171	10.0	0.093	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		198	10.0	0.093	0.8	NA	0.0	0.0	0.00	0.08	0.00	58.9
West: Oxley Highway												
11	T1	360	10.0	0.160	0.0	LOS A	0.0	0.1	0.00	0.00	0.00	60.0
12	R2	1	10.0	0.160	6.7	LOS A	0.0	0.1	0.00	0.00	0.00	57.8
Approach		361	10.0	0.160	0.0	NA	0.0	0.1	0.00	0.00	0.00	60.0
All Vehicles		597	10.0	0.160	1.0	NA	0.3	2.1	0.04	0.08	0.04	58.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

 **Site: 101 [2020PM + construction traffic - sensitivity]**

Oxley Highway / Country Road T-intersection Westdale

March 2020 counts

Site Category: (None)

Giveaway / Yield (Two-Way)

Flow Scale Analysis (Upper Limit): Results for Flow Scale (chosen as largest for any movement) = 124.0 %

Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Country Road												
1	L2	3	10.0	0.003	6.5	LOS A	0.0	0.1	0.30	0.54	0.30	52.3
3	R2	44	10.0	0.120	14.0	LOS A	0.4	3.3	0.67	0.86	0.67	47.3
Approach		47	10.0	0.120	13.5	LOS A	0.4	3.3	0.65	0.85	0.65	47.5
East: Oxley Highway												
4	L2	34	10.0	0.020	5.7	LOS A	0.0	0.0	0.00	0.57	0.00	53.2
5	T1	211	10.0	0.115	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		245	10.0	0.115	0.8	NA	0.0	0.0	0.00	0.08	0.00	58.9
West: Oxley Highway												
11	T1	446	10.0	0.198	0.0	LOS A	0.0	0.1	0.00	0.00	0.00	60.0
12	R2	1	10.0	0.198	7.1	LOS A	0.0	0.1	0.00	0.00	0.00	57.8
Approach		448	10.0	0.198	0.0	NA	0.0	0.1	0.00	0.00	0.00	60.0
All Vehicles		740	10.0	0.198	1.1	NA	0.4	3.3	0.04	0.08	0.04	58.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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WASTE MANAGEMENT PLAN

Establishment of Solar PV Power Generation Plant

329 Country Road, Warral NSW 2340

PREPARED FOR PROVIDENCE ASSET GROUP | DECEMBER 2020



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Address: 329 Country Road, Warral NSW 2340

Proposal: Establishment of Solar PV Power Generation

OBJECTIVES FOR THE WASTE MANAGEMENT ON THIS SITE

- + To minimise resource requirements and construction waste through reuse and recycling; and the efficient selection and ordering of resources.
- + To ensure the waste management systems are compatible with the relevant waste collection services.

The management of waste is addressed in this WMP in the following sections, according to the stages of the development:

- + Site preparation and construction; and
- + Ongoing operation.

1 SITE PREPERATION AND CONSTRUCTION STAGE

Construction waste will be separated on site by builder's contractors and builder's laborer's during the construction stage.

The site manager will erect a sign on site for waste areas and will inform the builder's staff where material is to be collected for recycling, and will set aside on site an area to store the recyclable materials for transportation to local recycling plants. The site manager and/or builder will impose the execution of the waste separation policy on a regular basis and to have on-going checks.

Stockpiles shall be located and managed appropriately to prevent sediment runoff and ensure minimal environmental impact from the building site.

A suitable all-weather vehicular access points shall be provided for the construction phase, and all sediment and erosion control devices implemented on site prior to commencement of construction works.

Type of waste generated	Estimates Volume in m ³ or area m ² or weight in tonne (t)	Reuse and Recycling		Disposal
		On-Site	Off-Site	
Excavated Material	<10m ³	Possible reuse of soil onsite.	Un-recyclable excavated material to be disposed at local waste facility.	
Metal (Ferrous) Eg. Steel	3t		Sent to local metal recycler by contractor.	
Metal (Non-ferrous) Eg. Aluminium	<1t		Sent to local metal recycler by contractor.	
Packaging (Wood) Eg. Pallets, dunnage	39.5t		Reuse by logistics contactor. Broken directed to recycler.	
Packaging (Other) (Plastic, cardboard etc)	4.8t		Cardboard/paper sent to recycler by contractor.	Disposed of at local waste facility by contractor
Green Waste	<8t		Directed for green waste reuse by local recycler.	
Other waste e.g. pvc plastics, paint, paper / cardboard	<2t	-		Disposed of at local waste facility by contractor

2 OPERATION STAGE

Staff will separate general waste and recyclables within the waste storage / management area. A minimum of two separate bins (general and recycle bins) will be located within the waste area. Waste and recycling bins will be clearly labelled and identifiable. The bins and waste storages areas will be cleaned by staff with protective gloves as required.

Type of waste generated	Estimated Volume per week	Reuse and Recycling		Disposal
		On-Site	Off-Site	
Food and General Waste	20L			Disposed of at local landfill by waste contractor on an as needs basis
Recyclable Waste	20L			Disposed of at local recycle plant by waste contractor on an as needs basis
Green Waste	20L			Disposed of at local recycle plant by waste contractor on an as needs basis