

Middlebrook Solar Farm Memo

Prepared for

NGH Consulting

Issue

B

Project Number

2301

Revision	Date	Author	Checked	Comment
A	28/08/2025	CD	-	Draft for Review
B	20/10/2025	CD	-	For Submission
C	12/12/25	CD	-	For Submission



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28th August 2025

Re: Middlebrook Solar Farm Modifications - Visual Impact Assessment

Moir Studio have been engaged to undertake a visual impact assessment of the proposed modification to the development consent for the approved Middlebrook Solar Farm to accompany the application to modify the development consent for the Project.

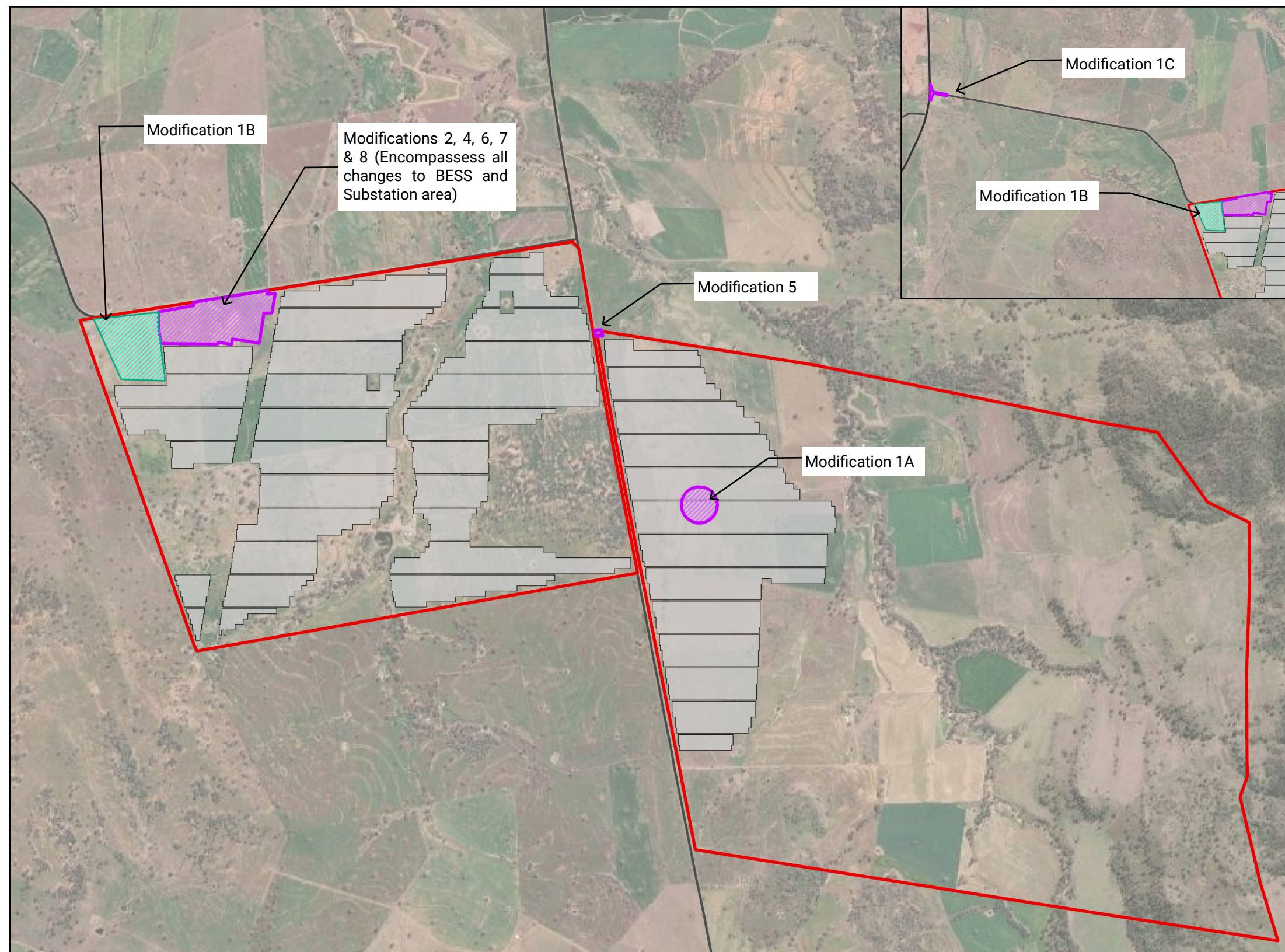
Moir Studio is a professional consultancy practice specialising in the areas of Landscape Architecture, Landscape Planning and Visual Impact Assessment. Our team has extensive experience in undertaking visual impact assessments for large scale renewable energy projects.

The purpose of this memo is to provide an assessment of the visual impacts relating to the proposed modification to the development consent and provide recommendations to reduce impacts if required.

The proposed modification consists of:

- 1.** Minor increases to the consented Development Footprint to:
 - a.** The removal of a host landowner residence, and expand the solar array in this area (R2)
 - b.** Expand temporary construction laydown areas, improving construction efficiency
 - c.** Expand the impact area for New England Highway / Middlebrook Road upgrades, to improve constructability
- 2.** Change in security fencing design for substation, to meet TransGrid requirements
- 3.** Change to Goonoo Bridge assessment approach (Level 2 instead of Level 3)
- 4.** Increase of assumed substation infrastructure height, including two new 30-meter-tall transmission towers (gantries/poles) for the 'cut in' to the existing 330kV line.
- 5.** Relocation of an existing private landholder access, within the consented Development Footprint, to improve access for the host landholder.
- 6.** Increase in Battery Energy Storage System (BESS) to:
 - a.** 1606.5 MWh nameplate capacity (1450 MWh delivery capacity)
 - b.** 4.5+ hours duration at the point of connection
- 7.** Change in number and size of transformers at substation, from 2 to 3
- 8.** Inclusion of blast walls around the transformers, in the event that these may be required by TransGrid.

Refer to **Figure 01** for the areas of change resulting from the proposed modifications.



Project Modifications

Refer to Page 3 & Section 1.0

LEGEND

- Project Boundary
- Design Modifications: Permanent Areas of Impact
- Design Modifications: Temporary Areas of Impact
- PV Array Area
- Highway
- Road

Figure 01 Project Modifications

Source - Esri, 2025

1.0 Modifications Assessment

1.1 Assessment for Modification 01A

The removal of a host landowner residence, and expand the solar array in this area (R2)

Modification 01A involves the removal of the host landowner's residence and the installation of additional solar panels in that area (see **Figure 02**). This expansion is located within the existing bounds of the approved solar array and will fill a gap currently surrounded by panels. As the overall footprint of the solar array remains unchanged, the visual impact of this modification is considered minimal.

The primary views potentially affected are from Middlebrook Road, an unsealed and infrequently used access road serving several properties. Viewers along this road are considered dynamic receptors, as there are no designated rest areas, pedestrian or cycle paths, or road shoulders that would allow for static viewing. As such, visibility of the Project is limited to fleeting glimpses by vehicle passengers.

Other private receptors that may be visually affected include Dwelling 07 (an associated dwelling of the Project) located to the southeast of the modification area. Dwelling 08, situated to the southwest, may also be potentially affected. However, based on the detailed assessment and photomontages produced for the EIS, dense existing vegetation at Dwelling 08 effectively screens views toward the modification area.

For Dwelling 5 (Photomontage 01), the cell count has increased by one (1), resulting in an updated total of seven (7) cells. This minor adjustment does not alter the overall visual impact rating (Magnitude: Very Low; Overall Impact: Low). All other modifications are either fully screened or negligible and that they do not change the assessment outcomes (refer to **Table 02**).

Overall, the visual change resulting from the proposed modification is considered minor.

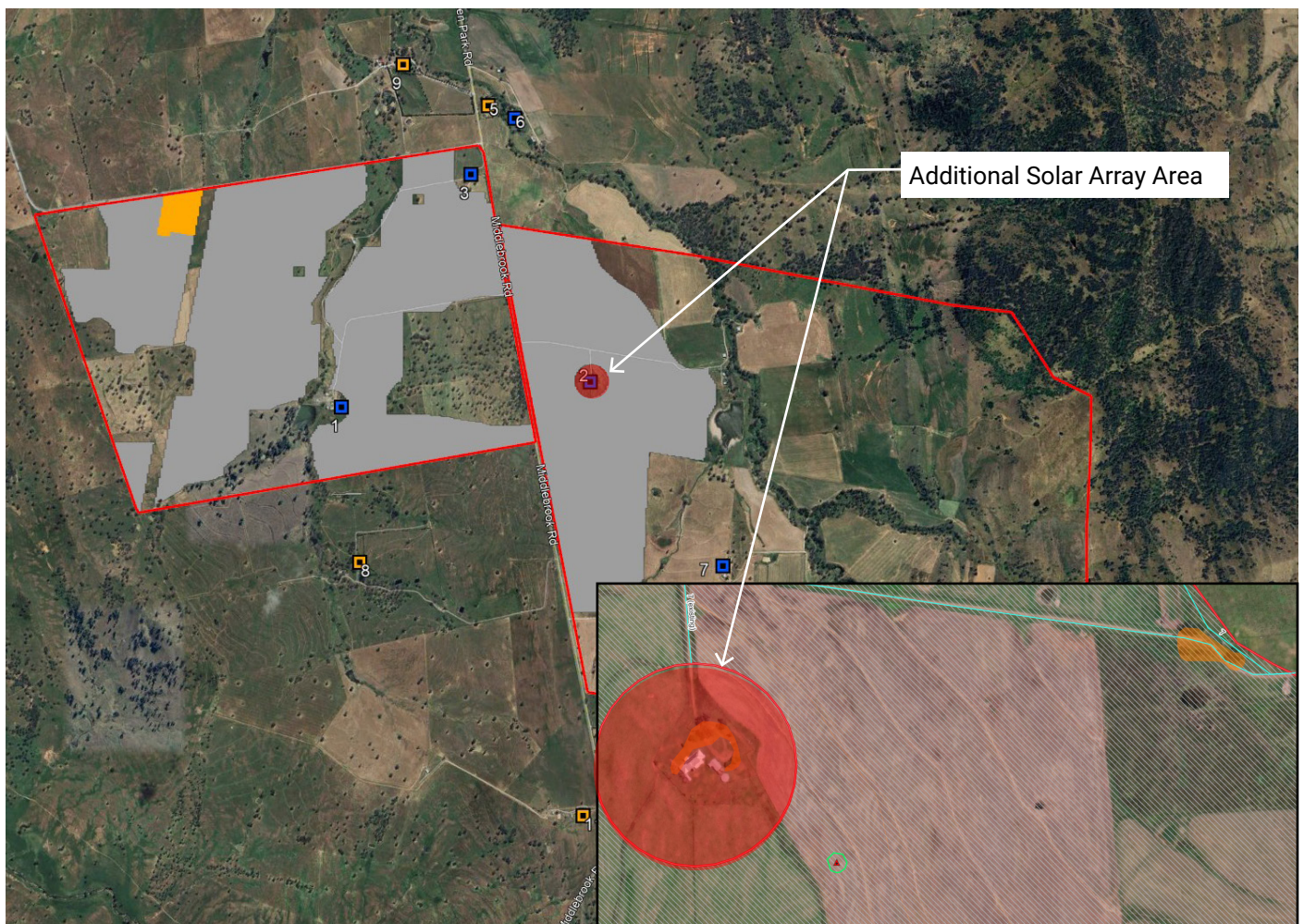


Figure 02 Modification 01A: Additional Solar Array Area
BaseMap Source - GoogleEarth 2025

1.1 Assessment for Modification 01B

Expand temporary construction laydown areas, improving construction efficiency

Modification 01B involves the expansion of the temporary construction laydown area into a location within the northwest of the Project area, adjacent to Middlebrook Road (refer to **Figure 03**). This area was originally designated as a visual setback to minimise views from the east.

Temporary facilities established at the site during the construction phase may include:

- Material laydown areas.
- Temporary construction site office.
- Temporary car and bus parking areas for construction workers.
- Staff amenities (kitchen and toilet/s).
- Temporary security lighting and CCTV at construction compound.
- Containers for the use of subcontractors.
- Bunded area for refuelling.
- Storage area.
- Generator for construction compound power supply.
- Skips with wind shield and lid.
- A hardstand area in the compound would consist of compacted stone to provide a clean, firm, level and free draining surface suitable for cabins and heavy traffic.

No change to the type or duration of activities during construction is proposed. No operational changes are proposed. The temporary construction areas will be rehabilitated at the end of construction, returned to existing conditions.

Viewshed mapping was undertaken to identify all areas with a potential line of sight the expanded temporary laydown area. This mapping is conducted using Geographic Information Systems (GIS), which model line-of-sight visibility based on the underlying topography between the Project's laydown area and surrounding viewpoints.

It's important to note that the viewshed is based solely on terrain and does not account for intervening elements such as vegetation, buildings, or other structures. As such, it represents a theoretical worst-case visibility scenario. For this assessment, viewshed modelling has been based on a worst-case infrastructure height of 4m.

The following provides a summary of the viewshed map assessment illustrated in **Figure 03**:

- A hill situated between Dwelling 10 and the Project (including the temporary construction laydown area) effectively screens the majority of potential visual impacts from view.
- While private receptors (dwellings) to the far west may have potential visibility of the temporary laydown area, the significant distance to the Project (with the closest dwelling approximately 3.7 km away) means that any visible elements would occupy only a minor portion of the view. At this distance, they would easily recede into the background be likely screened by intervening vegetation, topography, and built structures.
- All other nearby dwelling receptors have limited visibility of the expanded laydown area. Refer to Table 02 for assessment of potential visual impacts to private receptors (dwellings).
- The principal visual receptor is Middlebrook Road, an unsealed and infrequently used access road that serves several properties. Viewers along this road are considered dynamic receptors. Consequently, views of the laydown area are limited to fleeting glimpses by vehicle passengers.

As the laydown area will only be used during construction, any associated visual impacts will be short-term in nature. Therefore, the additional visual impact is expected to be minimal.

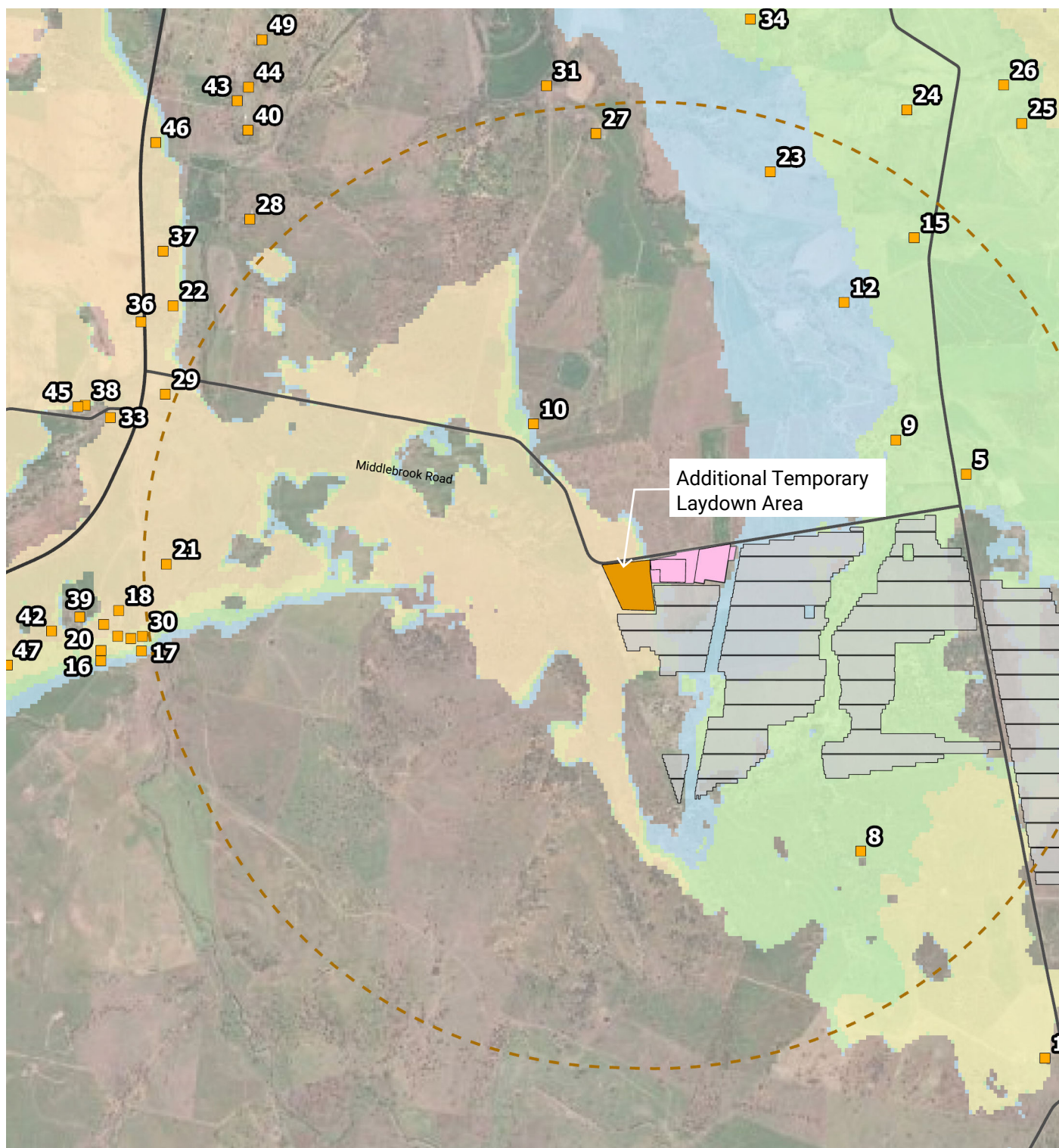


Figure 03 Modification 01B: Additional Temporary Laydown Area
BaseMap Source - Esri, 2025

Zone of Visual Influence Mapping (ZVI)

— Road

Extent of Temporary Laydown Area visible (@4m height) based on viewshed mapping

No Visibility

0-25% Visibility

25-50% Visibility

50-75% Visibility

LEGEND

PV Array Area

BESS and Substation Area

Temporary Laydown Area

4 km from Additional Temporary Laydown Area

Highway

1.2 Assessment for Modification 01C

Expand the impact area for New England Highway / Middlebrook Road upgrades, to improve constructability

Modification 01C involves the expansion of the impact area for road upgrades at the intersection of the New England Highway and Middlebrook Road (refer to **Figure 04**). The increase in the development footprint to accommodate construction activities is expected to result in only minor to negligible visual impacts, given the short-term nature of the works.

Additionally, the principal receptors potentially affected would be vehicles travelling along the New England Highway and Middlebrook Road, where any visual impacts would be fleeting due to the transient nature of the views.

While Dwelling 29 may experience some visual impact during the construction period, including the presence of trucks, equipment and other construction activities, the temporary nature of these works means that the overall visual impact is minimal. As such, the potential visual impact is considered acceptable.



Figure 04 Modification 01C: Expansion of impact area during construction of road upgrades
Source - Total Energies, 2025

1.3 Assessment for Modification 02

Change in security fencing design for substation and BESS areas, to meet TransGrid requirements

Modification 02 involves the addition of fencing to be installed surrounding and within the substation and BESS areas in accordance with Transgrid's Substation Primary Design Standard. **Table 01** describes the two types of fencing proposed.

Fencing Type	Description
Substation Fencing	The fencing installed surrounding the substations would be approximately 2.4 m high and topped with barbed wire (refer to Figure 05).
BESS and Perimeter Fencing	With the exception of the substation area fencing both perimeter and internal fencing will be devoid of barbed wire to protect entanglement of endangered species. The fencing would be approximately 2.3 m high (refer to Figure 06).

Table 01 Modification 02: Security fencing description

The primary receptor potentially affected by this visual change would be views from vehicles travelling along Middlebrook Road. However, screen planting along the road corridor is already proposed as part of the Project to minimise visual impacts. As a result, the visibility of the new fencing will be reduced by the proposed landscaping. For planting details and commitments, refer to the Development Consent: Middlebrook Solar Farm 2024. A photomontage has been prepared to assess the overall visual changes associated with the modified infrastructure, including fencing (refer to **Appendix A**).

Additionally, Middlebrook Road is an unsealed and infrequently used access road serving several properties. Views from this location are considered transient, as they are limited to fleeting glimpses by vehicle passengers.

Therefore, the visual change resulting from the proposed modification is considered minor.

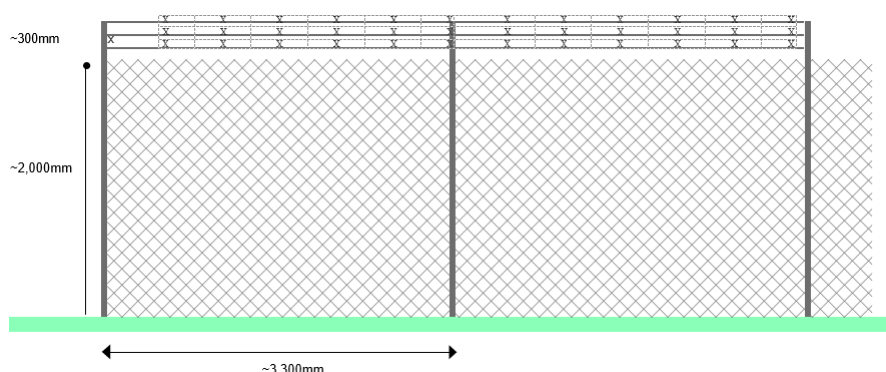


Figure 05 Modification 02: Security fencing with barbed wire (substation)
Source - Total Energies, 2025

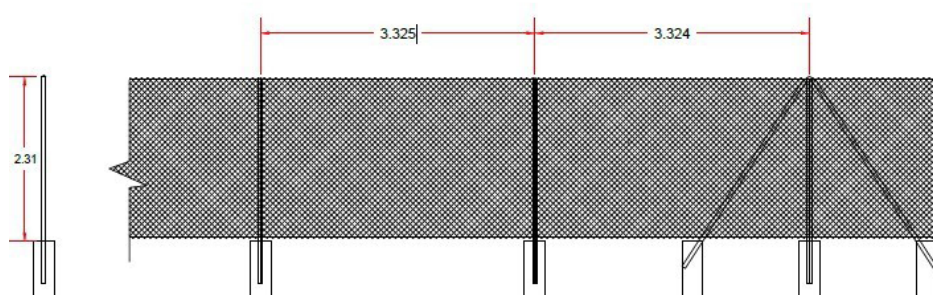


Figure 06 Modification 02: Security fencing without barbed wire (all other fencing)
Source - Total Energies, 2025

1.4 Assessment for Modification 03

Change to Goonoo Bridge assessment approach (Level 2 instead of Level 3)

This proposed modification results in no change to the Visual Impact Assessment and remains consistent with findings in the LVIA Report.

1.5 Assessment for Modification 04

Increase of assumed substation infrastructure height, including two new 30-meter-tall transmission towers (gantries/poles) for the 'cut in' to the existing 330kV line.

The Project requires connection to the electricity network. This will occur within the Development Footprint. No offsite works are required to connect the Project to the grid. Connection to the grid is assessed in this EIS. Once constructed, the connection infrastructure will be gifted to Transgrid, to be managed as part of their network. To ensure that Transgrid can manage their own assets, a subdivision will be sought through Council post approval, to delineate areas required for permanent Transgrid assets within the Development Footprint. A number of existing 11kv transmission lines occur within the Development Footprint. In consultation with Essential Energy and landowners, these may be moved or terminated to optimize the location of this change will eliminate some easement gaps within the solar array thereby optimising the efficiency of the layout.

Detailed design in consultation with TransGrid have now identified how the Project will connect to the grid. Modification 04 relates to the additional transmission line infrastructure that will be located within the consented Development footprint and include:

- a. 2 x 30m tall poles to accommodate the 'cut in' to the existing 330kV transmission lines (either steel, concrete or steel lattice) connecting to,
- b. 2 x 15m tall poles between the substation and the cut in poles (gantry type) connecting to,
- c. 3 x 8-9m tall poles within the substation area (individual poles or gantry type) that connect to the substation high voltage infrastructure.

The area where each pole would be located remains within the consented Development Footprint however, the proposed height is taller than that assessed in the visual assessment and a micro-siting allowance of 100m is required pending the detailed design.

In the EIS LVIA Report, the substation was assessed for potential visual impacts based on a height of 9 metres. Middlebrook Road was identified as the primary visual receptor due to its proximity to the substation. However, as Middlebrook Road is an unsealed and infrequently used access road, any potential views are considered fleeting due to the dynamic nature of the receptor. Visibility of the substation from nearby private residences was assessed as unlikely at the 9 metre height, due to intervening topography and existing vegetation.

Following a reassessment of potentially affected receptors in light of the increased infrastructure height (from 9 m substation heights to up to 30m transmission line heights), it is concluded that the primary views impacted are those from vehicles travelling along Middlebrook Road. These views remain transient, and the proposed screen planting along the road corridor will further minimise visual impacts (for planting details and commitments, refer to the Development Consent: Middlebrook Solar Farm 2024).

Nearby residential receptors potentially affected by the modification include Dwellings 10, 12, 9, and 5. However, as assessed in the LVIA Report, visibility of the Project, including the modified substation height, is screened by either topography or vegetation. Refer to **Table 02** for assessment of potential visual impacts to all nearby private receptors (dwellings).

A photomontage has been prepared to assess the overall visual changes associated with the modified substation infrastructure, including the 15 metre structures and 30 metre poles (refer to **Appendix A**).

Overall, the proposed screen planting along Middlebrook road will reduce the potential visual impacts to an acceptable level.

1.6 Assessment for Modification 05

Relocation of an existing private landholder access, within the consented Development Footprint, to improve access for the host landholder.

Modification 05 involves the relocation of an existing landholder access, resulting in an additional driveway off Middlebrook Road, located within the approved development footprint.

This proposed modification does not alter the findings of the Visual Impact Assessment and remains consistent with the conclusions of the LVIA Report. The additional access point is located on Middlebrook Road, a low-use, unsealed road with no pedestrian access or static viewpoints. As such, the visual change is minimal, and the overall visual impact is considered acceptable.

1.7 Assessment for Modification 06

Change in BESS from 780 to 998 MWH AC and from 2 hrs to 3 hrs storage

Modification 06 involves a small expansion of the area allocated in the General layout is required to accommodate a larger BESS. This proposed modification results in no change to the Visual Impact Assessment and remains consistent with findings in the LVIA Report.

1.8 Assessment for Modification 07

Change in transformer number at the onsite substation

Modification 07 involves a change in transformer configuration within the approved substation development area, replacing two (2) large transformers with three (3) smaller units.

The visually impacted area remains within the development footprint, and the height parameters assessed in the LVIA Report are consistent with those used for the transformer infrastructure. As such, the proposed modification does not alter the findings of the Visual Impact Assessment and remains consistent with the conclusions of the report.

1.9 Assessment for Modification 07

Inclusion of blast walls around the transformers, in the event that these may be required by TransGrid.

Modification 08 involves the potential addition of two (2) blast walls around the transformers with the Substation Area. These are now shown in the indicative layout (Refer to **Figure 07**). These may be required by Transgrid subject to detailed design and safety requirements. While currently considered unlikely, this option will be important to ensure the Project is resilient to these late-stage design decisions.

If required, blast walls can be constructed using reinforced concrete, steel panels, or composite systems such as Durasteel. The walls are expected to be 30cm wide, 11.6m in length and 5.8m high. The proposed blast walls can be accommodated within the consented Development Footprint and no change to the type or duration of activities during construction or operation is proposed.

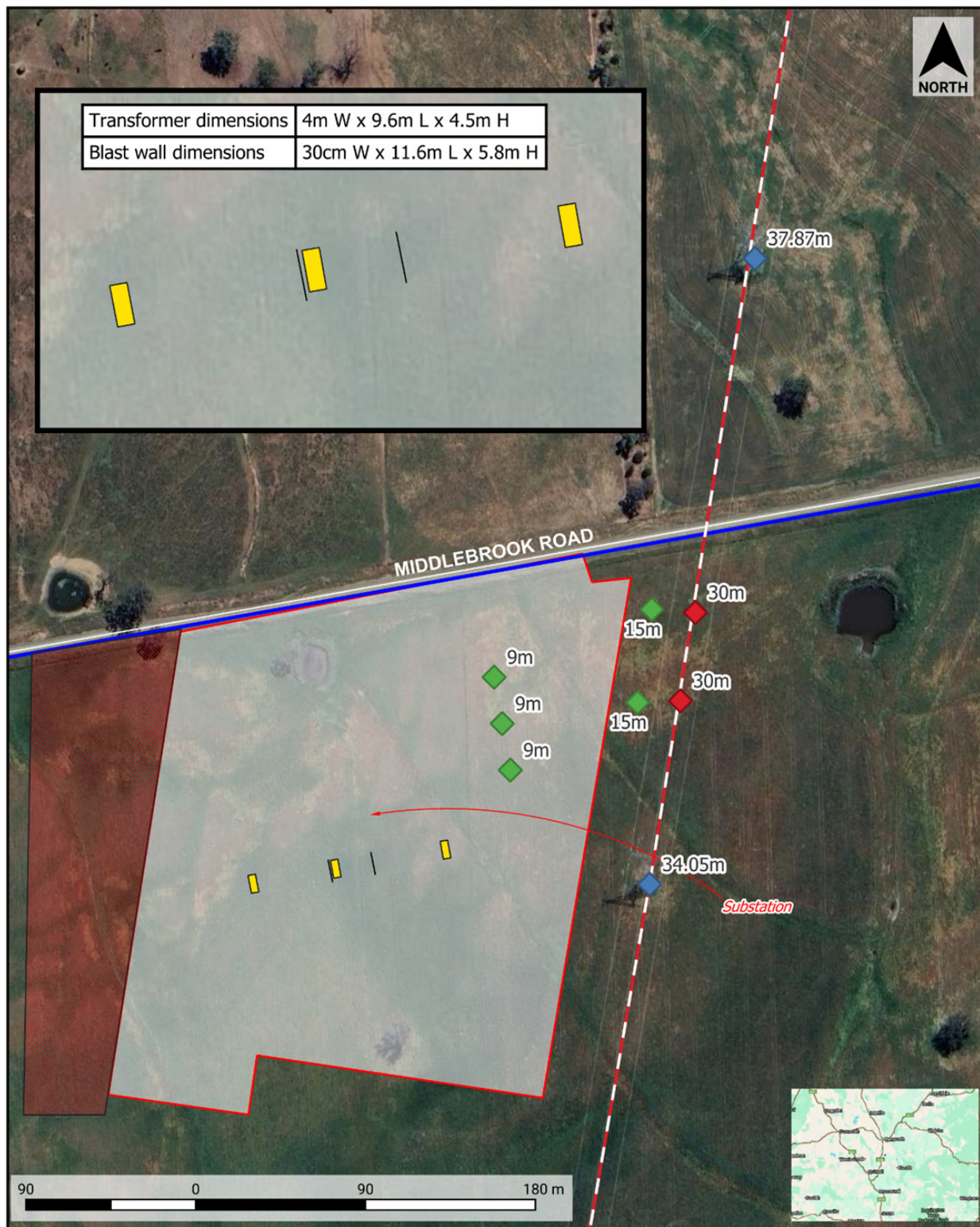
The addition of blast walls is considered supplementary infrastructure associated with the proposed substation. As such, the potential area of visual impact is confined to the designated substation area within the approved Project Layout.

The primary views impacted from changes to the substation infrastructure (including the addition of blast walls) are those from vehicles travelling along Middlebrook Road. These views remain transient, and the proposed screen planting along the road corridor will further minimise visual impacts (for planting details and commitments, refer to the Development Consent: Middlebrook Solar Farm 2024).

Refer to **Table 02** for assessment of potential visual impacts to private receptors (dwellings).

A photomontage has been prepared to assess the overall visual changes associated with the modified substation infrastructure, including the blast walls (refer to **Appendix A**).

Overall, the proposed screen planting along Middlebrook road will reduce the potential visual impacts to an acceptable level.



DATE
MAP / VERSION
DRAWN / CHECKED
PROJECTION
SCALE @ A4

05/11/2025
MSF-016-V03
RM /
EPSG:7856
1:2800

Legend

- Existing poles
- New poles
- New substation poles
- Transformers
- Blast Walls
- Substation or BESS area



Figure 07 Modification 07: Indicative substation layout showing location of blast walls

Source - Total Energies, 2025

2.0 Visual Impact on Receptors

2.1 Modifications Visual Impact on Receptors

A visual impact assessment for all residential receptors (dwellings) with a line of sight and within 4 km of the Project was conducted in the LVIA Report following the *Large-Scale Solar Energy Guideline - Technical Supplement - Landscape and Visual Impact Assessment* (DPHI November 2024).

In accordance with the Technical Supplement, for both the intermediate and detailed assessment, 'the applicant must identify the number of cells that are occupied by the built form of the project. A cell is occupied if it contains any element of the project, including solar panels, battery energy systems, transmission lines or other associated infrastructure except if it occupies less than 25% of a cell.' Therefore, due to the proposed modifications to the Project outlined in Section 1, a reassessment of the private receptors' visual impacts has been undertaken.

Table 02 reassesses the visual impact ratings for all affected private receptors identified in the EIS Report. For each receptor, the original LVIA assessment level (Intermediate or Detailed) and Visual Impact Rating are noted, followed by an evaluation of whether the proposed modifications would alter the original visual impact findings.

To assess whether a receptor would be impacted by the proposed modifications, the visual area of modification was identified using the horizontal field of view. Based on this defined field of view, the relevant visualisations (either wireframes or photomontages, depending on the assessment level required in the LVIA Report) were reviewed for each receptor to determine whether the proposed modifications would result in any visual effects.

Receptor ID:	EIS Assessment Level	EIS Visual Impact Rating	Project Modifications: Potential additional Impacts	Updated Visual Impact Rating
4	Intermediate Assessment (wireframe)	Cell Count (CC) in Intermediate Assessment = 12 Therefore Low Visual Impact Rating	Field of View (FOV) of potential visual change: 350°-356°. NOTES: <i>Minor visual change, won't affect cell count.</i>	Not Affected. Overall Visual Impact Rating remains consistent with results from EIS report.
5	Detailed Assessment (photomontage)	Cell Count (CC) in Detailed Assessment = 6 Therefore Low Visual Impact Rating	Field of View (FOV) of potential visual change: 155°-162°. NOTES: <i>Potentially 1 additional Cell count in detailed assessment: 6 ->7.</i>	Updated cell count to 7. Overall low visual impact . Visual Impact Rating remains consistent with results from EIS report.
6	Detailed Assessment (photomontage)	Cell Count (CC) in Detailed Assessment = 6 Therefore Low Visual Impact Rating	Field of View (FOV) of potential visual change: 160° -167°. NOTES: <i>Minor visual change, won't affect cell count.</i>	Minor visual change, won't affect cell count. Overall Visual Impact Rating remains consistent with results from EIS report.

Table 02 Modified Visual Impacts of Private Receptors (Dwellings)

8	Detailed Assessment (photomontage)	Cell Count (CC) in Detailed Assessment = 3 Therefore Low Visual Impact Rating	Field of View (FOV) of potential visual change: 48°-55°. NOTES: <i>Not affected, screened by vegetation.</i>	Not Affected. Screened by vegetation (shown in detailed photomontage assessment). Overall Visual Impact Rating remains consistent with results from EIS report.
9	Intermediate Assessment (wireframe)	Cell Count (CC) in Intermediate Assessment = 12 Therefore Low Visual Impact Rating	Field of View (FOV) of potential visual change (PV Addition): 146° -152°. NOTES: <i>Not affected, screened by vegetation+topography.</i> Field of View (FOV) of potential visual change (Associated Infrastructure): 231°-245°. NOTES: <i>Not affected, screened by vegetation+topography.</i>	Not Affected. Screened by topography and/or vegetation (shown in detailed wireframe assessment). Overall Visual Impact Rating remains consistent with results from EIS report.
10	Intermediate Assessment (wireframe)	Cell Count (CC) in Intermediate Assessment = 0 Therefore Low Visual Impact Rating	No Visibility of Project (shown in detailed wireframe assessment).	Not affected. (shown in detailed wireframe assessment). Overall Visual Impact Rating remains consistent with results from EIS report.
11	Intermediate Assessment (wireframe)	Cell Count (CC) in Intermediate Assessment = 5 Therefore Low Visual Impact Rating	Field of View (FOV) of potential visual change: 358°-3°.	Not Affected. Screened by topography (shown in detailed wireframe assessment). Overall Visual Impact Rating remains consistent with results from EIS report.
12	Intermediate Assessment (wireframe)	Cell Count (CC) in Intermediate Assessment = 7 Therefore Low Visual Impact Rating	Field of View (FOV) of potential visual change (PV Addition): 151°-154°d. Field of View (FOV) of potential visual change (Associated Infrastructure): 203°-217°.	Not Affected. Screened by topography and/or vegetation (shown in detailed wireframe assessment). Overall Visual Impact Rating remains consistent with results from EIS report.

Table 02 Modified Visual Impacts of Private Receptors (Dwellings) Continued...

13	Intermediate Assessment (wireframe)	Cell Count (CC) in Intermediate Assessment = 7 Therefore Low Visual Impact Rating	Field of View (FOV) of potential visual change (PV Addition): 347°-351°d. Field of View (FOV) of potential visual change (Associated Infrastructure): 318°-325°.	Not affected. Distance from modifications reduces any potential visual impacts to minor changes in the distant view. Easily screened by vegetation and topography. Overall Visual Impact Rating remains consistent with results from EIS report.
15	Intermediate Assessment (wireframe)	Cell Count (CC) in Intermediate Assessment = 8 Therefore Low Visual Impact Rating	Field of View (FOV) of potential visual change (PV Addition): 162°-165°. Field of View (FOV) of potential visual change (Associated Infrastructure) 208°-219°. NOTES: <i>Potentially 1 additional Cell count in detailed assessment 8->9.</i>	Minor visual change, may increase cell count to 8. Resulting in overall low visual impact rating. However, overall Visual Impact Rating remains consistent with results from EIS report.

Table 02 Modified Visual Impacts of Private Receptors (Dwellings) Continued...

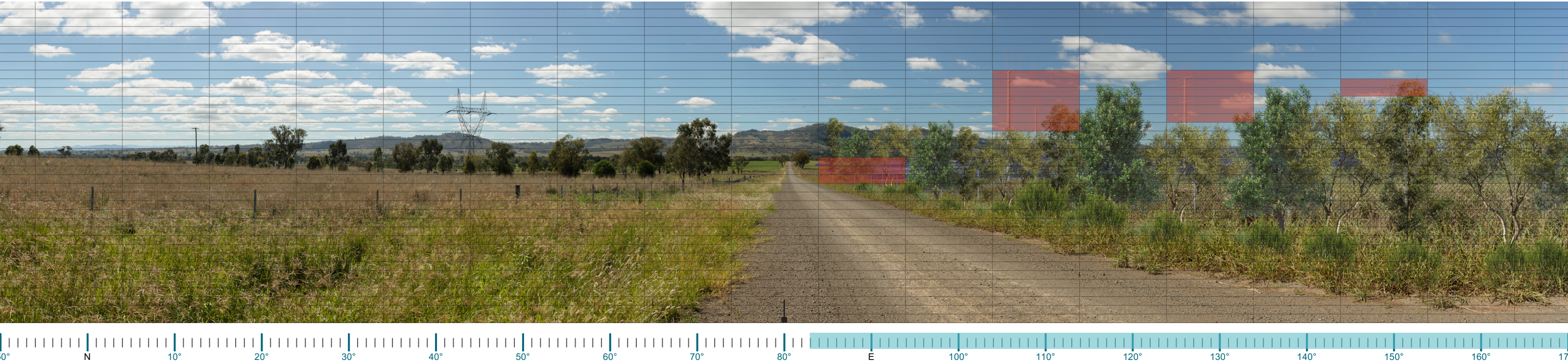


APPENDIX A - PHOTOMONTAGES

Middlebrook Solar Farm

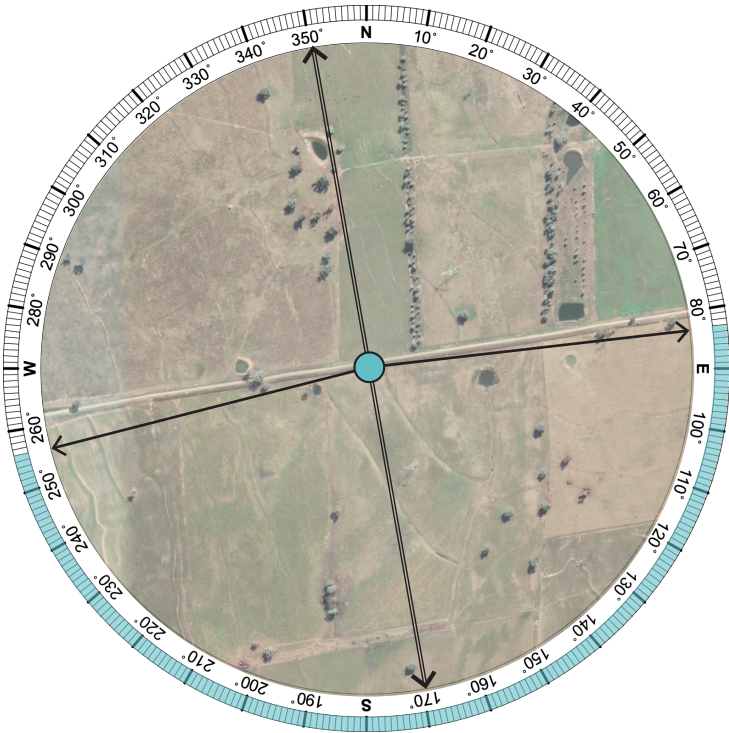
Viewpoint ID:

VP06 (East) Middlebrook Road, Loomberah NSW



180° Proposed View - Photomontage with Mitigation

Extent of Potential Visibility



Sensitivity:

	Viewpoint Type:	Local Road (unsealed) - Very Low
	Scenic Quality:	Low

Overall Potential Sensitivity: **Very Low**

Magnitude:

	Number of Occupied Cells:	18

Magnitude Rating: **Moderate**

Visual Impact Rating:

Impact Rating: **Low**

Viewpoint Summary:

Location:	
Middlebrook Road	
Coordinates:	Elevation:
31°17'52.04"S 150°57'6.52"E	480m
Viewing Direction:	Distance to Project:
East	0.01 km

Viewpoint ID:

VP06 (East) Middlebrook Road, Loomberah NSW



180° Proposed View - Without Mitigation



180° Proposed View - with mitigation after 5 years (Vegetation shown at a height of approximately 5m)

Viewpoint ID:

VP06 (East) Middlebrook Road, Loomberah NSW - Proposed Mitigation after 5 years



Proposed View | 60° Cropped (A) - with mitigation after 5 years (Vegetation shown at a height of approximately 5m)

Viewpoint ID:

VP06 (East) Middlebrook Road, Loomberah NSW - Proposed Mitigation after 5 years

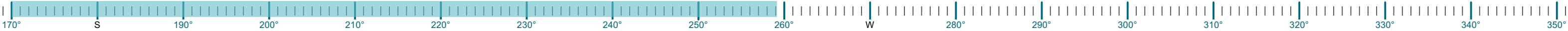


110° 120° 130° 140° 150° 160° 170°

Proposed View | 60° Cropped (B) - with mitigation after 5 years (Vegetation shown at a height of approximately 5m)

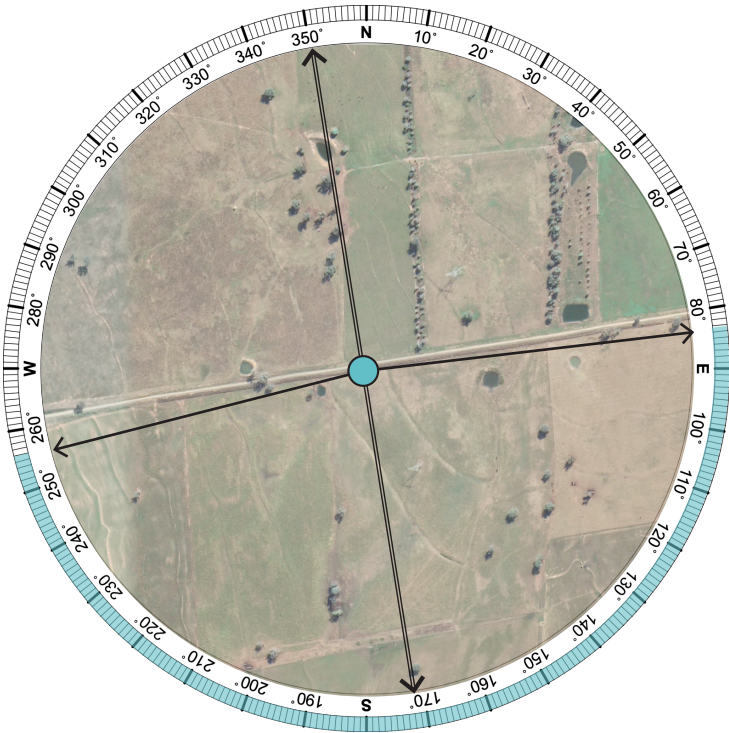
Viewpoint ID:

VP06 (West) Middlebrook Road, Loomberah NSW



180° Proposed View - Photomontage with Mitigation

Extent of Potential Visibility



Sensitivity:

	Viewpoint Type:	Local Road (unsealed) - Very Low
	Scenic Quality:	Low

Overall Potential Sensitivity: **Very Low**

Magnitude:

	Number of Occupied Cells:	0

Magnitude Rating: **Very Low**

Visual Impact Rating:

Impact Rating: **Very Low**

Viewpoint Summary:	
Location:	
Middlebrook Road	
Coordinates:	Elevation:
31°17'52.04"S 150°57'6.52"E	480m
Viewing Direction:	Distance to Project:
West	0.01 km

Viewpoint ID:

VP06 (West) Middlebrook Road, Loomberah NSW



180° Proposed View



180° Proposed View - with mitigation after 5 years (Vegetation shown at a height of approximately 5m)

Viewpoint ID:

VP06 (West) Middlebrook Road, Loomberah NSW - Proposed Mitigation after 5 years



170° S 190° 200° 210° 220° 230°

Proposed View | 60° Cropped (A) - with mitigation after 5 years (Vegetation shown at a height of approximately 5m)

Viewpoint ID:

VP06 (West) Middlebrook Road, Loomberah NSW - Proposed Mitigation after 5 years



Proposed View | 60° Cropped (B) - with mitigation after 5 years (Vegetation shown at a height of approximately 5m)