APPENDIX E VISUAL IMPACT ASSESSMENT

Visual Impact Assessment

PARKES SOLAR FARM

MARCH 2016

Document Verification

Project Title: Parkes Solar Farm

Project Number:	6495
Project File Name:	parkes via final v1.1.docx

Revision	Date	Prepared by (name)	Reviewed by (name)	Approved by (name)
Draft V1	23/12/15	Brooke Marshall	Jenny Walsh	Brooke Marshall
Final V1	8/03/16	Brooke Marshall (minor changes)		Brooke Marshall
Final V1.1	15/03/16	Brooke Marshall (minor changes)		Brooke Marshall

NGH Environmental Pty Ltd (ACN: 124 444 622. ABN: 31 124 444 622) and NGH Environmental (Heritage) Pty Ltd (ACN: 603 938 549. ABN: 62 603 938 549) are part of the NGH Environmental Group of Companies.

www.nghenvironmental.com.au e ngh@nghenvironmental.com.au

Sydney Region
18/21 mary st
surry hills nsw 2010 (t 02 8202 8333)

Canberra - NSW SE & ACT
unit 17/27 yallourn st (po box 62)
fyshwick act 2609 (t 02 6280 5053)

Wagga Wagga - Riverina and Western NSW
suite 1, 39 fitzmaurice st (po box 5464)
wagga wagga nsw 2650 (t 02 6971 9696)

Newcastle - Hunter and North Coast
153 tudor st
hamilton nsw 2303 (t 02 4969 4910)

Bega - ACT and South East NSW
suite 1, 216 carp st (po box 470)
bega nsw 2550 (t 02 6492 8333)

Bathurst - Central West and Orana
35 morrisset st (po box 434)
bathurst nsw 2795 (m 0448 820 748)

CONTENTS

TABLES

FIGURES

1 INTRODUCTION

NGH Environmental completed a visual impact assessment of the proposed Parkes Solar Farm, located approximately 10 kilometres north west of Parkes in central New South Wales (refer Appendix A.1). This report has been prepared on behalf of the proponent, Neoen Australia (Neoen) to assess the potential visual impacts of the proposed Parkes Solar Farm. Visual amenity values and visual impacts are subjective, therefore the assessment included a transparent systematic evaluation to address subjectivity as much as possible.

1.1 PROJECT OVERVIEW

The Parkes Solar Farm would be a commercial scale solar photovoltaic (PV) plant which would produce up to 57 megavolt-ampere (MVA) of electricity. The site covers approximately 240 hectares of land and the layout of the proposed solar farm is provided in Appendix A.2.

Key infrastructure components would include:

- Solar arrays: approximately 215,000 solar panels supported by approximately 27,000 piles, driven or screwed into the ground in order to support the solar array's mounting system. The panels to be installed would be either:
    - single-axis tracking panels (which would have approximately 2,850 tracker units)
    - north-oriented fixed-tilt panels
    - east-west facing fixed-tilt panels
    - or a combination of these alternatives.
- Approximately 28 PV boxes or PV skids (either containerised or installed on a 'skid' platform), each of them containing an inverter and an 11kV, 22kV or 33kV transformer.
- Onsite cabling and electrical connections between solar arrays and panel inverters.
- One delivery station in a container or on a skid platform.
- Cables and trenches.
- Internal access tracks to allow for site maintenance vehicles, and gravel access road and parking for staff and visitors.
- Staff amenities and offices.
- Perimeter security fencing, approximately 2.3m high.
- Vegetation buffer.
- A 66kV overhead or underground power line to connect into the existing Parkes Transgrid substation, approximately 600 metres (m) north of the site.

Environmental assessment in accordance with Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) is required for the proposal. The Secretary's Environmental Assessment Requirements (SEARs), provided by NSW Department of Planning and Environment (DPE) on 9 December 2014, specify the impacts to be considered in the environmental assessment, including visual impacts.

1.2 SITE CONTEXT

The site proposed for the solar farm is located to the south of Henry Parkes Way, a high use transport corridor. It is located east of Pat Meredith Drive, a low use unsealed road. An existing Transgrid substation is located at the corner of Henry Parkes Way and Pat Meredith Drive.

Two residences (one is project-involved) are located in close proximity (within 1km) of the site. The site is currently used as grazing and cropping land and is surrounded by similar land uses. Henry Parkes Way, and

to a lesser extent Pat Meredith Drive, have extensive roadside vegetation established within the road corridors.

1.3 OBJECTIVES OF THIS REPORT

This Visual Impact Assessment includes a full assessment of the visual impacts associated with the proposed Parkes Solar Farm. It includes an assessment of:

- Landscape character and scenic vistas (including significant or sensitive vistas).
- Stakeholder values regarding visual amenity.
- Potential impacts on representative viewpoints, including residences and road corridors.

Specifically, this report addresses the SEARs for the proposed Parkes Solar Farm as shown in Table 1-1.

Table 1-1 Secretary's Environmental Assessment Requirements for visual impact assessment of the Parkes Solar Farm

Requirement	Addressed in this report
Provide an assessment of the landscape character and values and any scenic or significant vistas of the area potentially affected by the development. This should describe community and stakeholder values of the local and regional visual amenity and quality, and perceptions of the development, based on surveys and consultation.	Landscape character is described in Section 3.4. Significant vistas in the locality are discussed in Section 3.2, with reference to community values and perceptions.
Include a full assessment of the visual impacts associated with the solar farm including identification and documentation of all key viewing points and corridors particularly from identified sensitive lands. This should include the transmission line. Alternative pole designs should be presented and assessed and potential for undergrounding in sensitive locations should be assessed.	Visual impacts are evaluated and discussed in Section 5.2. This includes reference to all key viewing points and sensitive areas identified in Section 3.2. This includes consideration of the transmission line Section 4.
Provide an assessment of the reflectivity from the panels and associated infrastructure and any safety impacts for motorists and aircraft.	Visual impacts, including reflectivity and impacts to motorists and aircraft are discussed in Section 4.

Requirement	Addressed in this report
Include photomontages of the development taken from potentially affected residences (including approved by not yet developed dwellings or subdivisions with residential rights), settlements and significant public view points, and provide a clear description of proposed visual amenity mitigation and management measures for the solar farm.	Potentially affected residential receivers were determined with reference to Zone of Visual Influence modelling (Appendix B), aerial photo interpretation and ground truthing. Representative viewpoints showing the scale of infrastructure from these locations are provided in Section 5.2 and Appendix E. No montages have been prepared but panoramic photographs are used to understand the visual extent of the impacts from key viewpoints. Clear mitigation measures are set out in Section 6.
Provide an assessment of the feasibility, effectiveness and reliability of proposed mitigation measures and any residual impacts after these measures have been implemented.	The feasibility, effectiveness and reliability of proposed mitigation measures are discussed in Section 6. The mitigation strategy (including a post construction Visual Verification Report) ensures that actual and not potential impacts will be addressed, increasing the reliability of the strategy.

1.4 TERMINOLOGY

Terminology used in this report includes:

Study area — Defined as within 16km of the proposed solar farm site.

Solar farm site / site — The lot boundaries within which the solar farm development is proposed, excluding offsite infrastructure such as access upgrades or transmission lines and connections.

Project — All infrastructure and activities required for the construction, operation and decommissioning of the solar farm.

Landscape Character Unit (LCU) — LCUs take into account topography, vegetation, land use, and other distinct landscape features. They are a way to categorise the existing scenic quality of the receiving environment and consider the ability of the environment to absorb visual change at the landscape scale.

Landscape Management Zone (LMZ) — LMZs are derived by combining scenic quality with viewer sensitivity and proximity to the proposed infrastructure at the landscape scale. A three-tiered management hierarchy sets out appropriate management objectives for each zone.

Zone of Visual Influence (ZVI) — ZVI modelling uses GIS modelling and topography to determine areas which would be shielded from views of infrastructure at the proposed solar site. It does not take into account other existing or proposed screening features such as vegetation or built structures.

2 METHODOLOGY

2.1 OVERVIEW

The visual impact assessment has been completed in the following stages:

- Background investigations, mapping and modelling.
- Field survey including reconnaissance, ground truthing and photography.
- Community consultation.
- Impact assessment.
- Development of a visual impact mitigation strategy.

These methods are detailed below.

2.2 BACKGROUND INVESTIGATIONS, MAPPING AND MODELLING

Background investigations included identifying key landscape features within the landscape that may be affected by the visual impacts of the proposed solar farm. This was done using existing literature, tourism information, topographic maps and aerial photos.

Mapping and modelling were undertaken to:

- Identify and classify LCUs within 16km of the proposed solar farm. This was done based on aerial imagery and lot zoning information. LCUs are a way to summarise differences in landscape amenity and the sensitivity of different areas within the landscape to visual impacts.
- Define areas in which the infrastructure may be visible, using ZVI modelling. A map identifying the ZVI (or viewshed) of the proposal was produced. This method uses topographic information to determine areas in which views of infrastructure would not be visible. The infrastructure was modelled as a 3m high rectangular block, equivalent to the project boundaries. Topography was based on a 25m resolution Digital Elevation Model (DEM) derived from 25m contours.
- Identify key viewpoints such as major travel routes, public recreation areas, potential receivers (dwellings and other structures), and built up areas. This step generally excluded areas deemed not to be visible from the ZVI modelling.
- Understand the feasibility of screening to mitigate visual impacts.

The results were used to inform the field survey.

2.3 FIELD SURVEY

With reference to the mapping and modelling, field reconnaissance and ground truthing was undertaken to:

- Verify and document the existing LCUs in the study area (16km).
- Document representative viewpoints within the LCUs.
- Understand the likely sensitivity of the LCUs to views of the proposed solar farm.

Fieldwork consisted of driving along major and minor roads, investigating views from key local landscape features and general views from different distances from the site and from within different LCUs. Photographs were taken at representative locations, including road sides and near to residences.

With the exception of Viewpoints 2 and 3, which occur within 1km of the site, photographs were not taken from private properties. Where photographs and panoramas were produced, these were generally taken from public roads, to maximise the view of the proposed solar farm site. Where possible, the horizontal extent of the solar array infrastructure was indicated on key viewpoint panoramas. View point locations are provided in Appendix B. Viewpoint panoramas are provided in Section 5 and Appendix E.

The property involved in the project (represented by Viewpoint 3) was not excluded from the assessment but is identified as involved in the assessment tables, Section 5.

2.4 COMMUNITY CONSULTATION

Community consultation specific to this assessment of visual impacts was required to:

- Understand how the community values existing visual amenity in the study area.
- Document the perceptions of the community to the proposed development.

Community consultation is being undertaken as part of the Development Application process, in accordance with a Community Consultation Plan. As part of the plan, respondents are being surveyed on their views regarding solar farm development and local visual amenity.

Specific questions relating to visual impacts were included in a feedback form distributed via:

- The project website.
- At a public information session to introduce the proposal, on 15 December 2015 in Parkes.
- Direct meetings and mail outs to near neighbours.

These questions related to:

- Local values, including views.
- Identification of views or landscape characteristics in the region and local area important to respondents.
- Perceptions and concerns about solar farm development.

The feedback form questions are included in Appendix C. The results are used in the identification of viewpoints and the impact assessment and are summarised in Section 3.3.2.

2.5 IMPACT ASSESSMENT AND DEVELOPMENT OF A MITIGATION STRATEGY

The impact assessment methodology used in this Visual Impact Assessment is based on the Bureau of Land Management (BLM) Visual Resource Management System, developed by the BLM, US Department of the Interior (n.d). The BLM developed a systematic process to analyse the visual impact of proposed developments. The basic philosophy states that the degree to which a development affects the visual landscape depends on the visual contrast imposed by the project.

Key steps undertaken to assess the visual impact are as follows:

- Define LMZs, for the representative viewpoints, based on:
    - The scenic quality of the study area's LCUs.
    - The expected sensitivity at representative viewpoints.
- Evaluate the degree of contrast the solar farm would result in at representative viewpoints and in consideration of the management objectives of the relevant LMZ.
- Determine the acceptability of the contrast with the management objectives of the relevant LMZ; this is the resultant visual impact, rated as high, medium or low.

Criteria for scenic quality, sensitivity, contrast and visual impact are included in the assessment, Section 5.

Mitigation measures are considered for impacts greater than medium visual impact; for a medium impact, the contrast is considered acceptable.

3 EXISTING ENVIRONMENT

3.1 STUDY AREA

Parkes was founded as a gold discovery settlement. Today, it provides an important contribution to agricultural output (primarily wheat and wool) and mining. Parkes and nearby townships offer a country lifestyle valued by its constituents. It is famous for the Parkes Observatory, and has an important role in the scientific community.

In addition to the Parkes Observatory, Bushmans Hill and the War Memorial Lookout, Goobang National Park, and Peak Hill open cut mine are local tourist attractions.

The study area is relatively flat, apart for the localised rises north and immediately east of the site and closer to Parkes.

3.2 SIGNIFICANT VISTAS

Scenic vistas in the study area and their distance from the site include:

- Bushmans Hill Reserve (8.7km), off the Newell Highway in Parkes, provides 360 degree views of the local area. Views to the proposed solar farm would be screened by topography (refer ZVI modelling, Appendix B) and due to distance.
- Memorial Hill Lookout (8.7km), off Bushman Street in Parkes. Views to the proposed solar farm would be screened by topography (refer ZVI modelling, Appendix B) and due to distance.

- Millers Lookout Road (2.4km) is a localised rise to the east of the proposed solar farm site. It is likely to provide full views of the proposed solar farm site, from the western side of the landform however, no public access road services the rise.
- Caloma lookout, Goobang National Park (26km) is located to the north east of the site, east of Parkes. While containing recreational areas and scenic lookouts, views to the proposed solar farm would be screened by topography (refer ZVI modelling, Appendix B) and due to distance.

Figure 3-1 provides examples of the vistas from Goobang National Park, Bushmans Hill, and Millers Lookout Road.

Figure 3-1 Scenic vistas in the study area

a) Caloma lookout, Goobang National Park Scenic Hill Reserve (Top) (Source: http://www.nationalparks.nsw.gov.au)
b) Bushman's Hill, looking toward proposed solar farm (Left)
c) Millers Lookout Road, viewed from the proposed solar farm site (Right)

3.3 COMMUNITY VALUES

3.3.1 General attitudes to solar infrastructure

Research indicates there is widespread support for solar energy as a source of energy for electricity generation in Australia (ARENA n.d); 78% of respondents are in favour of large scale solar energy facilities and 87% are in favour of domestic installations. The large scale solar energy sector is still at a relatively early stage of development in Australia, however. While most members of the community are aware of large scale solar energy, many do not know a great deal about their impacts (ARENA n.d.), including visual impacts.

Three approaches to improving community understanding of the visual impacts of large scale installations include:

- Provision of images (from many angles) of large scale solar facilities, particularly in the early stages of a proposal.
- Understanding the similarities between highly supported domestic scale installations and large scale facilities.
- Understanding the current function of the land proposed to hold the facility and the additional value the installation allows for.

(Source: extracted from ARENA n.d).

This report endeavours to address these issues.

3.3.2 Values of the local community to the proposal

Twelve people attended the Parkes Solar Farm information session held in Parkes on 15 December 2015. Only five feedback forms were returned; two by respondents less than 2km from the proposed solar farm site and three by respondents more than 5km from the proposed site.

- Views, community and family ties, work opportunities and recreational opportunities (such as sporting and nature-based activities) were selected equally as holding the most value for the local area (two respondents selected each item).
- All five respondents cited renewable energy generation as what they liked most about solar farms generally. Local economic opportunities (four respondents) and diversification of land use (three respondents) were also cited.
- One respondent cited potential visual impacts as a concern regarding solar farms generally.

Issues raised with specific reference to the proposed Parkes Solar Farm included:

- The proposal is a great initiative on local and environmental platforms.
- Views of cattle grazing land are an important visual characteristic of the local area.
- Memorial Hill is an important local view; contrasting town and country, particularly when crops are in season (canola and wheat).

Additionally, the project was presented at the Parkes Council Meeting of 15 December. The Council provided broad support at this meeting. No concerns were raised.

3.4 LANDSCAPE CHARACTER UNITS (LCU)

LCUs take into account topography, vegetation, land use, and other distinct landscape features. They are a way to summarise differences in the receiving environment that may affect the visual impact of the proposed solar farm at different locations.

Three key LCUs were identified within 16km of the proposed solar farm site:

- Agricultural.
- Residential (rural village, peri urban, suburban).
- Forests, woodlands, reserves.

Scenic quality is rated as follows:

- A high scenic quality rating describes areas with outstanding, unusual or diverse features.
- A moderate scenic quality rating applies to areas with the features and variety normally present in the character type.
- A low scenic quality rating is given for areas lacking features and variety.

The three LCUs identified within 16km of the proposed solar farm site are characterised in Table 3-1 in terms of their scenic quality.

Table 3-1 Landscape Characteristic Units within 16km of the Parkes Solar Farm

Landscape Character Unit	Key features
Agricultural	Cropped rectangular paddocks form a collection of worked agricultural areas. Wheat and other pasture crops on large landholdings are the dominant visual element. This results in a mosaic of large scale well-defined rectangular patches, from light green to grey, brown and yellow. Exposed earth, in paddocks and unsealed tracks, is a consistently hues of red. Graded roads are blue grey. The pastures are generally flat to slightly undulating. There are several rises that break up this pattern. The proposed solar farm site is located within this LCU. Pastures are dissected by road corridors, usually tree lined. Remnant vegetation survives in relatively isolated and sparse patches also breaking up the low pasture expanses. Rail way lines, powerlines along roadsides and through paddocks reinforce the linear patterns of the landscape and its key role as a production landscape. The powerlines, planted wind breaks and remnant tree cover where it occurs, provide rare vertical elements. Powerlines are relatively abundant in the study area (including an 11kv line onsite), with at least two lines either side of Pat Meredith Drive. The substation is located approximately 800m from the proposed solar farm site. Residences within this landscape are sparsely distributed and commonly screened with vegetation, presumably to separate the residential spaces from the farmland. Other infrastructure includes sheds and low open fences. Henry Parkes Way also features a sculpture promoting the Parkes Elvis festival. **Scenic quality is generally low. These areas are uniform in colour and form, lacking variety. Elements are production related. Existing infrastructure mostly includes powerlines, roads, rail way corridors and houses. This LCU is common in the study area.**






Landscape Character Unit	Key features
Residential	Parkes is a service centre and the major town in the study area. Residences in the centre and on the periphery of town are well maintained. Outlooks are generally broad, onto low relief rural views. Street trees are a common element, defining the built up areas. Gardens and lawns are vivid green with large feature trees. Roads are primarily sealed. Powerlines reinforce the linear pattern of the landscape. **Scenic quality is considered moderate. These areas have variety in colour and form normal in this character type. Elements include recreational aspects; parks and gardens. This LCU is common in the study area.**





Landscape Character Unit	Key features
Forests, woodlands, reserves	Gunningbland State Forest is located 9km west of the site. The forest structure provides a taller visual element. Deeper greens and dense vegetation create a more closed in landscape, experienced primarily from the road corridor. **Scenic quality is considered moderate. This area has variety in colour and is relatively rare in the study area. Elements include natural woodland and forest, although the area is used for production. This LCU is uncommon in the study area.**


3.5 VIEWPOINTS AND EXPECTED SENSITIVITY

The BLM methodology requires identification of representative viewpoints in the study area. These may be travel routes such as roads, waterways and recreational tracks, residential areas, tourist facilities, houses and farmland.

The predicted sensitivity of each viewpoint can be determined, considering its proximity to the proposed solar farm site and factors such as use, scenic quality and regional significance.

Criteria for proximity and sensitivity are as follows:

- Proximity to the proposed solar farm site:
    - Foreground 0 – 1 kilometres
    - Middle ground 1 – 5 kilometres
    - Background 5 – 16 kilometres
- Potential sensitivity to visual impact:
    - High sensitivity:
        - high use routes or areas
        - routes or areas of national or state significance
        - areas with high scenic quality
    - Moderate sensitivity:
        - moderate use routes or areas, or where the duration of view is moderate
        - routes or areas of regional or local significance
        - areas with moderate scenic quality
    - Low sensitivity:
        - low use routes or areas, or routes where the duration of view is short or which will be seen by few people
        - routes or areas of low local significance
        - areas with low scenic quality

The ZVI modelling produced a set of maps that estimated the areas that would be shielded from views of infrastructure at the proposed solar farm site, based on topography. . A height of 3m was used to model onsite infrastructure. This is realistic approximation of the height of panels and PV containers, which may actually be 2.3m and 3.4m, respectively. Viewpoints were not selected in areas predicted to be shielded

from views of the solar farm. Sixteen representative viewpoints were identified within the ZVI. The 16 viewpoints are described in Table 3-2 in terms of visual impacts from the proposed solar farm, with the viewpoint locations illustrated in Appendix B.

Generally, residences were assessed to have moderate sensitivity, even where residences are located in low use areas (off minor local roads) of low scenic quality (agricultural areas). It is noted that community members cited views of cattle grazing land and the changing crop colours as an important local value. The exception is one instance where a residence's formalised pool and garden face the direction of the proposed solar farm site; this was rated high sensitivity (Viewpoint 3). It is noted that, in agricultural areas, gardens and plantings have often been incorporated into house lots, most likely to provide shade as well as screening (views, dust, noise) from the adjacent farm lands.

Table 3-2 Representative viewpoints (ID) with reference to the Parkes Solar Farm proposal

Viewing ID	LCU	Scenic quality	Viewpoint	Proximity to proposal site	Sensitivity
1	Agricultural	Low	Road	Middle ground	High
2	Agricultural	Low	Residence	Foreground	Moderate
3 [1]	Agricultural	Low	Residence	Foreground	High
4	Agricultural	Low	Residence	Middle ground	Moderate
5	Agricultural	Low	Residence	Middle ground	Moderate
6	Agricultural	Low	Road	Foreground	Low
7	Agricultural	Low	Road	Middle ground	Moderate
8	Agricultural	Low	Road	Middle ground	Low
9	Agricultural	Low	Road	Middle ground	Low
10	Agricultural	Low	Road	Middle ground	Low
11	Urban	Moderate	Residence	Background	Moderate
12	Urban	Moderate	Park	Background	High
13	Urban	Moderate	Park	Background	High
14	Forestry	Moderate	State Forest	Background	Moderate
15	Agricultural	Low	Road	Background	Low
16	Agricultural	Low	Road	Foreground	Moderate

[1] Involved landowner.

4 VISUAL CHARACTERISTICS OF KEY INFRASTRUCTURE COMPONENTS

The key infrastructure components of the proposed Parkes Solar Farm, with reference to the stage of the project and the potential visual amenity impacts they may generate are discussed below and referenced in the visual impact assessment, Section 5.

4.1 INFRASTRUCTURE COMPONENTS

- Solar arrays: approximately 215,000 solar panels supported by approximately 27,000 piles, driven or screwed into the ground in order to support the solar array's mounting system. The panels to be installed would be either:
    - single-axis tracking panels (which would have approximately 2,850 tracker units)
    - north-oriented fixed-tilt panels
    - east-west facing fixed-tilt panels
    - or a combination of these alternatives.
- Approximately 28 PV boxes or PV skids (either containerised or installed on a 'skid' platform), each of them containing an inverter and an 11kV, 22kV or 33kV transformer.
- Onsite cabling and electrical connections between solar arrays and panel inverters.
- One delivery station in a container or on a skid platform.
- Cables and trenches.
- Internal access tracks to allow for site maintenance vehicles, and gravel access road and parking for staff and visitors.
- Staff amenities and offices.
- Perimeter security fencing, approximately 2.3m high.
- Vegetation buffer.
- A 66kV overhead or underground power line to connect into the existing Parkes Transgrid substation, approximately 600 metres (m) north of the site.

Ancillary facilities would be located within the site boundary and would include:

- Material laydown areas.
- Temporary construction site offices.
- Temporary car and bus parking areas for construction workers transportation. Once the plant has been commissioned a small car park would remain for the minimal staff required and occasional visitors.
- Permanent staff amenities. Once constructed, the plant would be monitored and operated remotely and would therefore require a minimum number of maintenance personnel to be onsite and only intermittently.

These components are discussed in terms of their visual impacts potential below.

4.1.1 Construction components

Construction impacts would be temporary, confined to approximately 9 months. Visual impacts could be generated during this time by:

- Development of site compound areas, site offices and stock piles, located within the site boundaries. Steel sheds can generate reflectivity and glare although would be a similar look to existing farm sheds. Material stockpiles may detract from visual amenity, particularly if dispersed across broad areas.
- Construction traffic will increase visual impacts and add to dust generation on Pat Meredith Drive (an unsealed road). Onsite parking areas would be visible from surrounding properties and from Pat Meredith Drive.
- Areas of bare soil created through grading or trenching cables could contribute to dust and detract from visual amenity until they are rehabilitated. These areas would be visible to surrounding properties and from Pat Meredith Drive.

4.1.2 Operational components

Operational impacts centre on the look of the solar farm, once construction is complete.

- The solar arrays would be no higher than 3m (more likely approximately 2.3m).
- Several different solar PV mounting technology options are still being considered:
    - North facing fixed tilt.
    - East-west facing fixed tilt (lower cost of installation and better density).
    - Single-axis trackers (lower density but higher yield).

  The mounting technology will affect the views of infrastructure; that is, whether panels or mountings are the dominant element from a specific viewing location.

  The potential for glare associated with non-concentrating photovoltaic systems which do not involve mirrors or lenses is relatively limited. PV solar panels are designed to reflect as little sunlight as possible (generally around 2% of the light received; Spaven Consulting 2011), resulting in negligible glare. The reason for this is that PV panels are designed to absorb as much solar energy as possible in order to generate the maximum amount of electricity or heat. The panels will not generally create noticeable glare compared with an existing roof or building surfaces (NSW Department of Planning 2010). Seen from above (such as from aircraft) they appear dark grey and do not cause a glare or reflectivity hazard. Solar photovoltaic farms have been installed on a number of airports around the world.

  Other onsite infrastructure that may cause glare or reflections depending on the sun angle, include:

    - Steel array mounting - array mounting would be steel or aluminium.
    - Temporary site offices, sheds, containerised PV boxes.
    - Permanent staff amenities.

  This infrastructure would be relatively dispersed and unlikely to present a glare or reflectivity hazard to motorists or aircraft.

- PV boxes or PV skids would contain the inverter and transformer stations and could measure up to 3.4m.

- Electricity cables would be installed between the array modules, either underground or mounted to the underside of the array, producing negligible additional visual impact.
- Either:
    - A 66kV line will be pulled from the delivery station of the solar farm to the Transgrid Parkes substation, approximately 600m to the north. The line will likely be installed overhead, situated to the west of the existing 33/66kV facilities owned by Transgrid. The existing Transgrid easement would be enlarged by approximately 20 meters. Poles would be concrete or steel and pole heights would be subject to Transgrid design but would be no higher than 20m and more likely, approximately 15m in height.

      OR

    - The line may be underground in the road reserve, in which case it would produce not additional visual impact.
- The substation is existing and would not have any additional visual impact.
- Fencing would be 2.3m high security fencing along the site boundaries. It is expected to be cyclone fencing with a strand of barbed wire at the top. While much higher than the array, the fence would not be solid. Views would be afforded beyond the fence.
- The main access to the site is via Henry Parkes Way onto Pat Meredith Drive. Minimal upgrades would result in negligible visual impact.
- An area for parking would be included within the site boundaries. This would accommodate a small number of vehicles and have negligible visual impact.

With the exception of the power poles, infrastructure would be of low height, less than 3m, and in this low relief landscape, relatively easily screened as part of the project. Examples of the look of some of the key infrastructure components are provided in Figure 4-1 below.

a) Driven piles, during construction.

b) Operational array - Example of single-axis tracking systems with multicrystalline modules.

c) Example of north-facing fixed-tilt mounting system with thin-film technology.

d) Example of east-west facing fixed-tilt mounting system with multicrystalline modules.

e) Overhead power pole design will be subject to Transgrid assessment and may differ from existing powerlines adjacent to Pat Meredith Drive.

f) Example of a PV box (contains an inverter and a transformer).

g) Example of a PV 'skid' (contains an inverter and a transformer).

Figure 4-1 Images representative of infrastructure components proposed

5 IMPACT ASSESSMENT

The visual impact assessment was undertaken considering the:

a) Infrastructure components proposed (set out in Section 4).
b) Their potential impact on landscape character units and representative viewpoints.
c) The degree of contrast the development would have within the identified Visual Landscape Management Zones and if these are considered acceptable.

Points b) and c) are addressed in Section 5-2.

This section defines the LMZs for the study area and assesses the contrast with the LMZ management objectives to determine the level of visual impact. The potential for mitigation is then discussed for higher impacted viewpoints, to reduce them to an acceptable medium or lower impact.

5.1 DEFINITION OF LANDSCAPE MANAGEMENT ZONES

Visual Landscape Management Zones (LMZ) were developed for the study area. These zones were derived by combining information about scenic quality (from the LCU, Section 3.2), viewer sensitivity and the distance of the area from viewpoints (section 3.3). Combined they produce a three-tiered management hierarchy: A – C, as shown in Table 5-1.

Table 5-1 Visual Landscape Management Zone decision matrix

		Proximity / sensitivity						
		Foreground High	**Middle ground High**	**Background High**	**Foreground Moderate**	**Middle ground Moderate**	**Background Moderate**	**Foreground Low**
Scenic quality	**High**	A	A	A	A	B	B	B
	Moderate	A	B	B	B	B	C	C
	Low	B	B	B	B	C	C	C

Each zone has associated objectives to guide management of visual change and to help evaluate proposed project impacts. These are shown in Table 5-2:

Table 5-2 Visual Landscape Management Zone management objectives

Management priority	Management objectives
A	Maximise retention of existing visual amenity. Landscapes are least able to absorb change. Developments may lead to a major change.
B	Maintain existing visual amenity, where possible. Protect dominant visual features. Developments may be allowed to be visually apparent.
C	Less importance for retaining existing visual amenity. Landscapes are able to absorb change. Developments may be allowed to dominate but should reflect existing forms and colours where possible.

5.2 VISUAL IMPACT ASSESSMENT AT REPRESENTATIVE VIEWING POINTS

5.2.1 Evaluation

The ratings for the degree of contrast created by the proposed solar farm infrastructure in each viewpoint have the following definitions (BLM n.d.).

- High contrast: the proposal would be dominant within the landscape and generally not overlooked by the observer, the visual change would not be absorbed.
- Medium contrast: the proposal would be moderately dominant and noticed, the visual change would be partially absorbed.
- Low contrast: the proposal would be seen but would not attract attention, the visual change would be well absorbed.
- Indistinct: contrast would not be seen or would not attract attention, the visual change would be imperceptible.

To determine if the objectives for the VLM zone are met, the contrast rating for the viewpoint is compared with the relevant management objectives to give a visual impact level. The visual impact level is consequently defined as:

- High impact: contrast is greater than what is acceptable.
- Medium impact: contrast is acceptable.
- Low impact: visual contrast is little or not perceived and is acceptable.

Table 5-3 below evaluates the representative viewpoints. They are ordered in terms of highest visual impact rating.

Figures 5-1 to 5-7 illustrate, where possible, the indicative horizontal extent of the view of solar array infrastructure from high and medium impact viewpoints.

Table 5-3 Visual impact at representative viewpoints with reference to the Parkes Solar Farm

View ID	Viewing opp.	Scenic quality	Proximity	Sensitivity	LMZ	Objective	Contrast	Visual Impact
2	**Residence**	**Low**	**Foreground**	**Moderate**	**B**	**Protect dominant visual features**	**High**	**High impact** Existing vegetation around the house will screen views from the residence itself to some extent. The contrast between the existing landscape and the infrastructure at this distance may be greater than acceptable however, given the 200 degree view potential. Mitigation should be considered for this residence. **Solar site vegetation screening is proposed and could effectivity mitigate this impact.**
3 [2]	Residence	Low	Foreground	High	B	Protect dominant visual features	Medium	Medium impact Existing vegetation between the residence and the proposed solar site will reduce the horizontal extent of the views considerably. The contrast between the existing landscape and the low level infrastructure at this distance is considered to be acceptable. Views could be reduced further by supplementing existing plantings on Pat Meredith Drive.
1	Road	Low	Middleground	High	B	Protect dominant visual features	Low	Medium impact Substantial existing vegetation along the road corridor will largely screen views for motorists. View durations would be short. The contrast is considered to be acceptable.
16	Road	Low	Foreground	Moderate	B	Protect dominant visual features	Medium	Medium impact Existing vegetation along the road corridor will reduce views for motorists. View durations would be short. The contrast is considered to be acceptable. However, views could be reduced further by supplementing existing plantings on Pat Meredith Drive.

[2] Involved landowner.

View ID	Viewing opp.	Scenic quality	Proximity	Sensitivity	LMZ	Objective	Contrast	Visual Impact
6	Road	Low	Foreground	Low	C	Reflect existing forms and colours	Medium	Medium impact Existing vegetation will limit the horizontal extent of the view. View durations would be short for motorists. The contrast is considered to be acceptable. However, views could be reduced further by plantings on the solar farm site.
13	Park	Moderate	Background	High	A	Maximise existing visual quality	Indistinct	Low impact The contrast is considered to be acceptable, no mitigation required.
12	Park	Moderate	Background	High	B	Protect dominant visual features	Indistinct	Low impact The contrast is considered to be acceptable, no mitigation required.
15	Road	Low	Background	Low	C	Reflect existing forms and colours	Indistinct	Low impact The contrast is considered to be acceptable, no mitigation required.
14	Park	Low	Background	Moderate	C	Reflect existing forms and colours	Indistinct	Low impact The contrast is considered to be acceptable, no mitigation required.
11	Residence	Moderate	Background	Moderate	C	Reflect existing forms and colours	Indistinct	Low impact The contrast is considered to be acceptable, no mitigation required.
8	Road	Low	Middleground	Low	C	Reflect existing forms and colours	Indistinct	Low impact The contrast is considered to be acceptable, no mitigation required.
10	Road	Low	Middleground	Low	C	Reflect existing forms and colours	Indistinct	Low impact The contrast is considered to be acceptable, no mitigation required.
7	Road	Low	Middleground	Moderate	C	Reflect existing forms and colours	Indistinct	Low impact The contrast is considered to be acceptable, no mitigation required.

View ID	Viewing opp.	Scenic quality	Proximity	Sensitivity	LMZ	Objective	Contrast	Visual Impact
9	Road	Low	Middleground	Low	C	Reflect existing forms and colours	Low	Low impact The contrast is considered to be acceptable, no mitigation required.
5	Residence	Low	Middleground	Moderate	C	Reflect existing forms and colours	Low	Low impact The contrast is considered to be acceptable, no mitigation required.
4	Residence	Low	Middleground	Moderate	C	Reflect existing forms and colours	Medium	Low impact The contrast is considered to be acceptable, no mitigation required.

Figure 5-1 Extent of views of infrastructure for highly affected viewpoint: View point 2 HIGH IMPACT (view to south east)

Existing vegetation around the house would screen views from the residence itself to some extent. The contrast between the existing landscape and the infrastructure at this distance may be greater than acceptable however, given the 200 degree view potential. Mitigation should be considered for this residence.

Figure 5-2 Extent of views of infrastructure for highly affected viewpoint: View point 2 HIGH IMPACT (view to south)

Figure 5-3 Extent of views of infrastructure for highly affected viewpoint: View point 2 HIGH IMPACT (view to south west)

Figure 5-4 Extent of views of infrastructure for medium affected viewpoint: View point 1 MEDIUM IMPACT

Substantial existing vegetation along the road corridor will largely screen views for motorists. View durations would be short.

Figure 5-5 Extent of views of infrastructure for medium affected viewpoint: View point 3 MEDIUM IMPACT

The indicative depth of the panels is shaded in the background. Existing vegetation between the residence and the proposed solar site will reduce the horizontal extent of the views considerably.

Figure 5-6 Extent of views of infrastructure for medium affected viewpoint: View point 6 MEDIUM IMPACT

The indicative depth of the panels is shaded in the background. Existing vegetation will limit the horizontal extent of the view. View durations would be short for motorists.

Figure 5-7 Extent of views of infrastructure for medium affected viewpoint: View point 16 MEDIUM IMPACT

The indicative depth of the panels is shaded in the background. Existing vegetation along the road corridor will reduce views for motorists. View durations would be short.

5.2.2 Results summary

High impact - mitigation required

Highest impacts are seen for one residence in closest proximity to the site. It is represented by Viewpoint 2 (panorama presented in Figures 5.1 – 5.3). While it occurs in a low use area (off a minor road) and existing vegetation will to some extent screen views to the proposed solar farm site from the residence itself, there would be dominant views of infrastructure from many areas of the yard. The form of the infrastructure, low (<3m) and in rectangular arrays, is not incongruous with the existing low lying rectangular forms in this agricultural areas however, screening as a mitigation strategy should be implemented for this viewpoint.

A suggested screening plan has been developed (refer Appendix D) to specifically consider views to this residence. This is discussed further in Section 6.1

Medium impact – mitigation could be considered

Medium impacts are seen for four viewpoints located further from the site, where intervening trees obscure the view such that the low height infrastructure proposed is not likely to be dominant. These are represented by Viewpoints 1, 3, 6 and 16 (panorama presented in Figures 5.4 – 5.7).

While impacts are considered acceptable, further minimisation of impacts would be feasible, by supplementing existing plantings on Pat Meredith Drive or providing some boundary plantings on the solar farm site. Suggested screening is provided in Appendix D and discussed further in Section 6.1. Additionally, general design measures have been recommended that would further lessen the contrast of the infrastructure from these locations.

Low impact – no mitigation

Low impacts are seen for roads and residences, parks and forestry reserves in the middle and background where views of the solar farm infrastructure would be difficult to perceive or indistinct. No mitigation is required for these locations.

5.3 CUMULATIVE IMPACTS

Adverse cumulative impacts occur when the infrastructure or activities at the proposal site exacerbate the negative impacts of other infrastructure or activities occurring nearby.

During construction, the additional traffic impact is probably the greatest potential for cumulative visual impacts. The Henry Parkes Way is a high use road corridor carrying a large proportion of heavy vehicles, particularly in harvest periods. The visual impact of increased traffic movements to the site would be predominantly limited to construction (approximately 9 months). During operation, excepting unusual maintenance operations such as inverter or transformer replacement, a small maintenance team using standard vehicles are all that will be required.

The operational view of the solar farm may generate a cumulative impact with the existing substation and powerlines. While the substation is relatively well screened by tree plantings, both facilities would have security fencing and steel dominated infrastructure and be visible from the Henry Parkes Way – Pat Meredith Drive intersection. The additional powerlines would exacerbate an already dominant view of powerlines in some locations. This would not affect any residences due to existing vegetation screening and topography. View durations would be short and considered acceptable, however mitigation strategies have been recommended to reduce impacts where possible.

It is possible another large scale development could be approved within view of the proposed solar farm, however none are known to be proposed at this time.

Generally, adverse cumulative visual impacts are anticipated to be manageable due to the ability to effectively screen infrastructure in this low relief landscape.

6 MITIGATION MEASURES

A Visual Impact Management Plan is recommended to address the 'as built' visual impacts of the proposed solar farm. The plan would include:

- Screening (either onsite or offsite) for viewers for which a high level of impact is confirmed. This would be aimed at 'breaking up' not blocking views of onsite infrastructure. It may include additional screening for specific medium impact viewpoints to further minimise views.
- General methods to reduce visual impact. This would centre on the colour and form of infrastructure, to reduce the overall visual contrast of the project.
- Verification of predicted and actual impacts. This would improve the reliability of the measures and provide a trigger to undertake additional mitigation if required.

These measures are outlined below. They are considered feasible, in that the proponent has agreed the measures can be implemented as part of the project. They are considered effective, as the measures would be implemented post construction and in consultation with affected landholders (where relevant). It is noted that vegetation screens can take time to grow, grow differently than expected or expire before effective height is achieved. Furthermore, the as built infrastructure may differ from that assessed in this report, predicted impacts may be found to be different to actual impacts. For this reason, a verification process is included in the plan.

6.1 SCREENING

6.1.1 Screen location

One residence has been identified with potential for a high level impact; Viewpoint 2. Onsite planting within the solar farm boundaries is expected to screen views effectively for this receiver. A suggested onsite planting layout is provided in Appendix D.

Additionally, medium impacts could be reduced further at three viewpoints located further from the site; Viewpoints 3, 6 and 16. While impacts are considered acceptable, further minimisation of impacts would be highly feasible, by supplementing existing plantings on Pat Meredith Drive and providing some boundary plantings on the solar farm site. Suggested screening is provided in Appendix D.

6.1.2 Screen requirements

- Plantings would be more than one row deep and be located on the outside of the security fence, so that it breaks up views of the fencing as well as onsite infrastructure.
- The plant species to be used in the screen are recommended to be native, derived from the naturally occurring vegetation community in this area. They should be fast growing, with spreading habitat and having a mature height of 3-4 m. Species selection could be undertaken in consultation with affected near neighbours and a botanist or landscape architect.
- The timing is recommended to be within 2 months of completion of construction so that actual and not predicted impacts of infrastructure are mitigated.
- The screen would be maintained for the operational life of the solar farm. Dead plants would be replaced. Pruning and weeding would be undertaken as required to maintain the screens visual amenity and effectiveness in breaking up views.

It is noted that the aim of plant screens is to break up the view and not eliminate it entirely. Partial views are considered likely, particularly while vegetation is developing to maturity.

6.2 GENERAL MEASURES

The following measures are recommended to reduce the general visual impact of the development for all other receivers:

6.2.1 Design

- If feasible, underground rather than overhead power lines would be considered.
- If feasible, co-location of powerlines would be undertaken to minimise the look of additional power poles. If additional poles are required, these would match existing pole design as much as possible.
- The materials and colour of onsite infrastructure will, where practical, be non-reflective and in keeping with the materials and colouring of existing infrastructure or of a colour that will blend with the landscape. Where practical:
    - Buildings will non-reflective and in eucalypt green, beige or muted brown.
    - Pole mounts will be non-reflective.
    - Security fencing posts and wire would be non-reflective; green or black rather than grey would reduce the industrial character of the fence.

6.2.2 Construction

- During construction, dust would be controlled in response to visual cues.
- Parking areas, material stock piles and other construction activities would be located as far as practical from nearby residences or screened (by existing vegetation or constructed screens) for the period of construction.
- Areas of soil disturbed by the project would be rehabilitated progressively or immediately post-construction, reducing views of bare soil.
- Ground cover would be maintained beneath the panels and within the site boundary, to break up views of the infrastructure from the side view.

- Night lighting would be minimised to the maximum extent possible (i.e. manually operated safety lighting at main component locations).

6.3 VERIFICATION OF ACTUAL IMPACTS

A verification process would be implemented within 2 months of the completion of the construction phase. A Visual Verification Report and Landscape Plan would:

- Confirm the assumptions of this assessment by ground based assessment and ensure all high impacts are mitigated.
- Finalise the location and species for proposed screening, in consultation with affected landholders and roads authority, where relevant.
- Detail planting methods and maintenance requirements of the screen planting.

7 CONCLUSION

This report has been prepared to assess the potential visual impacts of the proposed Parkes Solar Farm. A systematic evaluation has been undertaken to address subjectivity as much as possible. The report was informed by background investigations, mapping and modelling, field survey including reconnaissance, ground truthing and photography and the results of project-specific community consultation.

The proposed Parkes Solar Farm would be located in an agricultural area of generally low scenic quality. However, the visual characteristics of the cropping and grazing land are important to members of the local community. The solar farm site is located next to a high use transport corridor and in close proximity (<1km) from two residences. A high impact was determined for one residence. Screening is proposed to break up views of the proposed infrastructure from this residence, in consultation with the affected landholders.

General measures to reduce impacts for all receivers have also been recommended. These centre on use of design elements to reduce visual contrast, mitigation of construction impacts such as dust and traffic that may reduce visual amenity and mitigation of operation impacts, such as maintaining ground cover beneath the panels, to break up side on views of infrastructure and soften the appearance of the facility.

Large scale solar farms are still relatively new in Australia. While they enjoy support from many in the community, provision of information on expected visual impacts and involvement in mitigating impacts (for affected receivers) is considered very important to obtaining social license to operate. With the involvement of the affected landowners in the mitigation strategy set out in Section 6, the visual impacts of the proposal are considered acceptable and manageable.

8 REFERENCES

Australian Renewable Energy Agency (ARENA) no date. Establishing the social licence to operate large scale facilities in Australia; insights from social research for industry.

BLM (n.d.) BLM Visual Resource Management System. Available online from the Bureau of Land Management, US Department of the Interior. (www.blm.gov)

NSW Department of Planning (2010). Discussion Paper On Planning For Renewable Energy Generation - Solar Energy, prepared April, 2010.

Spaven Consulting (2011). Solar Photovoltaic Energy Facilities: Assessment of potential for impact on aviation. Report prepared January 2011, for RPS Planning and Development.

APPENDIX A LOCATION AND PROPOSED INFRASTRUCTURE LAYOUT

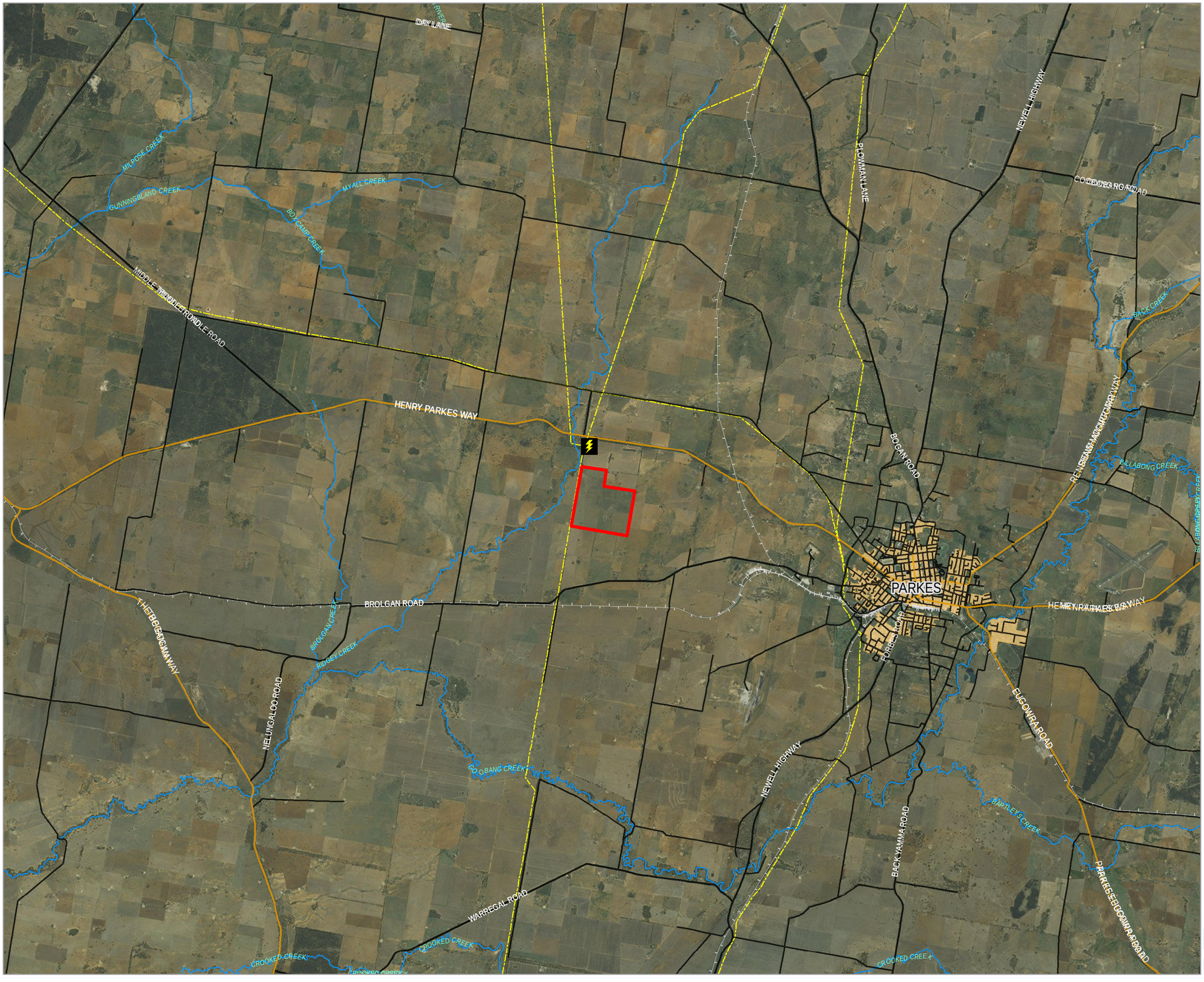
Regional location of proposal site

Proposed infrastructure

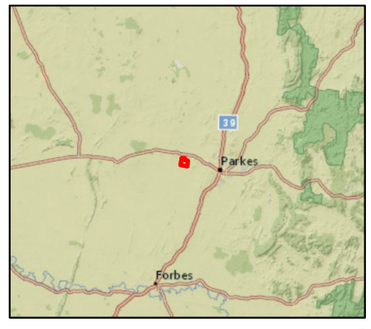
neoen renewing energy

PARKES solar farm

REGIONAL LOCATION OF PROPOSAL SITE



- Substation
- Proposal site boundary
- Main road
- Primary road
- Local road
- Existing transmission and distribution lines
- Watercourse
- Railway
- Built up area (Parkes)

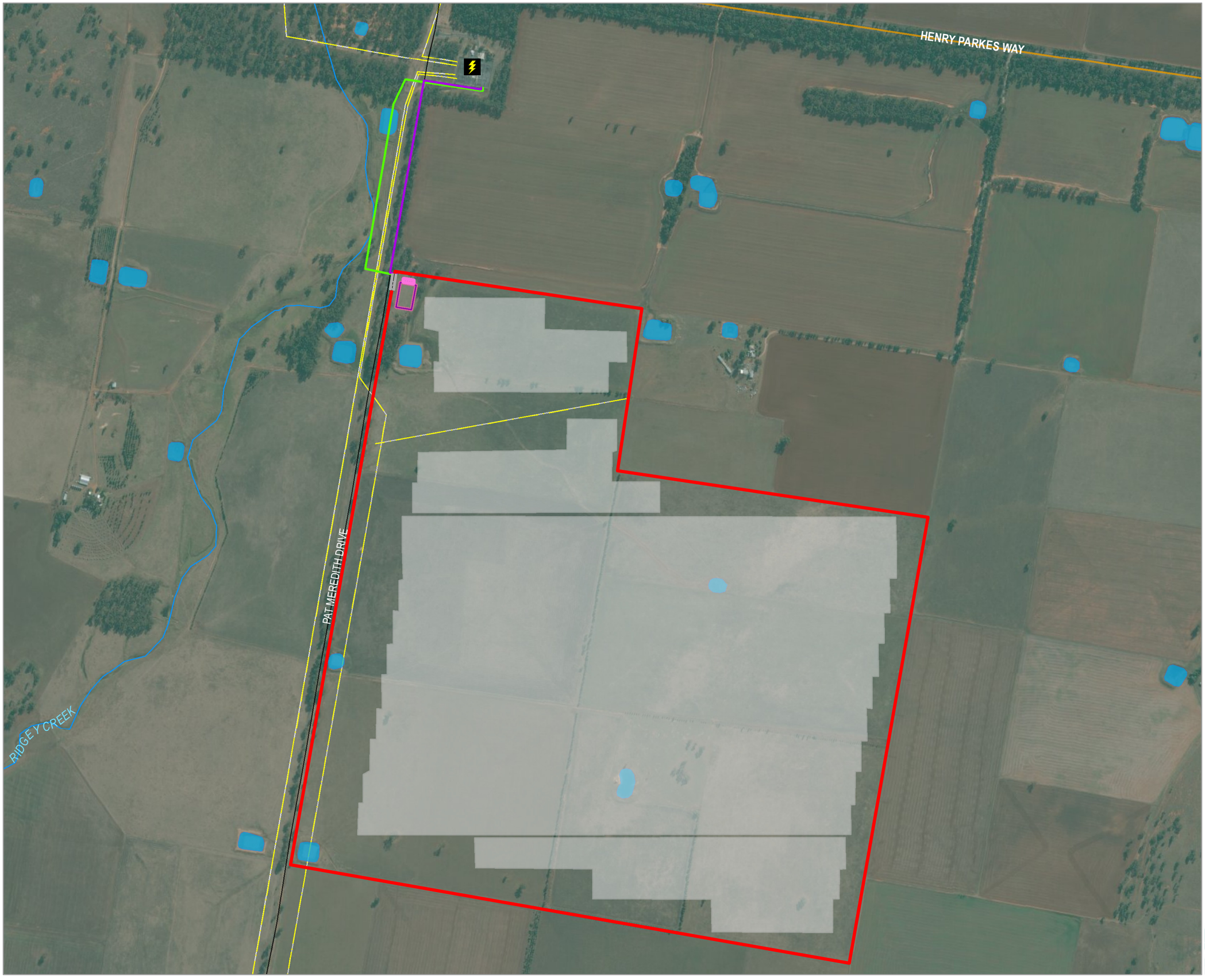


0 0.5 1 2 Kilometres

A3 @ 1:100000
Ref: SW064
Author: SP

ngh environmental

www.nghenvironmental.com.au

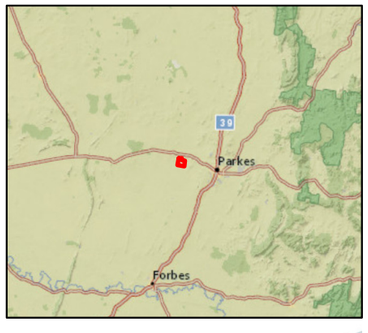


neoen renewing energy

PARKES solar farm

PROPOSED INFRASTRUCTURE

- Substation
- Site access
- Proposal site boundary
- Proposed underground transmission line (indicative)
- Proposed above ground transmission line
- Laydown area, construction offices, site carpark, operation and maintenance buildings
- Transformer pad
- Proposed photovoltaic arrays and inverter/ transformer stations – indicative area
- Main road
- Local road
- Existing transmission and distribution lines
- Watercourse
- Farm dam or other water body



0 100 200 400 Metres

A3 @ 1:10000
Ref: SW064
Author: SP

ngh environmental

www.nghenvironmental.com.au