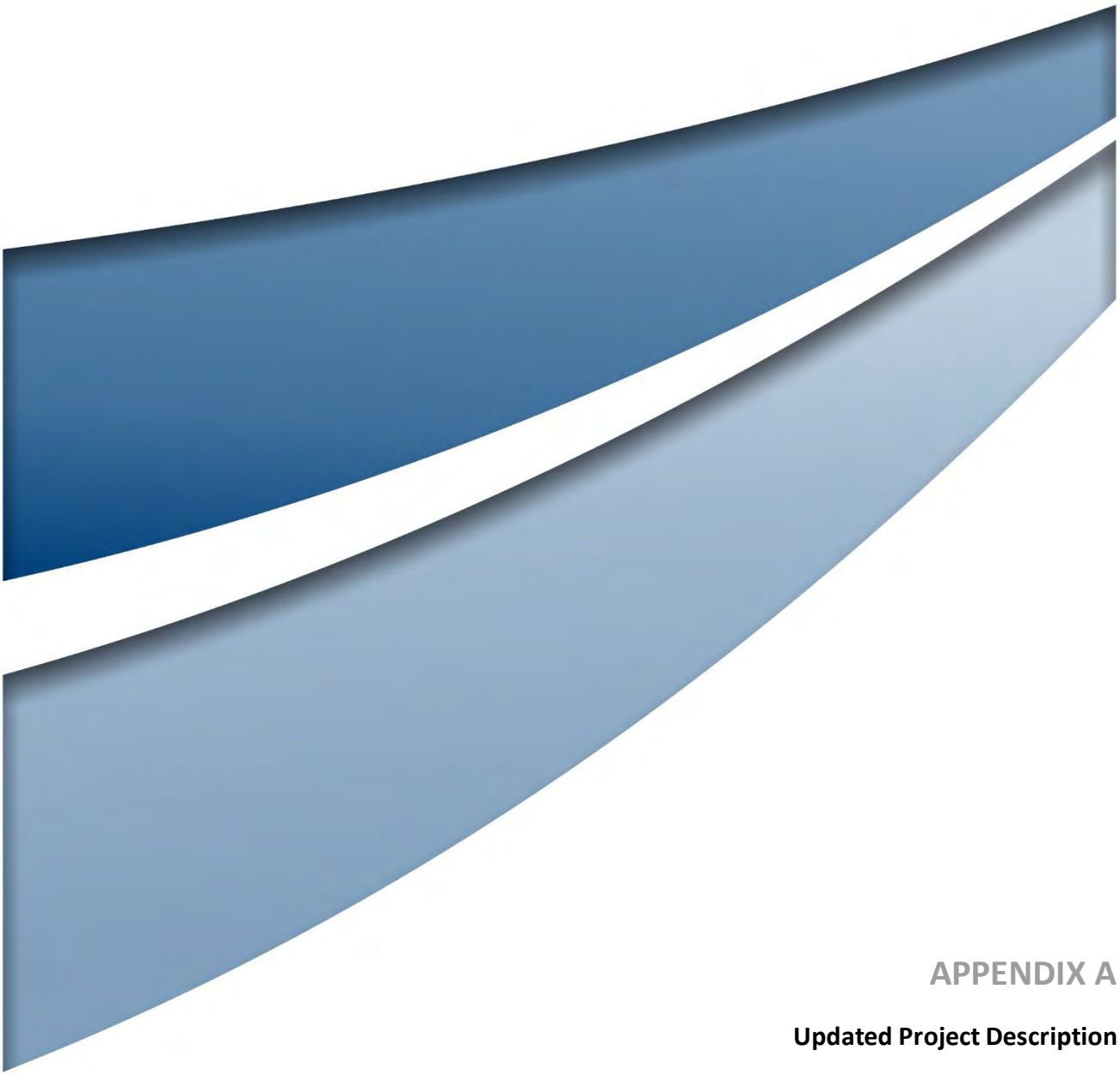

APPENDIX A

Updated Project Description

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lightsource bp

Goulburn River Solar Farm

Updated Project Description

FINAL

December 2023

lightsource bp

GOULBURN RIVER SOLAR FARM

Updated Project Description

FINAL

Prepared by Umwelt (Australia) Pty Ltd
on behalf of Lightsource bp

Project Director:	Malinda Facey
Project Manager	Jessica Henderson-Wilson
Report No.:	23485/R03/Appendix A
Date:	December 2023

umwelt
Environmental & Social Consultants

APPROVED COMPANY ISO 9001
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This report was prepared using Umwelt's
ISO 9001 certified Quality Management System.

Acknowledgement of Country

Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.

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Document Status

Rev No.	Reviewer Name	Review Date	Approved for Issue Name	Approved for Issue Date
V1	J Henderson-Wilson	22/11/2022	M Facey	22/11/2022
V2	J Henderson-Wilson	12/12/2023	M Facey	12/12/2023

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1.0 Project Description

1.1 Project Overview

The Project involves the construction, operation and decommissioning of approximately 550 megawatt peak (MWp) of solar photovoltaic (PV) generation as well as a Battery Energy Storage System (BESS) with a maximum 1,030 MWp/2,060 megawatt hour (MWh) capacity. The Project will include a substation and connection to an existing 500 kilovolt (kV) transmission line which passes through the Project Area. The Project will include various associated infrastructure, including road repairs and upgrades to Ringwood Road, Wollara Road, and the Golden Highway intersection, temporary construction facilities, operation and maintenance buildings, internal access roads, civil works and electrical infrastructure to connect the Project to the existing transmission line.

The conceptual layout of the solar arrays (refer to Figure 1.2 of the Amendment Report (copied here in **Appendix 1**)) has been designed to maximise solar efficiency while also considering ecological, heritage and other site constraints.

Table 1.1 provides a summary of the key components of the Project.

Table 1.1 Project Summary

Project Element	Summary of the Project
Project Application Number	SSD-33964533
Project Description	The Project includes the construction, operation, and decommissioning of the proposed 550 MWp solar farm, maximum 1,030 MWp/2,060 MWh capacity BESS, road repairs and upgrades and associated infrastructure (such as operations and maintenance buildings, temporary construction compound, security fencing), civil works (such as regrading, re-sheeting and culvert upgrades) and electrical infrastructure (including a new onsite substation and underground and overhead cabling) required to connect to the electricity transmission network. A 30 m telecommunications tower is also proposed. No subdivision is required for the Project as part of this development application, however the Project Area is intended to be subdivided to facilitate a biodiversity stewardship area (BSA). The Project's conceptual layout is provided to Figure 1.2 of the Amendment Report (copied here in **Appendix 1**).
Project Location	2335 Wollara Road, Merriwa NSW, approximately 28 km south-west of Merriwa, within the Upper Hunter Local Government Area.
Project Area – Solar Farm Area	Approximately 1,996.5 ha.
Development Footprint	Approximately 792.19 ha and 8.1 km of road repairs and upgrades.
Schedule of Lands	Refer to Appendix 4 of the EIS.

Project Element	Summary of the Project
Solar Arrays	Approximately 1 million bifacial solar panels on ground-mounted single axis tracking framework Row spacing: Maximum 5 m apart, depending on tracker configuration. Height: Average height approximately 3.1 m at full tilt, with a maximum of 4 m in some areas due to undulating site topography.
Battery Storage	The option to construct and operate a 450 MWp/900 MWh centralised BESS, a 580 MWp/1160 MWh decentralised BESS or a combined centralised and decentralised BESS with a total capacity of 1,030 MWp/2,060 MWh. Each proposed option has a discharge duration of two hours. There will be a 50 m APZ surrounding the centralised BESS facility security fencing.
Electrical Reticulation	Connection to existing 500 kV transmission line in south-eastern corner of Project Area. Additional cabling may also be required along the existing transmission line, connecting the site to the substation in Wollar. This would involve access along the existing easement and potential aerial cable instalment via helicopter. If any works to the existing transmission line between Wollar and the Project Area are required, this would be undertaken by Transgrid and is separate to this EIS. Power conversion units consisting of approximately 67 inverters. On-site substation covering approximately 4 ha, enclosed by security fencing.
Telecommunications Tower	Up to 30 m high, providing a secondary communications channel between the Project and Wollar and Bayswater substation. This will be capable of radio communications, located in the substation compound area.
Temporary Construction Facilities	Main construction site compound to include office amenities, parking, storage, and associated facilities. Laydown areas suitable for storing plant and equipment, solar panels and cable drums, and areas to support waste management activities. A temporary helipad for emergency response purposes during construction.
Permanent Operational Facilities	This would include the system control building, switch room and storage facilities, and car parking.
Security Fencing, Lighting and CCTV	Perimeter security fencing around the Development Footprint to a height of approximately 2.3 m plus CCTV and security lighting.
Road repairs and Upgrades	• Road upgrades are required for the safe transportation of materials and personnel to the Project Area including. • Upgrades to culverts at the existing road crossings of Bow River and Killoe Creek located on Ringwood Road. • Realignment, widening and sealing of a 4.7 km section of Wollara Road. • Realignment, widening and sealing of 3.4 km of Ringwood Road, across two sections. • Upgrades at the Golden Highway and Ringwood Road intersection including vegetation removal, minor lane widening, addition of an acceleration lane and formalisation of the bus stop pullover area.

Project Element	Summary of the Project
Project Access	Major solar components would be delivered via the Port of Newcastle, New England Highway, Golden Highway, Ringwood Road and Wollara Road from the north. Light vehicle access would generally occur from the north via Merriwa. Three access points to be provided along the western boundary of the Project Area, off Wollara Road. One point will be a permanent site access and the remaining two are emergency access points.
Internal Access Tracks	Approximately 49 km of unsealed access tracks of approximately 4 m width. A single main access road footprint of between 8 and 10 m width will connect Project areas and accommodate the proposed buried cable easements.
Workforce	Construction: Up to 350 direct jobs at the peak of construction with an average 250 jobs, aspirational target of 10% (35 jobs) sourced locally. Operation: Approximately 10 direct jobs. Aspirational target of all permanent roles based locally.
Construction Hours	Construction hours: • Monday to Friday 6:00 am to 6:00 pm. • Saturday 6:00 am to 6:00 pm. • No works on Sundays or Public Holidays. Approval is also sought to undertake activities which are inaudible at non-involved dwellings, emergency work, and deliveries and dispatches (where required by authorities for safety reasons) outside of standard construction hours. Road upgrades on Ringwood Road are proposed to be undertaken within standard construction hours.
Operational Hours	24/7.
Construction Period	27 months.
Operational Period	40 years.
Capital Investment Value	Estimated $880 million.

1.2 Project Area

The Project Area covers approximately 1,996.5 ha with a Development Footprint of approximately 792.19 ha, as shown in Figure 1.2 of the Amendment Report (copied here in **Appendix 1**). Access to the Development Footprint will be off Wollara Road via the existing driveway towards the southern end of the property's western boundary. Two secondary access points, also off Wollara Road, will be available towards the north of the property's western boundary for emergency use.

Emergency services and NPWS access will be maintained through the Project Area, to be used for emergencies only or on request.

The layout of the solar arrays and associated infrastructure would be entirely contained within the Development Footprint. The Project also includes road repairs which are located outside of the Project Area. These encompass parts of Ringwood Road (including culverts at two waterway crossings), Wollara Road and the intersection of Golden Highway and Ringwood Road. Works on the two culverts and the intersection are required to support Project construction traffic, whilst other road improvements are in response to feedback and represent part of a community benefit offered by the Project. All road upgrades will improve safety outcomes for both the Project and the broader community.

The works on Wollara Rd and Ringwood Road are contained to the road reserve and landowners' consent from Upper Hunter Shire Council has been obtained, refer to Appendix B of the Amendment Report.
The upgrades to the intersection of the Golden Highway and Ringwood Road require works which will be largely contained within the road reserve, but which will encroach into the cadastral boundary of Lot 1 DP34496 (outside of the existing fence-line). The formalisation of the bus stop on Ringwood Road at the intersection with Golden Highway will be contained within Lot 7303 DP 1146691; refer to Appendix D of the Amendment report.

The Project Area has been subject to land clearing, grazing, cropping and pasture improvement, and as such, the Development Footprint supports a mosaic of exotic vegetation. Despite these long-running land management practices, the Project Area still supports areas of biodiversity value, including derived native grasslands in a range of conditions, scattered paddock trees, areas of thinned woodland and forest, and areas of intact woodland and forest, providing habitat for threatened vegetation communities and species. The presence of these biodiversity values has been a key driver for the design of the Development Footprint in order to maximise the avoidance of impacts (refer to Section 6.2 of the EIS and Part B of the Amendment Report). The presence of one Aboriginal heritage item, seven potential culturally significant trees (four outside of the Development Footprint) and historic heritage feature (Slab Hut) have also contributed to the placement of the final Development Footprint. Key heritage constraints are shown in Figure 1.7 of the Addendum Aboriginal Cultural Heritage Assessment. Dams, waterways and flooding potential were another key consideration for Project design.

The Project has been designed through a comprehensive process that incorporates community and other stakeholder feedback to maximise positive social, economic and environmental outcomes, while minimising environmental and social impacts.

1.3 Physical Layout and Design

1.3.1 Solar Arrays

The Project would involve the installation of approximately one million bifacial PV solar panels across the Project Area, providing an estimated 550 MWp capacity. The panels would be arranged in a series of rows approximately 5 m apart, positioned to maximise the solar resources available. The solar arrays would be installed through pile driving on ground-mounted single axis tracking framing, in rows configured in a north-south direction. The panels would move throughout the day from east to west, tracking the sun. The tracking system is estimated to have a tracking range of 120 degrees, or ≤ 60 degrees from the horizontal position.

The standard dimensions of PV solar panels are up to 2.4 m tall by 1.3 m wide, which provides a surface area of approximately 3 m^2 per PV solar panel. PV solar panels are designed for maximum light absorptivity and constructed of solar glass with anti-reflective surface treatment. The PV modules would have a height of approximately 3.1 m at full tilt, with a maximum of 4 m in some areas due to undulating topography throughout the Project Area.

Photo 1.1 Example of Solar Panels (Umwelt, 2021)

Photo 1.2 Example of Typical Single Axis Tracking System

1.3.2 Onsite Electrical Reticulation and Substation

The solar arrays would be connected to the onsite substation via a network of underground cables which are buried in trenches (up to one metre deep and 0.3 m wide). The electricity generated by the Project would be directed via these cables to the inverters. The number of inverters would be dependent on the final detailed design; however, it is estimated that approximately 140 inverters grouped in blocks of two would be required. The inverters change the direct current (DC) electricity generated into alternating current (AC), so that it is in a useable form to transport across the grid. In addition to this, power transformers would be required to step up voltage to the solar farm reticulation voltage, medium voltage switchgear and communication and ancillary equipment.

The Project would include an onsite substation, to be in the south-eastern corner of the Project Area (refer to Figure 1.2 of the Amendment Report (copied here in **Appendix 1**). The substation would include a range of electrical equipment to manage and control the supply of electricity (up to 10 m in height) and a lightning rod up to 18 m in height. The substation would include an elevated busbar, switch room, lightning protection system, circuit breakers, disconnectors, current transformers, voltage transformers, and a 500 kV transformer. The anticipated footprint of the substation is approximately 4 ha.

The substation would connect via overhead lines to the existing 500 kV transmission line that passes through the south-eastern corner of the Project Area. This transmission line is owned and operated by Transgrid, and the Project will connect directly to the national grid through this transmission line.

A transmission tower will be installed in the southeastern portion of Project Area as depicted in Figure 1.4 of the Amendment Report (copied here in **Appendix 1**), adjacent to the existing 500 kV transmission line easement. The transmission tower would be constructed at a height of approximately 65 m, in line with existing transmission towers within the Project Area.

1.3.3 Battery Energy Storage System (BESS)

The Project is considering three BESS options including a centralised BESS, a decentralised BESS or the option for both a centralised and decentralised BESS system combined.

The centralised system would include a BESS with a capacity of up to 450 MWp/900 MWh. The BESS would most likely comprise of a lithium phosphate iron battery system, to be housed in a series of outdoor containers, aggregated in one central location. The BESS would be located adjacent the substation in the south-eastern corner of the Project Area.

The decentralised system would include a BESS with a capacity of up to 580 MWp/1160 MWh. The decentralised BESS option involves 560 individual 6.1 m (i.e., 20 foot) battery containers and DC-DC converters, and associated infrastructure situated next to the PV inverter stations located throughout the solar arrays. The layout of the centralised and decentralised options is shown in Figure 3.5 and Figure 3.6 respectively of the Amendment Report (copied here in **Appendix 1**).

The third option would include both centralised and decentralised BESS units, with a combined BESS capacity of 1,030 MWp/2,060 MWh.

1.3.4 Access, Parking and Security Fencing

Three access points are to be provided along the western boundary of the Project Area off Wollara Road, as shown in Figure 1.2 of the Amendment Report (copied here in **Appendix 1**). The two northern-most access points would be provided for emergency access only, with primary access provided through the southernmost point (the existing access point for the property).

Major solar components would be delivered to the Port of Newcastle and transported to the Project Area by truck via the New England Highway and through to the Golden Highway, Ringwood Road and Wollara Road. All vehicles will travel from the north and enter the Project Area from the southern entrance off Wollara Road through the primary access point. Construction vehicles would be restricted to a left in and left out movement at the Golden Highway and Ringwood Road intersection, facilitated by the use of an existing vehicle turning area on Barnett Street which will allow for return traffic towards Merriwa.

Landowners consent has been obtained refer Appendix B of the Amendment Report.

Approximately 49 km of internal wet weather access roads would be constructed to provide access to the various areas of the site for construction as well as to facilitate on-going operations and maintenance.

Internal access roads would be constructed of compacted gravel and predominantly 4 m wide. The main access track footprint will be 8 to 10 m wide in order to accommodate transformer delivery to the substation, allow for the safe delivery, unloading and installation of key components, and allow for the subterranean transmission corridors which will be used as part of the internal reticulation network. These subterranean transmission corridors will travel parallel to selected internal access roads.

During construction, a suitable number of parking spaces will be available within the temporary laydown areas. The indicative location of laydown areas is illustrated in Figure 1.2 of the Amendment Report (copied here in **Appendix 1**).

The perimeter of the Development Footprint would be enclosed by security fencing (no security fencing is proposed around the Project Area boundary), approximately 2.3 m high, subject to final design. The Project is committing to avoid use of barbed wire, to minimise the risk of harm to wildlife. The security fencing would involve casting concrete footings for posts and installing fencing mesh. Fencing will restrict public access to the Development Footprint and is required under *Australian Standard (AS) 1725.2010 Parts 1-5.* CCTV cameras and security lighting would also be provided around the onsite substation, maintenance buildings and offices and the full length of the perimeter of the Development Footprint.

1.3.5 Operations and Maintenance Facility

A permanent operations monitoring and maintenance facility would be constructed to support the ongoing operation of the solar farm. The operation and maintenance facility would be used on an ongoing basis to support maintenance and repair activities. This would include an office with staff amenities (kitchenette, toilets, showers), car park, workshop/shed and laydown/temporary storage area. The facility would have a footprint of approximately 10 ha (refer to Figure 1.2 of the Amendment Report (copied here in **Appendix 1**)).

1.3.6 Construction Workforce

The Project would generate approximately 350 jobs during the peak months of the construction period. Onsite workforce numbers would vary from month to month, depending on the intensity of the proposed works at the time. The workforce would include licensed electrical trade personnel, mechanical and electrical trades assistants, machinery operators, riggers, and labourers.

Lightsource bp aims to hire 10% (or 35 FTE positions) local labour for construction, and source local sub-contractors and suppliers. It is envisaged that the majority of the local workforce would be residing in towns within one hour's drive from the site (i.e., Merriwa, Mudgee, Gulgong and Rylstone). The majority of the non-local workforce during the peak construction phase are proposed to be housed in a temporary workforce accommodation facility in Merriwa.

1.3.7 Road Repairs and Upgrades

The Project would require road repairs and upgrades on Ringwood Road, Wollara Road and the intersection of Golden Highway and Ringwood Road, which are located outside the Project Area. Roadworks will be completed prior to the commencement of construction of the solar farm. The location of these road repairs and upgrades are provided in Figure 3.2, Figure 3.3 and Figure 3.4 of the Amendment Report (copied here in **Appendix 1**) and the detailed designs are provided in Appendix D of the Amendment Report.

Upgrades to culverts at existing road crossings of Bow River and Killoe Creek located on Ringwood Road. The culvert upgrades will include:

- Installing culverts designed to accommodate two-way heavy vehicles, including B doubles and various farm machinery.

- Culvert width 7 m (3.5 m lane width) sealed carriageway with suitable guardrail and signage and associated drainage works.
- Stockpile site to be located on disturbed land within the road reserve in consultation with the Upper Hunter Shire Council.
- Temporary side track at both locations to facilitate access during construction (also within road reserve).

Upgrades to Wollara and Ringwood Roads including:

- Upgrades to culverts at the existing road crossings of Bow River and Killoe Creek located on Ringwood Road.
- Widening and resealing of 1.8 km of Ringwood Road between Bow River and Killoe Creek.
- Realignment, widening and sealing 1.6 km section of Ringwood Road between Killoe Creek and Binks Road
- Realignment, widening and sealing a 4.7 km unpaved section of Wollara Road between the Goulburn River National Park boundary and 1621 Wollara Road. No upgrades are proposed in the portion of Wollara Road within the Goulburn River National Park.
- These upgrades will include eight (8) m bitumen-sealed formation with a minimum of 500 millimetre (mm) unsealed shoulders. The horizontal and vertical alignment of the proposed road will ensure safe sight distance and an improved road network for the users.
- The proposed Wollara Road and Ringwood Road upgrades are illustrated on Figure 3.3 of the Amendment Report (copied here in **Appendix 1**) below.

Upgrades to the intersection of the Golden Highway and Ringwood Road in line with Austroads Safe Intersection Site Distance (SISD) standards. These upgrades would include:

- Pruning and removal of vegetation and select trees on the western side of the intersection on Lot 1 DP34496. Currently estimated at six (6) established trees.
- The construction of a 325 m acceleration/merge lane to allow vehicles to safely turn left onto the Golden Highway from Ringwood Road.
- Realignment of the existing low voltage power line to provide clearance to the acceleration lane (if required and subject to detailed design).
- Extension of the existing Golden Highway westbound and Ringwood Road left-in deceleration lane taper to 30 m and widening of the intersection.
- Pruning of vegetation on the eastern side of the intersection, wholly within the road reserve.
- Formalisation of the informal bus stop on Ringwood Road at the intersection with Golden Highway (Lot 7303 DP1146691).
- The proposed Golden Highway and Ringwood Road upgrades are illustrated on Figure 3.2 and Figure 3.3 of the Amendment Report below (copied here in **Appendix 1**).

1.3.8 Site Preparation and Earthworks

The first stages of construction within the Development Footprint would include:

- Site survey, based on initial geotechnical investigations and LIDAR data, to confirm infrastructure positioning and placement.
- Ongoing geotechnical investigations to confirm the ground conditions.
- Biosecurity controls (e.g., weed spraying) prior to ground disturbance commencing.
- Construction of internal access tracks for accessing the site from the local road network and car parking, including creek crossings (i.e., small culverts and bed level crossings).
- Installation of temporary construction fencing around work areas and boundary fencing.
- Establishment of temporary construction compounds, site facilities and laydown areas for construction materials and equipment (refer to Section 1.4.4 of the EIS).
- Preliminary earthworks and installation of environmental controls including erosion and sediment control structures.
- Identification and establishment of no-go zones around sensitive biodiversity and heritage features as required.

The need for heavy earthworks and compaction will be minimised as much as practicable, although some grading and levelling is likely to be required for the substation and BESS.

1.3.9 Temporary Construction Facilities

To facilitate construction of the Project, a range of temporary buildings and facilities will be required within the compound area. Temporary staff amenities would be designed to accommodate the number of workers at the peak of the construction period, and include:

- Car parking.
- Staff offices.
- Control room.
- Lunchroom and first aid room.
- Toilet and shower facilities.
- Water tanks.
- Covered walkways.
- Covered storage area.
- Associated data, water, and electrical reticulation.
- Emergency helipad (as part of site compound).

1.3.10 Infrastructure Installation

The construction and commissioning phase of the Project is anticipated to involve the following works:

- Installation of steel posts and framing system to support the solar panels, which would be driven or screwed into the ground to a depth of approximately 1.5 to 2.4 m depending on geotechnical conditions.
- Installation of PV panels.
- Installation of permanent fencing and security.
- Preparation of foundations for the permanent buildings, BESS and on-site substation.
- Installation of underground cabling (trenching and installation of power conversion stations).
- Construction of site operations and maintenance facility.
- Establishment of the BESS.
- Construction of the onsite substation and associated grid connection infrastructure.
- Construction of the Project transmission tower.
- Testing and commissioning of infrastructure.
- Removal of temporary construction facilities.
- Revegetation of disturbed areas.

It is expected that some of these construction tasks would occur concurrently. It is noted that the solar arrays would be sited above the ground and existing ground cover would be maintained underneath, to facilitate potential sheep grazing across the site and maintain biodiversity values.

1.3.11 Construction Hours

The construction phase is expected to be undertaken over approximately 27 months from the commencement of site establishment works. It is anticipated that construction works would commence in mid-2024.

1.3.11.1 Solar Farm Site Construction Hours

It is anticipated that construction works would be undertaken both during and outside standard construction hours (as defined by the Interim Construction Noise Guideline (ICNG) (Department of Environment and Climate Change, 2009). Proposed construction hours are:

- 6:00 am to 6:00 pm – Monday to Friday.
- 6:00 am to 6:00 pm – Saturday.
- Sunday and Public Holidays – no works to be completed.

Exceptions to these hours may occur, however would be limited to activities with low noise generation, where practicable, which would be assessed on a case-by-case basis prior to commencement of those activities.

An indicative timeline for the Project phases is outlined in **Table 1.2**.

Table 1.2 Indicative Timing

Phase	Approximate Commencement	Approximate Duration
Construction & Commissioning	2024	27 months
Operation	2026	40 years
Decommissioning[1]	2064	8 months

1.3.11.2 Road Repairs and Upgrades Construction Hours

Construction hours for the road repairs and upgrades will be undertaken within the ICNG standard hours as there are sensitive receivers closer to these works than that of the solar farm site. Proposed construction hours are:

- 7:00 am to 6:00 pm – Monday to Friday.
- 8:00 am to 1:00 pm – Saturday.
- Sunday and Public Holidays – no works to be completed.

The construction of the road repairs and upgrades package is estimated to require three (3) months to be delivered prior to primary construction works commencing on the Solar Farm. Road repairs and upgrades are anticipated to occur in 2024 and are accounted for within the 27 months of the construction period.

1.3.12 Construction Traffic

During the peak of the construction period, the majority of personnel would travel to the Project Area on a daily basis via shuttle buses to be provided from a temporary workforce accommodation facility in Merriwa, requiring approximately 15 two-way shuttle bus trips per day. Assuming some of the other personnel would carpool (at a rate of 1.2 people per private vehicle) there would also be approximately 60 two-way light vehicle trips per day. Although many of the shuttle buses and light vehicle traffic would travel to the site from the north, some movement of locally-based personnel via light vehicles from the south is also anticipated.

Heavy vehicle transportation would be restricted to accessing the site from the north. It is anticipated that 55 two-way heavy vehicle trips per day would be required during the peak construction period. There are expected to be approximately six (6) oversize overmass vehicle movements during the construction period, which will be under traffic management.

[1] After the operational period the solar farm would either be decommissioned, removing all infrastructure, and returning the site to its existing pre-solar agricultural land capability, or repurposed with new PV equipment subject to additional technical feasibility and planning consents.

As noted in Section 1.3.4 of the EIS, all Project construction vehicles will be limited to a left in left out manoeuvre at the intersection of Ringwood Road and Golden Highway. Construction vehicles will be diverted to a privately owned vehicle turning area on Barnett Street.

Mobilisation to site would be expected to occur for the first three months of the Project delivery timeframe and heavy vehicle movements during this period are anticipated to include:

- Delivery of infrastructure including temporary offices and associated equipment, power generation equipment, ablutions.
- Delivery of equipment and machinery for civil construction, clearing (if required) and general site establishment.
- Delivery of structural components and some PV equipment.

More intense construction would be expected to follow during months 3 to 20, to achieve mechanical completion with the following heavy vehicle movements:

- Delivery of equipment and machinery for structural, electrical, and civil construction activities.
- Ongoing delivery of PV and electrical equipment including deliveries of major equipment such as inverters, switchgear, transformers etc.
- Trucks for removal of waste.

Following mechanical completion, the site will move into a commissioning phase estimated to occur during months 20 to 27 where both equipment deliveries and the workforce would be significantly reduced. During commissioning, most of the traffic would be expected to be light vehicles for personnel movement.

Construction traffic generated during the road repairs and upgrades along Ringwood Road, Wollara Road and the Golden Highway and Ringwood Road intersection upgrade are anticipated to be lower than the number of vehicles generated during the construction of the Solar Farm site. Impacts from these works in general are considered low, given the low volume of traffic on this road.

A detailed assessment of traffic movements and transport routes is provided in Section 6.9 of the EIS and Section 7.1 of the Amendment Report.

1.4 Operations and Maintenance

Once fully operational, activities will include:

- Routine visual inspections, general maintenance and cleaning operations of the solar arrays and substation, as required.
- Vegetation management including potential sheep grazing and the use of seeding or armouring (i.e., jute mesh) to avoid erosion.
- 24-hour site security response.
- Replacement of equipment and infrastructure, as required.

- Pest and vermin control.
- Livestock operations.

During the operational phase of the Project, it is anticipated that a workforce of up to 10 FTE personnel would be required, and traffic movements would be restricted to light vehicles for routine operations and maintenance.

1.5 Decommissioning

The Project is expected to operate for 40 years or more. After the initial 40-year operating period, the solar farm would either be decommissioned, removing all infrastructure, and returning the site to its existing pre-solar agricultural land capability, or repurposed with new PV equipment subject to additional technical feasibility and planning consents.

At the end of the useful life of the asset, decommissioning would involve the mobilisation of a workforce and additional temporary facilities, and the subsequent removal of equipment and infrastructure. At this time, it is expected that significant movements of light vehicles and trucks for transporting waste would occur. The decommissioning phase would be expected to last less than eight months.

During decommissioning, works would include:

- Removal of solar arrays, including the foundation posts, and sorting and packaging of all materials for removal from the site and recycling and/or reuse.
- Removal of all site amenities and equipment, and recycling and/or reuse of materials wherever practicable.
- Removal and recycling of posts and cabling and removal of security fencing including small concrete footings, unless otherwise useable for livestock operations.

1.6 Services and Utility Supply

1.6.1 Water

The Project would require a water supply during the construction, operational and decommissioning phases.

During construction, water would primarily be used for the establishment of hard-stand areas and dust suppression. The associated water demand would likely be in the order of 11.26 megalitres (ML) for the 27-month construction period. Water for construction would be sourced from commercial suppliers in the nearby region (via water trucks) and farm dams located within the Project Area. Water sources would be determined prior to the commencement of construction in consultation with suppliers and landholders. Town water supplies will be generally avoided for use in construction but may be used where appropriate and available. It is anticipated that during construction 3,000 L would be used on site daily at the operations and maintenance facility.

During operations, it is expected that approximately 3 ML of water per year would be required for ongoing maintenance activities such as fire mitigation and for livestock grazing within the Development Footprint.

Panel cleaning is expected to require 8 ML per year noting washing of the panels would not require any detergent or cleaning agents. Road maintenance works that require water usage are anticipated to require 2 ML per year.

Potable water supplies would be required for staff amenities. Rainwater would be collected onsite through tanks across the Project Area with supply supplemented by water trucks.

1.6.2 Electricity

Access to electricity during operational activities would be via a dedicated low voltage feeder from the substation, battery backup is provided for essential services at the Operation and Maintenance Facility (O&M Facility). During construction electricity access would be via the local distribution network or alternatively a diesel generator when required.

Electricity requirements during operation would include lighting at ancillary infrastructure (office, workshop, amenities, and parking), power for internal office facilities and appliances, and onsite security systems. Electricity generated by the solar farm would be used for most activities during operations via a dedicated low voltage feeder from the substation, except for maintenance of the inverters during the night which would involve a small amount of auxiliary load being supplied from the grid.

1.6.3 Telecommunications

A telecommunications tower (approximately 30 m in height) would be installed within the Project Area in the substation compound area to support the Project and to facilitate communications between the solar farm site and nearby Transgrid substation. In addition, the telecommunications tower would provide radio communications coverage to the Project Area and wider region.

1.6.4 Sewer

There is no sewer access in the Project Area. Therefore, construction amenity facilities would be pumped out via tanker and delivered to the nearest sewage treatment facility, or as agreed with Upper Hunter Shire Council during construction.

It is likely that a septic system would be installed for the operational amenities. This would be constructed and managed in accordance with the relevant Council requirements. This would be in accordance with the Upper Hunter Shire Council Liquid Trade Waste Regulation Policy 2016.

1.7 Environmental Management

Lightsource bp would develop and implement an Environmental Management Strategy (EMS) as part of the Project to provide the strategic framework for environmental management. The EMS would:

- Incorporate a Construction Environmental Management Plan (CEMP), Operational Environmental Management Plan (OEMP) and Decommissioning and Rehabilitation Environmental Management Plan (DREMP), including all required sub-plans, protocols, management, and mitigation measures proposed in this EIS.
- Identify all relevant statutory approvals.

- Establish roles, responsibilities, authority, and accountability of all key personnel involved in the environmental management of the Project.
- Establish procedures for consulting with the local community and relevant agencies about the operation and environmental performance of the Project.
- Establish procedures for handling of complaints, disputes, non-compliances, and emergency response.

Appendix C of the Amendment Report provides a consolidated summary of the management measures that would be implemented during the construction and operation of the Project to manage, mitigate and/or monitor potential impacts identified within this EIS.

APPENDIX 1

Figures from EIS and Amendment Report

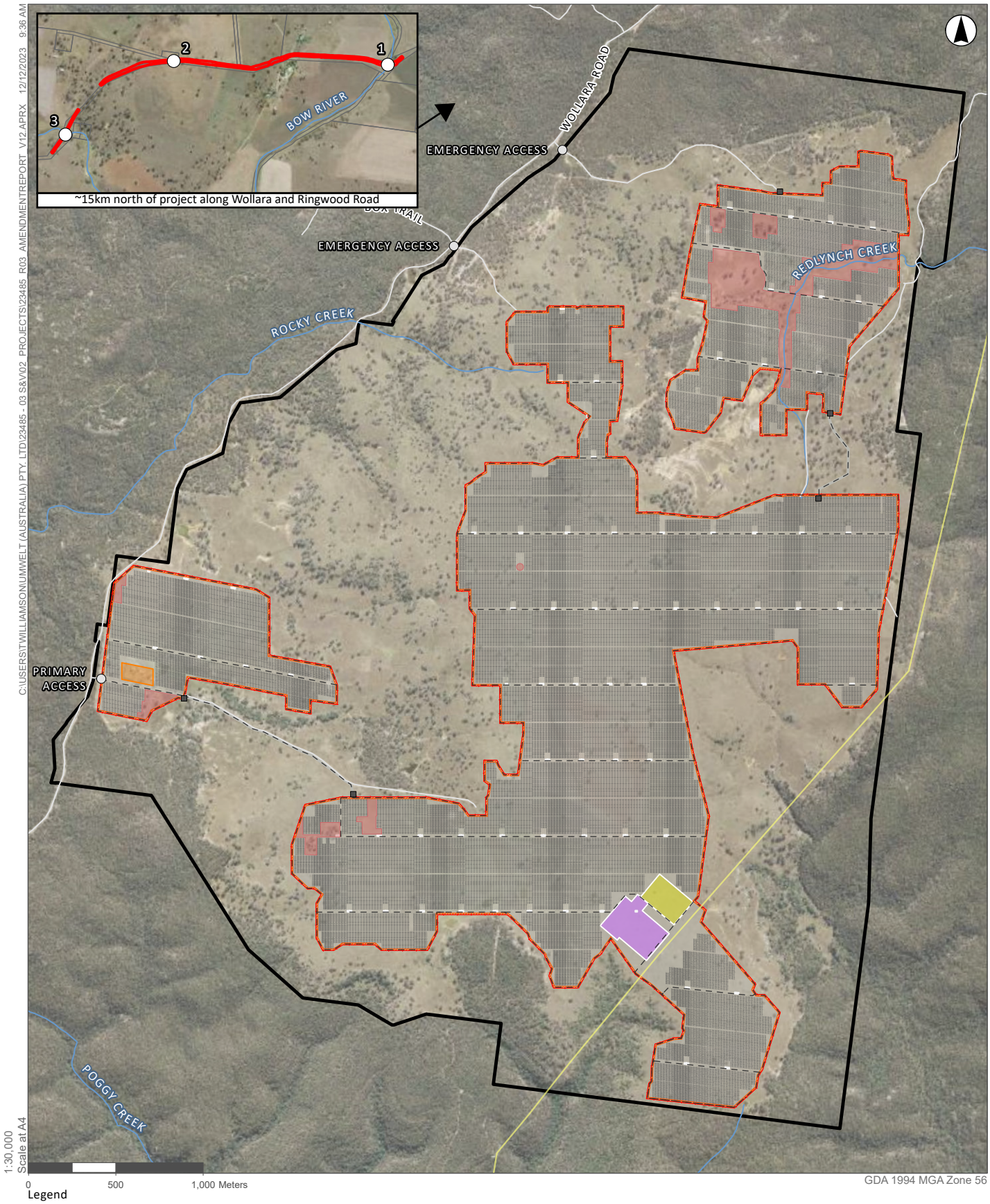


FIGURE 1.2

EIS Project - Development Footprint and Internal Layout

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)

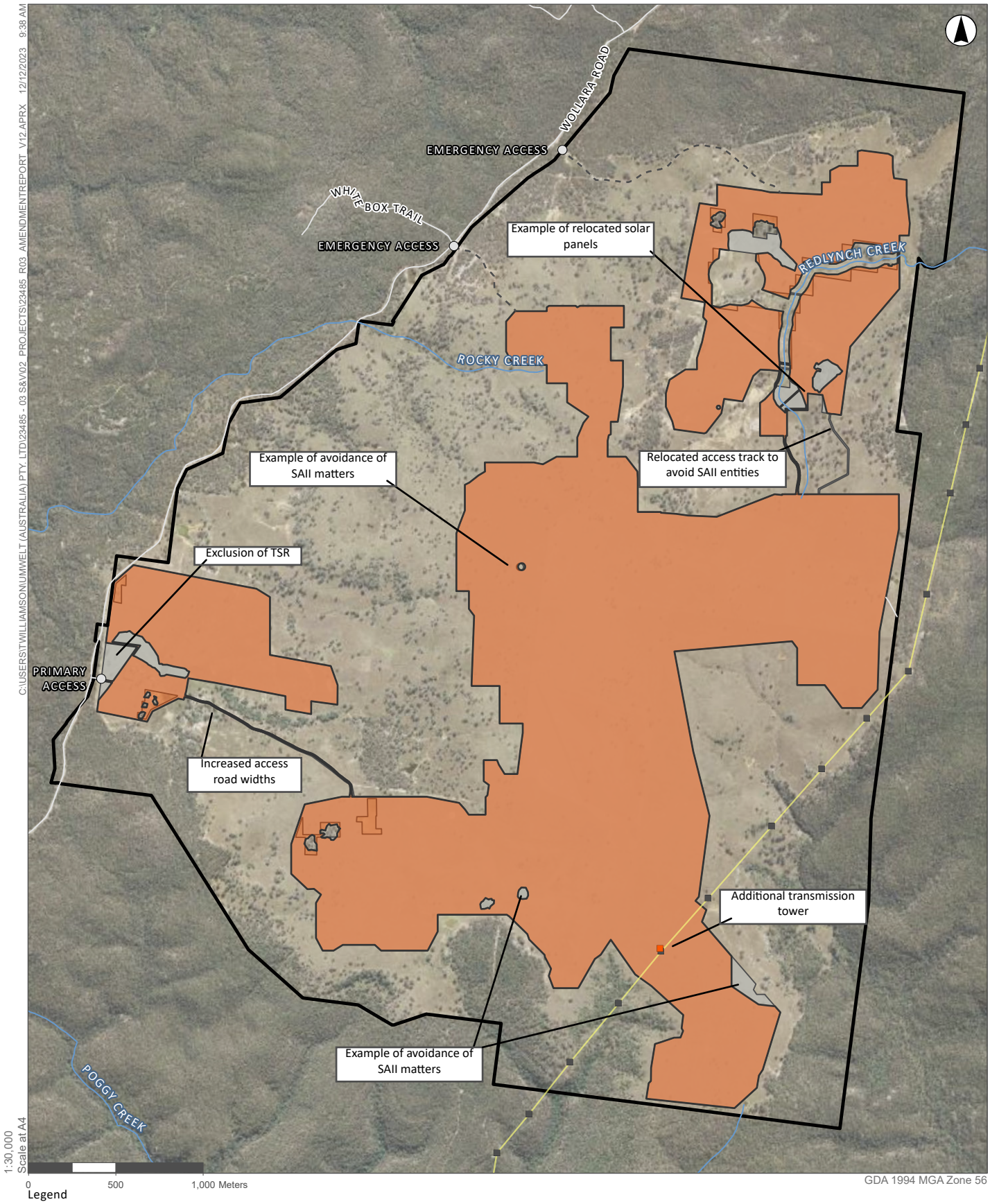


FIGURE 1.4

Summary of the Proposed Amendments to Development Footprint

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)

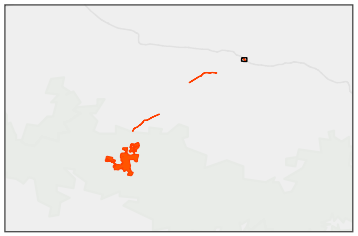
FIGURE 3.2

Amended Project - Golden Highway and Ringwood Road Intersection Upgrade

Legend

- Lot Boundary
- Waterbodies
- Road Upgrade Development Footprint

NOTE: Development Footprint comprises ground disturbance works within the road reserve and vegetation clearing/pruning on adjacent land



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Meters

Scale: 1:0 at A4
GDA2020 MGA Zone 56

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Image Source: ESRI Basemap (2022) | **Data Source:** NSW DFSI (2022)

FIGURE 3.3

Amended Project - Wollara Road and Ringwood Road Upgrades

Legend

- Watercourse
- Lot Boundary
- Waterbodies
- Road Upgrade Development Footprint

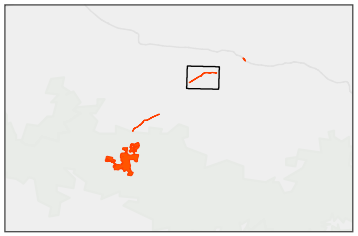

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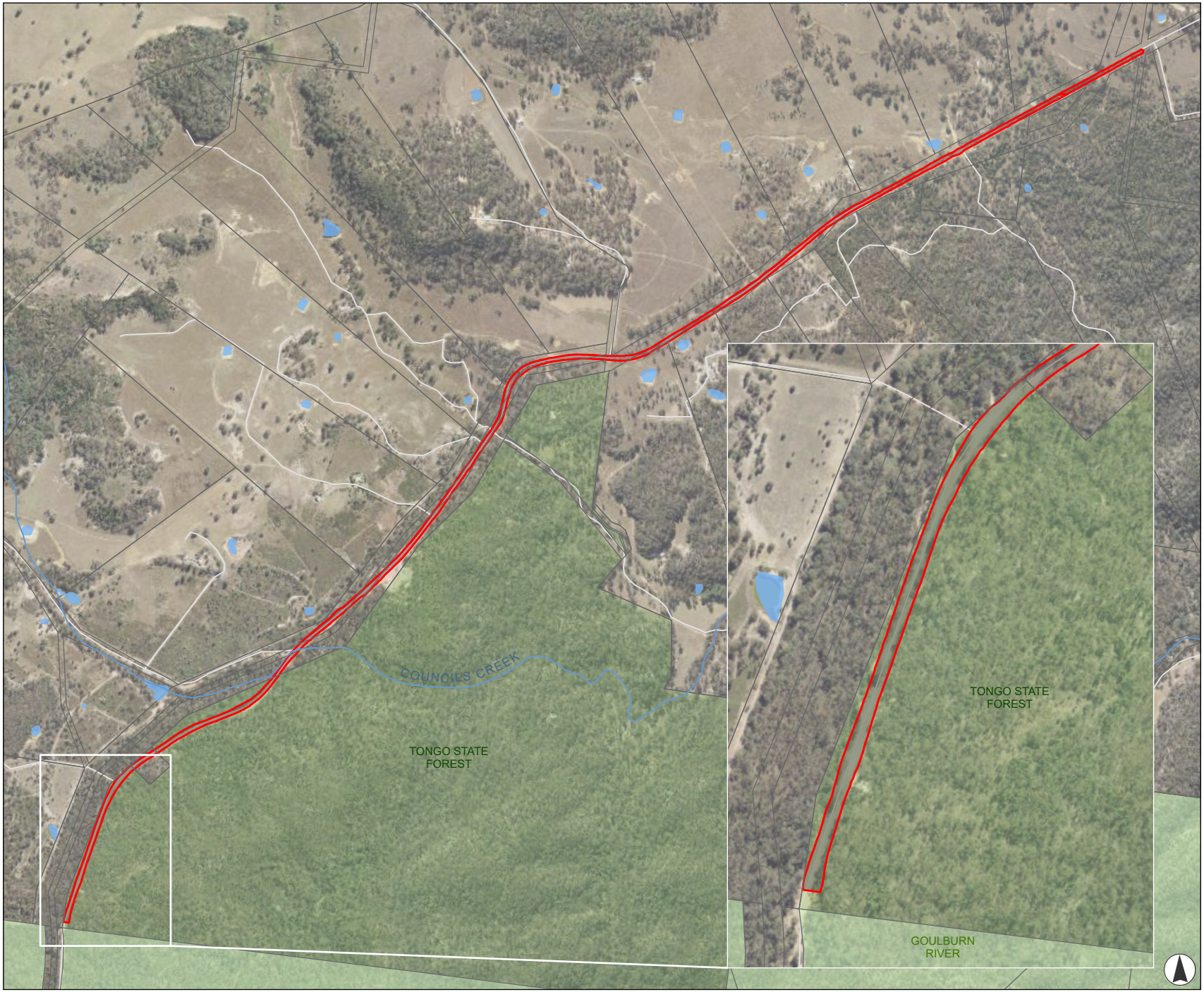
Image Source: ESRI Basemap (2022) | **Data Source:** NSW DFSI (2022)

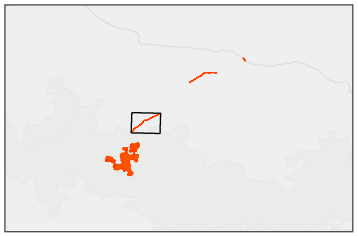
FIGURE 3.4

Proposed Section of Road Sealing along Wollara Road



Legend

- Watercourse
- Lot Boundary
- NSW National Parks
- NSW State Forests
- Waterbodies
- Road Upgrade Development Footprint



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Scale: 1:0 at A4
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Image Source: ESRI Basemap (2022) | **Data Source:** NSW DFSI (2022)

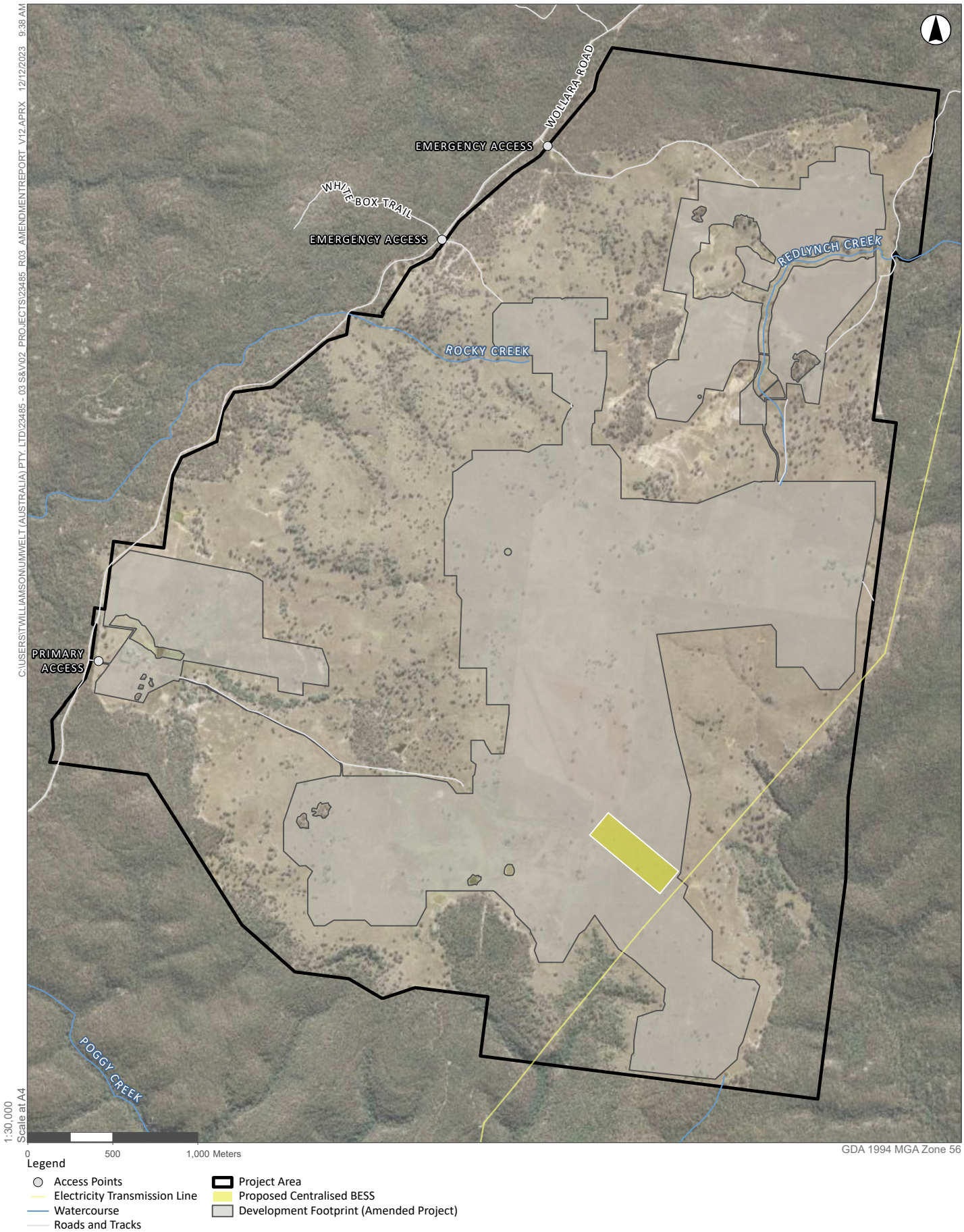


FIGURE 3.5

Proposed Centralised BESS Layout

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)

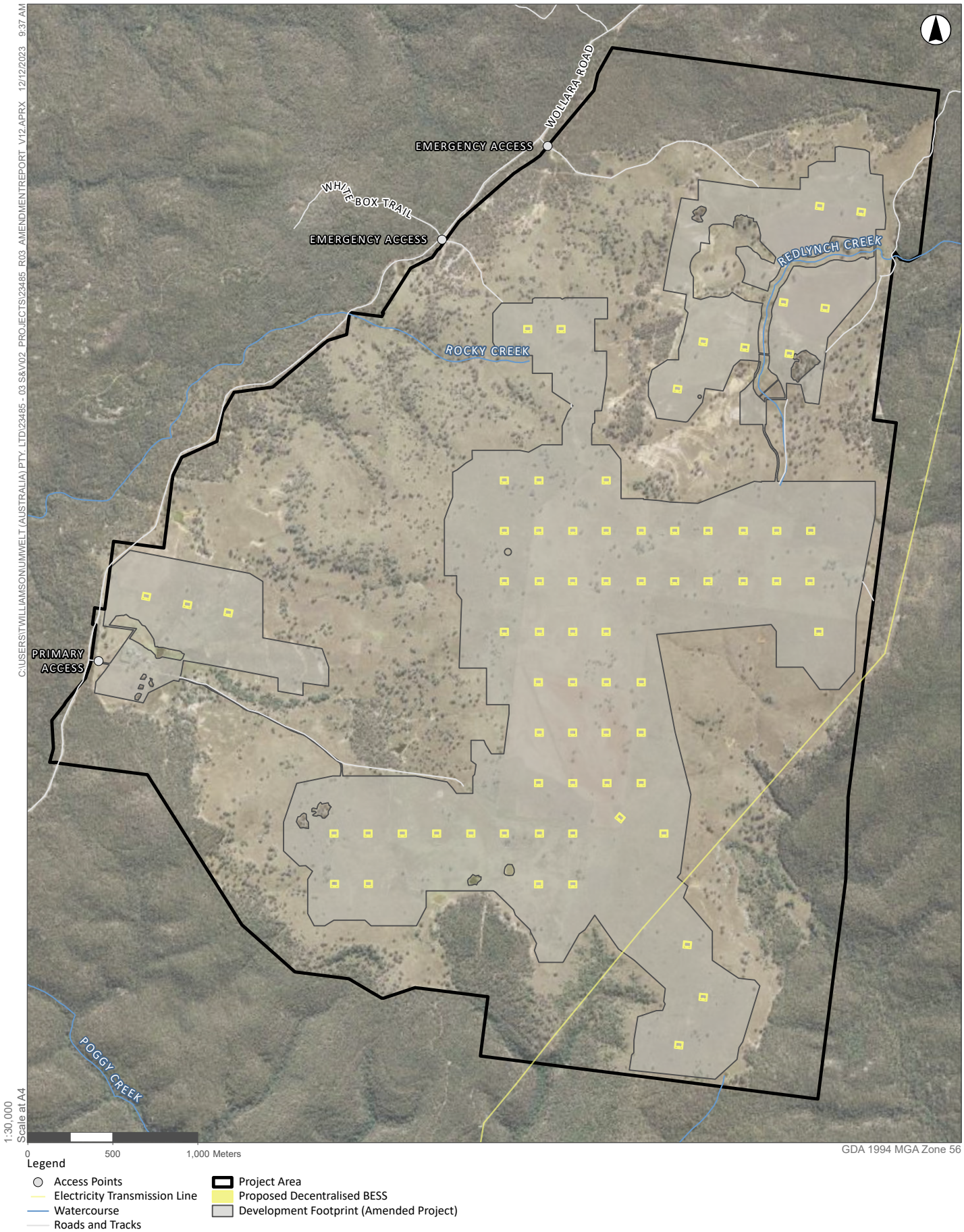


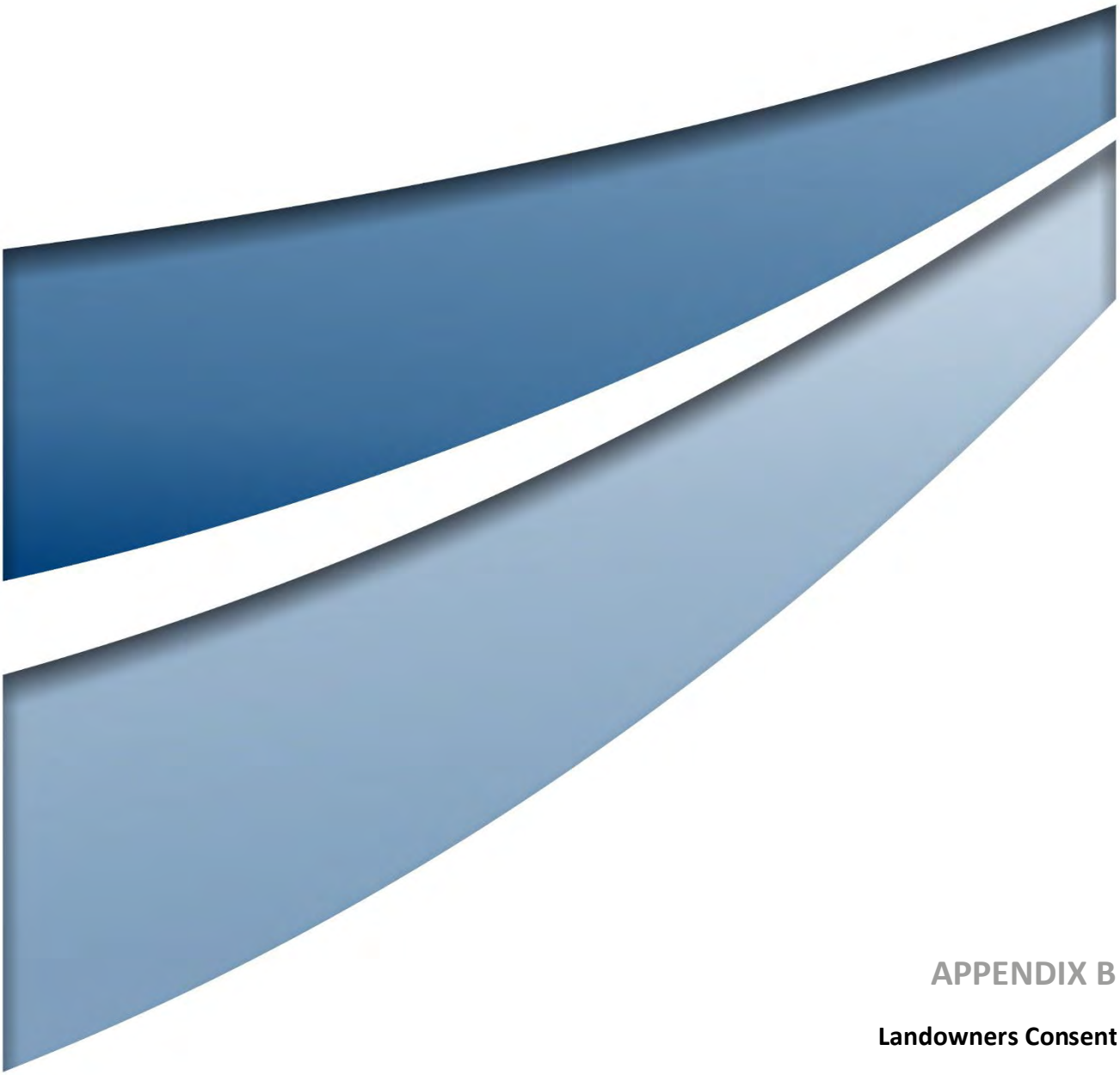
FIGURE 3.6

Proposed Decentralised BESS Layout

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)

umwelt
Environmental & Social
Consultants

Umwelt (Australia) Pty Limited
T| 1300 793 267 E| info@umwelt.com.au www.umwelt.com.au



APPENDIX B

Landowners Consent

lightsource bp

Lightsource Development Services Australia Pty Ltd
'CBW' Level 19, 181 William St
Melbourne
Vic 3000
Australia

Telephone 1300 873 575
www.lightsourcebp.com/au

27 September 2023

Ewan Davies,
Director, Energy Assessments
NSW Department of Planning and Environment
4 Parramatta Square
12 Darcy St.
Parramatta NSW 2150

Dear Ewan,

Forestry Corporation of NSW, being the owner of the Tongo State Forrest under the following titles references:

- Lot 78, DP 750956
- Lot 7005, DP1027957

Provide consent to the applicant,

Lightsource Development Services Australia Pty Limited ABN 26 623 301 799 of Level 29, 420 George Street, Sydney, NSW, 2000,

to apply to a consent authority under section 4.12 of the Environmental Planning and Assessment Act 1979 (NSW) for consent to carry out development, known as Goulburn River Solar Farm, under development application number SSD 33964533,

which is to be carried out on the land described above and includes the widening and sealing of Wollara road adjacent to, and on top of the title listed above.

Signature: JDashwood

Name: Jarod Dashwood
Position: Land Access Manager – Western Region
Date: 5 October 2023

Contact Name: Greg McDonald
Contact No: 6540 1126
Our Reference: OUT-8184/23

17 October 2023

~~Nicole Brewer~~ Iwan Davies
Director, Energy Assessments
NSW Department of Planning and Environment
4 Parramatta Square
12 Darcy Street
PARRAMATTA NSW 2150

Dear Nicole

Being the owner of the Council Public Road comprising:

- Ringwood Road, Merriwa;
- Wollara Road, Merriwa; and
- Barnett Street, Merriwa

Upper Hunter Shire Council provides consent to the applicant:

Lightsource Development Services Australia Pty Limited
ABN 26 623 301 799
Level 29, 420 George Street,
Sydney, NSW, 2000

to apply to a consent authority under section 4.12 of the *Environmental Planning and Assessment Act 1979* (NSW) for consent to carry out development, known as Goulburn River Solar Farm, under development application SSD 33964533, which is to be carried out on the land described in Figure 1.2 (Land Ownership). The development includes the following:

- the construction and operation of a photovoltaic generation facility with an estimated capacity of 550 MW;
- a Battery Energy Storage System (BESS) with an estimated capacity of 570 MWh and associated infrastructure including grid connection; and
- various road repairs and upgrades along Ringwood Road and Wollara Road, Merriwa.

Yours sincerely

Greg McDonald
GENERAL MANAGER

Letter to Applicant
Consent Granted
Department of Planning and Environment

Our reference: 23/00144#01
LOC No: 638122

Janet Meyn
janet.meyn@crownland.nsw.gov.au

7 March 2023

Via email: stephen.archer@lightsourcebp.com
diana.mitchell@lightsourcebp.com

Attention: Stephen Archer – Development Manager

Consent for Development Comprising:	Proposed as described below: • State Significant Development (SSD) application 33964533 for the purpose of the Goulburn River Solar Farm at Wollara Road, Merriwa (Refer DOC22/001292). • The Project will involve the construction, operation and decommissioning of a 520 megawatt (MW) solar farm with a Battery Energy Storage System (BESS) of approximately 520 MW-hours and associated infrastructure. The Project will connect to an existing 500 kilovolt (kV) transmission line via a proposed substation to be located in the south-eastern section of the Project Area. • The proposed Goulburn River Solar Farm (the Project) is located approximately 28 km south of Merriwa, New South Wales, off Wollara Road, within the Upper Hunter Local Government Area. The Project encompasses two freehold properties and some sections of Crown land and roads (approximately 21 ha), covering an area of approximately 2000 ha in total. The development footprint for the Project is approximately 882 ha)
Crown Land	Crown Land R44841 for purpose of travelling stock and Crown roads administered under the *Roads Act 1993.* Matters relevant to the Roads Act are central to the considerations for Landowners Consent as set out in the application.
Crown reserve	R44841 for purpose of travelling stock – Lot 7306 DP 1165073 (primary access point) and Lot 7308 DP 1165052 (2 x emergency access points).
Parish	Tongo

County	Brisbane
Applicant	Lightsource Development Services Australia Pty Limited

Consent is granted by the Minister for Lands and Water, to the lodgement of applications for approval under the *Environmental Planning and Assessment Act 1979*, and other associated applications required under other legislation, for the development proposal described above.

The Land Owner Consent is granted conditional to the following:

1. Land Owner Consent will expire after a period of 12 months from the date of this letter if not acted on within that time. Extensions of this consent may be sought.
2. You are required to forward a copy of the DA approval to the NSW Department of Planning and Environment – Crown Lands ("the Department") after approval and prior to commencing works.
3. You are required to ensure that the approval provided is consistent with this Land Owner Consent.
4. The Land Owner Consent is provided for the works detailed on the plans provided by you and retained by the Department as DOC23/002122.

Land Owner Consent is granted in accordance with the following:

- Land Owner Consent is given without prejudice so that consideration of the proposed development may proceed under the *Environmental Planning and Assessment Act 1979* and any other relevant legislation;
- The grant of this Land Owner Consent does not guarantee that any subsequent authority to occupy will be granted;
- Land Owner Consent does not imply the concurrence of the Minister for Lands and Water, for the proposed development and does not provide authorisation under the Crown Lands Act 1989 for this proposal;
- The issue of Land Owner Consent does not prevent the Department from making any submission commenting on, supporting or opposing an application;
- The Minister reserves the right to issue Land Owner Consent for the lodgement of applications for any other development proposals on the subject land concurrent with this Land Owner Consent;
- Any changes made to the proposal, including those imposed by the consent authority, must be consistent with the Land Owner Consent and therefore if modifications are made to the proposed development details must be provided to the Department for approval;
- Land Owner Consent also allows application to any other approval authority necessary for this development proposal.

This letter should be submitted to the relevant consent or approval authority in conjunction with the development application and/or any other application. You are responsible for identifying and obtaining all other consents, approvals and permits required under NSW and Commonwealth laws from other agencies for the proposed development.

It is important that you understand your obligations relating to Condition 3. If any alterations are made to the application (whether in the course of assessment, by

conditions of consent, or otherwise), it is your responsibility to ensure the amended or modified development remains consistent with this Land Owner Consent. If there is any inconsistency or uncertainty you are required to contact the Department before undertaking the development to ensure that the Department consents to the changes. A subsequent LOC application may incur additional application fees.

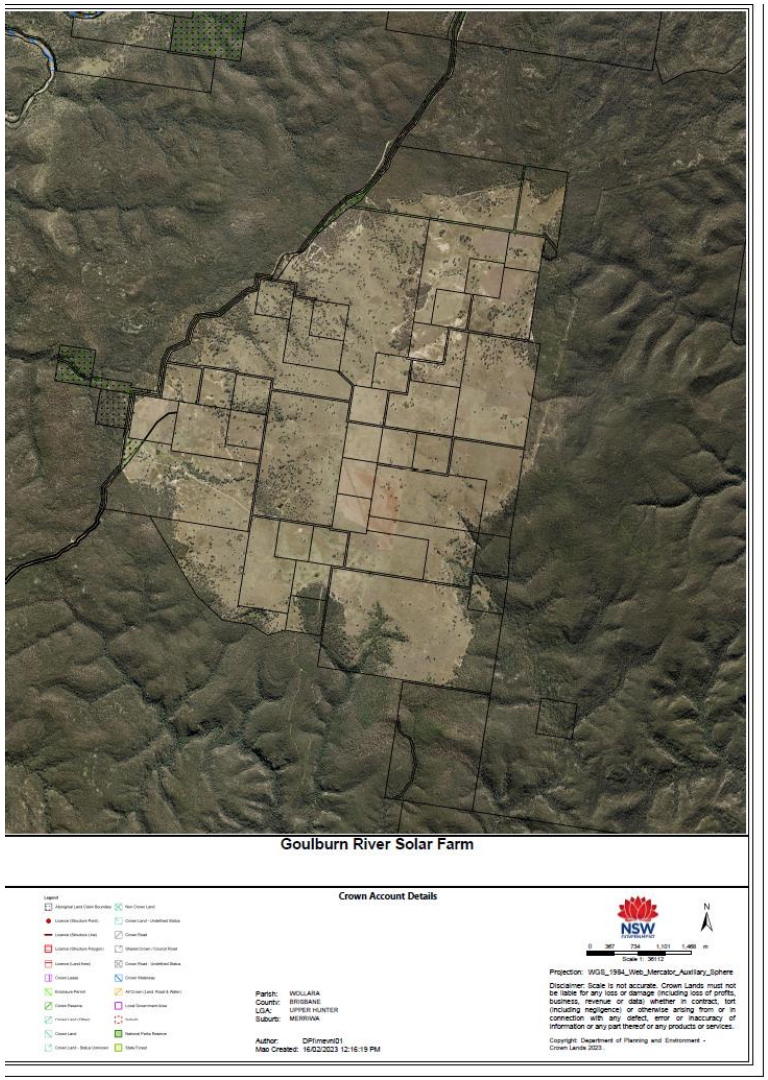
It is advised that the Department will provide the Department a copy of this Land Owner Consent and will request that the Department notify the Department of the subsequent development application, for potential comment, as part of any public notification procedure.

For further information, please contact Janet Meyn.

Yours sincerely

Janet Meyn
Senior Property Management Officer
Department of Planning and Environment - Crown Lands

Attachment A – Location Map



19 July 2023

RESERVE USE PERMIT P23/011

This Permit authorises:

Name of Applicant: Stephen Archer

On behalf of Organisation: Lightsource Development Services Australia Pty LTd

Address: 'CBW' level 19, 181 William St Melbourne VIC 3000

Phone: **Mobile:** 0484683245 **Email:** Stephen.archer@lightsourcebp.com

Proposed Activity: Access through TSR to undergo Possible upgrades of the existing road and driveway. Routine access, and permission to upgrade Wollar Rd and driveway where it is TSR

Date(s) of proposed activity: 1 July 2023 – 30 June 2024

Reserve No/Name: **R44841** - Poggy TSR - **DP 1165073, 7304,7305,7306; DP1165052/7308; DP114853/7309**

Location of Reserve: Ringwood Rd, Merriwa NSW 2329

Fee (including GST) $2000.00

CONDITIONS – As per attached

Additional Conditions that must be followed include:

- The maintenance and upgrades of the road will occur at no cost to LLS and be completed to an accepted standard

Apiarist Registration No: N/A

Insurance Details:

Insurance Company:
AON Chubb Insurance Company Australia

Policy No: 04CI012482 **Amount of Cover:** $20,000,000

Commencement & Expiry Dates: 31 October 2022 to 31 October 2023

I hereby agree to abide by the relevant provisions of the Local Land Services Act 2013 and the fees and conditions relating to this permit.

Signature of Applicant **Date:** 20/07/2023

Signature of Authorised Officer of Hunter LLS **Date:** 24/07/2023

Office Use Only	
Date Received:	
Receipt Number:	
Amount Received:	
Invoice No:	4000525161
Customer No:	10431210

Lightsource Development Services Australia
L29/420 George St
Sydney
2000
Australia

www.lightsourcebp.com

3/10/2022

Iwan Davies
Director, Energy Assessments
NSW Department of Planning and Environment
4 Parramatta Square
12 Darcy Street
Parramatta NSW 2150

Dear Iwan,

Being the owner of the land located east of the Ringwood Road / Golden Highway intersection, and the vehicle turning area on Barnett Street, Merriwa 2329, identified as the following title references:

- Lot 1 DP34496 (northwest of the Ringwood Road intersection)
- Lot 1 DP 1108292 (North of Barnett st truck turnaround)
- Lot 167 DP750913 (East of Barnett st truck turnaround)
- Lot 180 DP750913 (West of Barnett st truck turnaround)

provide consent to the applicant:

Lightsource Development Services Australia Pty Limited
ABN 26 623 301 799
Level 29, 420 George Street,
Sydney, NSW, 2000

to apply to the consent authority under section 4.12 of the *Environmental Planning and Assessment Act 1979* (NSW) for consent to carry out development associated the construction of the Goulburn River Solar Farm, development application SSD-33964533.

The construction of the Goulburn River Solar Farm Project would involve upgrades to the existing Ringwood Road and Golden Highway intersection to improve Safe Intersection Sight Distances (SISD) generally in accordance with Ausroad guidelines. The upgrades will involve the removal of vegetation on private property owned by the parties to this letter, and the installation of an acceleration lane within the Golden Hwy Road Reserve.

Further traffic design has also indicated that the use of the privately owned vehicle turning area on or adjacent to Barnett Street (council road), Merriwa, will be required to allow 19m semi's leaving the Project site to safety turn around and return east along the Golden Highway towards Merriwa. Minor ancillary upgrades and repairs may also be required to keep this asset in serviceable order during the construction of the project.

Signed,

As a director of Alexander Downs Pty Ltd

Address

Date:

or disseminating it or any information contained in it, save to the intended recipient.
Please consider the environment before printing this email

From: Wat Buddha Dhamma <wbdoffice@gmail.com>
Sent: Thursday, September 7, 2023 9:31 AM
To: Stephen Archer <stephen.archer@lightsourcebp.com>
Subject: Re: road upgrades adjacent to Tongo State Forest

Hi Stephen,

Thanks for the chat and info regarding the upgrades on Wollara Road. It's fine with us. However, we are looking to sell the property in the next six months. I guess the Forestry Dept will have the details of the new owner and will refer them to you in due time.

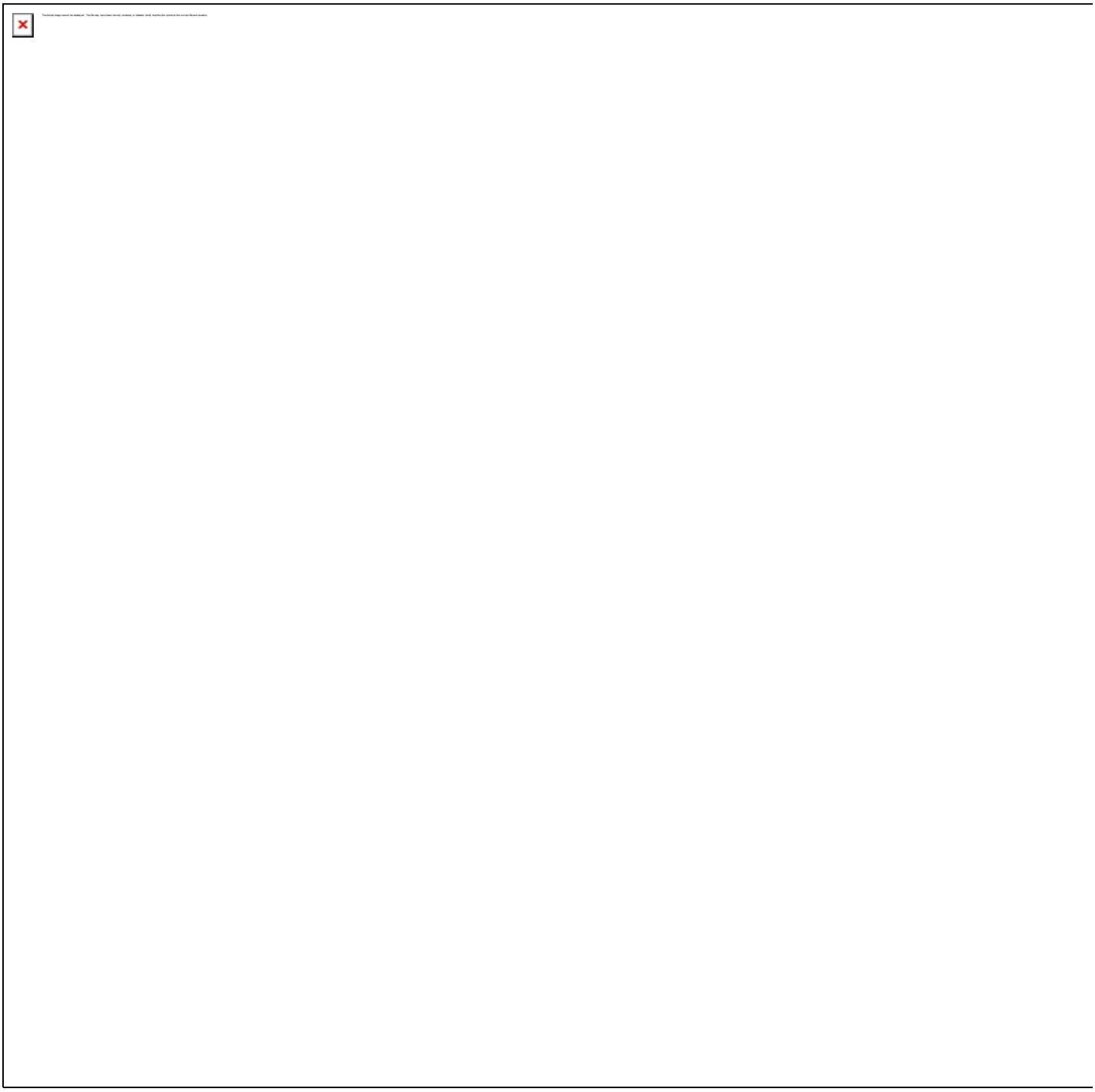
All the best with your project.

Regards,

Ajahn

On Mon, 4 Sept 2023 at 15:04, Stephen Archer <stephen.archer@lightsourcebp.com> wrote:

> Hi Ajahn,
>
> Thanks for speaking to me on the phone about our proposed upgrades to Wollara Rd in support of the Goulburn River Solar Farm at 2771 Wollara rd, Merriwa NSW.
>
> As mentioned, we are looking to widen and seal the gravel road adjacent to the Tongo State Forest, which your group has an interest in.
>
> At times, the road sways away from the road reserve and onto the State Forrest land, as a result some of the trees we remove and the works conducted will be within the State Forest.
>
> We estimate the works will take place between February and April of 2024
>
> The plans attached are for the road upgrades, however the image below shows the area of the road that sways into the State Forrest.
>
> If you can respond with any further questions you have about the works, otherwise an email noting you are aware of the works, it would be greatly appreciated.'
>
> Thanks



Stephen Archer Senior Development Manager | t +61283113058

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Please consider the environment before printing this email

From: Wat Buddha Dhamma <wbdoffice@gmail.com>
Sent: Thursday, August 31, 2023 11:20 AM
To: Stephen Archer <stephen.archer@lightsourcebp.com>
Subject: Re: road upgrades adjacent to Tongo State Forest

Hi Stephen,

Thanks for the introduction. You can call me 2 - 5 pm today or 8 -11 tomorrow at 0480105070.

Regards

Ajahn

On Wed, 30 Aug 2023, 15:43 Stephen Archer, <stephen.archer@lightsourcebp.com> wrote:

> Hi,
>
> Apologies for reaching out directly, I have been speaking with Jarod Dashwood from TfNSW and he passed me your email as the lessee of Tongo State Forrest.
>
> I was hoping to organize a call to introduce Lightsource bp, we have some proposed works due to commence later this year near Tongo State Forest, and we would like to inform you of the works prior to commencing.
>
> If you can please suggest a few times you are available to discuss it would be greatly appreciated.

Apologies again, Jarod didn't pass on any details apart from your email due to confidentiality.

Thanks

Stephen Archer Senior Development Manager | t +61283113058

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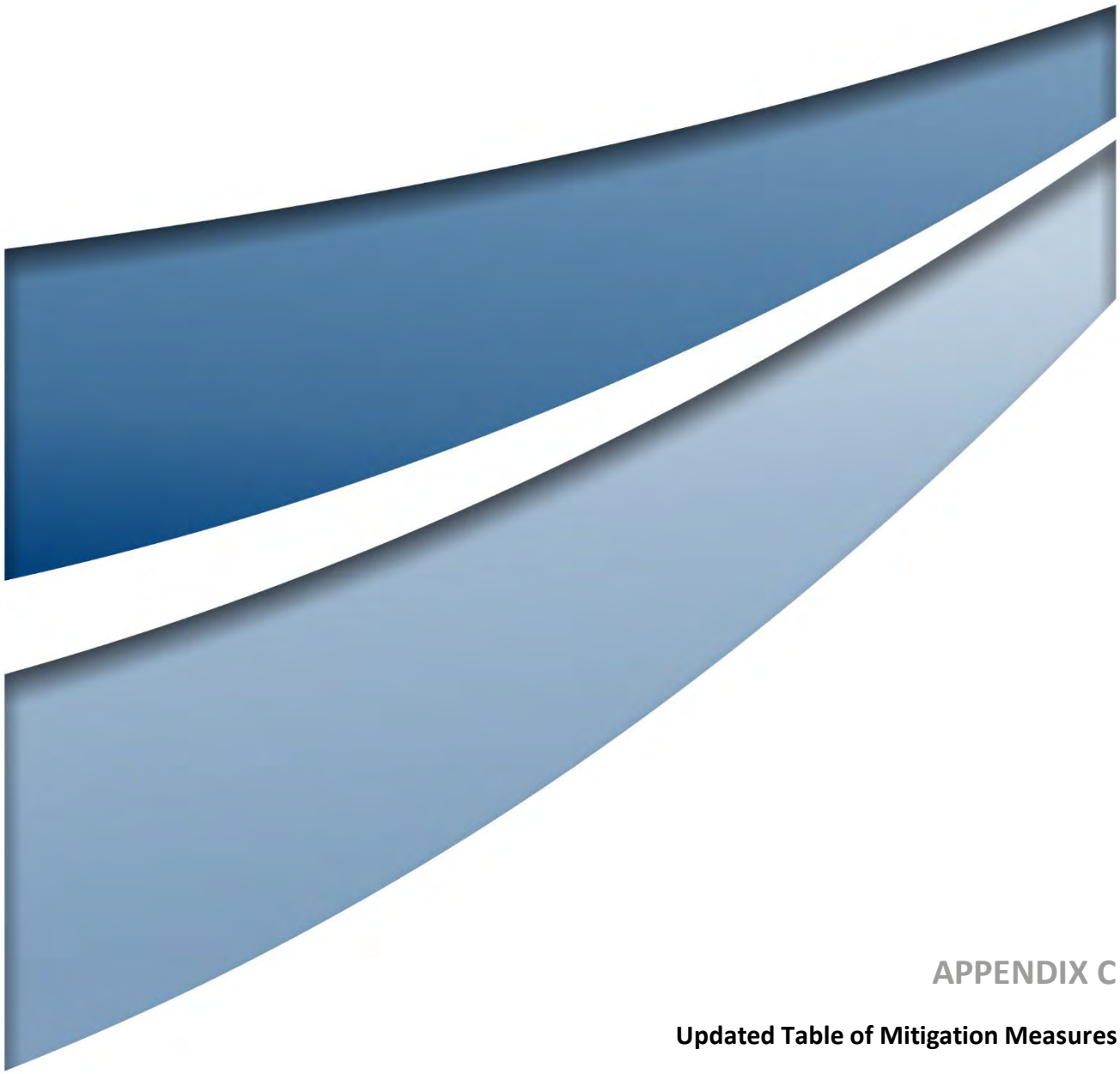


APPENDIX C

Updated Table of Mitigation Measures

Appendix C Mitigation and Management Measures

Lightsource bp (LSbp) will be responsible for implementing the management and mitigation measures identified in the EIS. The management and mitigation measures will be implemented through a Construction Environmental Management Plan (CEMP), Operational Environmental Management Plan (OEMP) and Decommissioning Environmental Management Plan (DEMP). These plans will be prepared sequentially, prior to each stage of the Project by LSbp and the relevant contractor, and in consultation with relevant Government Agencies.

Table C.1 provides a comprehensive list of the management and mitigation measures identified through the EIS applicable to the Project, mitigation and management measures added as a result of the RtS and outlined in the Amended Project and the relevant timing for implementation. Mitigation and Management measures added as a result of the RtS and Project review process are *italicised and rows shaded blue.*

Table C.1 Consolidated Management/Mitigation Measures (EIS Project and Amended Project)

Aspect	Management/Mitigation Measure	Timing
Terrestrial biodiversity	Maintain a wildlife corridor across the Project Area through retention of large areas of suitable habitat for the regent honey eater (*Anthochaera phrygia*) and White Box – Yellow Box – Blakely's Red Gum Grassy woodland and derived native grassland.	Life of Project (Construction, Operation and Decommissioning)
	Implement the following specific control measures to minimise the impacts of the Project on biodiversity: • workforce education and training • implementation of vegetation protection zones for areas to be retained • ecologist pre-clearance surveys and supervision of works • erosion and sedimentation control measures • weed management • fencing, access control and fauna exclusion measures.	Life of Project (Construction, Operation and Decommissioning)
	Develop a biodiversity offset strategy (BOS) in consultation with Biodiversity Conservation Division (BCD), DPE and DCCEEW based on the credits required to be retained to offset the impacts of the Project.	Pre-construction

Aspect	Management/Mitigation Measure	Timing
	The Biodiversity Management Plan will include implementation of measures to minimise fauna strike, as follows: • *Speed limits will be enforced on roads within the Project Area during construction and operation, to reduce the risk of fauna strikes.* • *Native fauna encountered along access tracks during construction and operation would be avoided and given an opportunity to move on.*	*Construction/Operation*
Aquatic biodiversity	During construction: • implementation of appropriate erosion and sediment controls • avoidance of waterfront land during construction works • provision of onsite spill kits for construction works within 100 metres of a watercourse • undertaking instream construction works (for access tracks) when watercourses are dry (where practicable) • design of any instream structures using relevant guidelines (to maintain fish passage and minimise impacts to natural flow regimes), particularly on watercourses mapped as Key Fish Habitat KFH • rehabilitation of disturbed bed and banks of watercourses mapped as KFH with stabilising vegetation • implementation of pre-clearance surveys carried out prior to construction, undertaken by a suitably qualified ecologist • implementation of an unexpected species finds protocol.	Construction
	During operation and decommissioning: • routine maintenance of vehicles (to reduce the risk of oil spills etc) • routine maintenance of culverts (to ensure they are clear of debris) • minimal use of herbicides to control exotic species (to reduce pollutants entering downstream watercourses) • re-establishment of native riparian vegetation endemic to the region and aquatic habitat features within and on the banks of any watercourses directly impacted.	Operation and Decommissioning

Aspect	Management/Mitigation Measure	Timing
	Sections of Redlynch Creek and the unnamed tributary of Rocky Creek containing bed and banks, are to be electronically mapped in order to identify Waterfront land. Waterfront land is measured as 40 m from the top of bank and any waterfront land disturbed is to be revegetated following completion of works.	*Pre-construction*
Aboriginal cultural heritage	Following development consent, the proponent will develop an Aboriginal Cultural Heritage Management Plan (ACHMP) which is to be agreed to by the RAPs and DPE (with input from Heritage NSW). The ACHMP will include an unanticipated finds protocol, unanticipated skeletal remains protocol, protocols related to heritage inductions for work crews, and long-term management of any Aboriginal sites being impacted.	Pre-construction
	Eight Aboriginal sites within the Development Footprint will be salvaged by a surface collection of visible artefacts. The recommended methodology for the salvage will be set out in the ACHMP and will include the measures outlined in Section 9.2.1 of the ACHAR.	Pre-construction
	Four of the seven trees of community interest will be retained. The three trees of community of community interest located within the Development Footprint will be removed in accordance with a methodology set out in the ACHMP.	Life of Project (Construction, Operation and Decommissioning)
	The ruins of the O'Brien homestead slab hut will be avoided from all ground disturbing impacts by a 20 metre buffer.	Life of Project (Construction, Operation and Decommissioning)
	The two identified sites of cultural significance that lie outside the Project access route/Development Footprint will be retained. The sites will be included on all applicable construction plans and the locations made known to all work crews working in the vicinity of the site to ensure the sites are not inadvertently harmed.	Pre-construction
	A reassessment and detailed mapping of the AHIMS site #37-1-0053 will be conducted in accordance with the provisions outlined in the ACHMP.	*Pre-construction*
	Four known Aboriginal sites, 37-1-1027 (Redlynch Creek IF1), 37-1-1032 (Ringwood Gully IF6), 37-1-1033 (Killoe Creek GG1), and 37-1-1037 (Rocky Creek Gully OS4) will not be harmed by the Project as they are located outside the Access route and the Development Footprint.	*Pre-construction*

Aspect	Management/Mitigation Measure	Timing
	Seven known Aboriginal sites, 37-1-1028 (Rocky Creek Slope IF2), 37-1-1029 (Wollara Road IF3), 37-1-1030 (Monaghans Creek IF4), 37-1-1031 (Rocky Creek Gully IF5), 37-1-1034 (Redlynch Creek OS2), 37-1-1035 (Redlynch Creek OS1), and 37-1-1036 (Redlynch Creek OS3) will be salvaged by a surface collection of visible artefacts. The recommended methodology for the salvage will be set out in the ACHMP and will include the measures outlined in Section 9.2.1 of the ACHAR.	*Pre-construction*
	Further recording and investigation of the grinding groove site (Killoe Creek GG1) will be conducted. The methodology of this investigation will be set out in the ACHMP but will include detailed mapping and photography of the site.	*Pre-construction*
	All land-disturbing activities must be confined to within the Addendum study area. Should the parameters of the proposed work extend beyond this, then further archaeological assessment will be required.	*Life of Project (Construction, Operation and Decommissioning)*
Historic heritage	Impacts to the areas of high historical archaeological potential should be avoided wherever possible. An exclusion zone of at least 20 m should be established around identified areas of high historical archaeological potential (e.g. slab hut).	Life of Project (Construction, Operation and Decommissioning)
	If impacts to areas of high historical archaeological potential cannot be avoided through design changes, further assessment and investigation would be required prior to the commencement of construction activities. This would include the preparation of an archaeological research design and test excavation methodology to confirm the extent of historical archaeological remains present, and the likely significance level of any historical archaeological remains on the site.	Pre-construction
	All contractors and project team for the Project should be made aware of the archaeological potential and heritage sensitivity of the site, through a heritage-specific induction which outlines their requirements under the *Heritage Act 1977* and the Project Approvals.	Life of Project (Construction, Operation and Decommissioning)
	An unexpected heritage finds protocol should be implemented for the construction works in the unlikely event that historical archaeological remains should be encountered during construction works.	Construction
Land	A CEMP will be prepared by Lightsource bp that identifies erosion and sediment control measures prior to works commencing.	Pre-construction

Aspect	Management/Mitigation Measure	Timing
	An ESCP will be developed as part of the CEMP, in accordance with the Managing Urban Stormwater: Soils and Construction Volume 1 (NSW DPIE, 2004) "The Blue Book". The ESCP will be implemented, and particular consideration of the dispersive soils identified within the Project Area will be considered.	Pre-construction
	Areas outside of the Developmental Footprint but within the Project Area may be established as a Biodiversity Stewardship Site. If determined to be compatible, cattle grazing will be facilitated throughout this area during operation.	Pre-construction
	If a sheep grazing trial is undertaken, the OEMP will incorporate a Sheep Grazing Vegetation Management Plan (SGVMP) that will outline measures for solar grazing in line with the Agrisolar Guide (2021) and other animal and welfare standards and guidelines. This will include measures to manage the stock appropriately, including a requirement to keep the stock in good health, ensuring frequent shearing (to keep wool growth low), ensure mustering is conducted in an agreed safe manner, and that any fatalities are managed. As a part of the OEMP a Wild Dog Management Plan will also be prepared for sheep grazing management.	Operation
	The OEMP will be developed in consultation with the host landholders and DPI Agriculture and will be implemented post construction.	Operation
	The Project Area will be rehabilitated to a condition as close as practicable to the condition that existed prior to construction of the Project and in consultation with the landowner. This will be achieved through the implementation of a Rehabilitation Management Plan as part of the OEMP for the Project.	Decommissioning
	The OEMP will detail the management requirements, including: • inspection of all vehicles and machinery entering the Project Area, and cleaning if applicable to remove weeds including seeds • appropriate weed management practices to be adopted, including regular weed spraying • appropriate pest management practices to be adopted • limit vehicle access to the established internal road network.	Life of Project (Construction, Operation and Decommissioning)

Aspect	Management/Mitigation Measure	Timing
	All areas disturbed by the Project during construction will be rehabilitated to maintain a groundcover (minimum of 70%) to prevent soil erosion following completion of construction and during operation.	*Operation*
	In the event that a sheep grazing trial is conducted, a Sheep Grazing Vegetation Management Plan will be prepared in consultation with DPI Agriculture.	*Operation*
	The local Land Services office will be contacted in the design of the OEMP with regard to the grazing and biosecurity content.	*Operation*
Visual	Retention of as much existing vegetation within the Project Area as possible.	Design
	Setback of the construction compound, vehicle parking and equipment storage areas from Wollara Road by a minimum of 50 m and partially screened from view (from Wollara Road) via existing and new vegetation screening.	Design
	Signage (if required) would be of sufficient size to contain only information sufficient for the basic facility and company identification, for safety, navigation, and delivery purposes.	Construction
	Where soil disturbance is required, wind erosion controls would be implemented including the use of water carts, covering of stockpiles and avoiding ground disturbance during windy conditions.	Construction
	Lighting would be installed in accordance with AS4228-1997 – Control of Obtrusive Effects of Outdoor Lighting and designed and installed to best practice principles identified within the Dark Sky Planning Guidelines.	Construction
	Where possible colour treat ancillary components of the Project.	Construction
	Landscaping in accordance with the draft Landscape Plan (prepared as part of the VIA) to screen views of the Project Area. The plan illustrates proposed tree and shrub planting on-site, along the western perimeter of the Project Area to screen views from Wollara Road.	Construction
	Monitor visual impacts. If social issues experienced, discuss possible remedies.	Operation
	Subsequent to Project approval, refine the landscape plan to encompass the Amended Project. The aim of the detailed landscape plan is to establish a quick growing, dense screen to reduce public views of the solar panels from Wollara Road, as well as providing additional ecological benefits.	*Pre-construction*

Aspect	Management/Mitigation Measure	Timing
	The detailed landscape plan is to be prepared prior to landscape implementation and, be guided by ongoing consultation with NP&WS and TfNSW (particularly regarding plant species, spacing, and whether soil improvement is required and road safety measures/tree clearance zones and TFNSW relevant policy).	*Pre-construction*
	Progressively stabilise surfaces as construction is completed.	*Construction*
	Monitor road upgrades to ensure the stabilisation of verges.	*Construction*
	Implement correctional measures if erosion occurs or dust is an issue.	*Life of Project (Construction, Operation and Decommissioning)*
	Include retention of trees where possible within/near the road upgrade construction zone.	*Construction*
	Include protection of trees within/near the road upgrade construction zone. Monitor disturbed trees that have been heavily impacted within their root zone for stability and longevity.	*Construction*
Noise and vibration	All sensitive receivers likely to be affected should be notified at least 7 days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification should include: • details of the Project • the construction period and construction hours • contact information for Project management staff • complaint and incident reporting • how to obtain further information.	Construction
	All employees, contractors and subcontractors are to receive an environmental induction. The induction must include at a minimum, all applicable mitigation measures; hours of works; any limitations on high noise-generating activities; location of nearest sensitive receivers; designated parking areas; relevant approval conditions and incident procedures.	Construction
	Contractors should keep noise to a minimum, including limiting the use of loud stereos/radios, shouting on site and car door slams.	Construction
	Where practical, no dropping of materials from height or throwing of metal items.	Construction

Aspect	Management/Mitigation Measure	Timing
	The noise levels of plant and equipment should have operating sound power levels consistent with those nominated in the NVIA.	Construction
	Noise emitting plant to be directed away from sensitive receivers and to be throttled down or shut down when not in use.	Construction
	Non-tonal reversing beepers could be fitted and used on construction vehicles and mobile plant used regularly on site and for any out of hours work.	Construction
	Limit the use of engine compression brakes.	Construction
	In the unlikely event that any vibration-generating equipment would be used within the recommended safe working distances nominated in Table 6.11 of the EIS, the following is recommended: • An independent specific structural assessment is undertaken on the structure to ascertain the structural integrity and its ability to withstand vibration, and establishment of an appropriate vibration criterion. • A dilapidation survey is undertaken on the structure prior to works commencing, and regular inspection of the structure throughout the construction activities. • Site specific vibration minimum working distances are established for the nominated equipment on site. • Where appropriate, continuous vibration monitoring is conducted on the structure for the duration of the period of construction while vibration generating equipment is used. The vibration logger should be equipped with the facility to remotely alert the site to reduce or cease construction activities if vibration levels are approaching the criterion threshold.	Construction
	Prior to the commencement of construction, finalise and implement the mitigation measures/controls outlined in the Draft Construction Noise and Vibration Management Plan (DCNVMP), which has been prepared for the management of potential noise and vibration impacts associated with Ringwood Road upgrade works.	Construction

Aspect	Management/Mitigation Measure	Timing
Traffic and Transport	Prior to the commencement of construction, a Construction Traffic Management Plan (CTMP) would be prepared in accordance with relevant guidelines and in consultation with TfNSW, Upper Hunter Shire Council, National Parks and Wildlife Service and any other relevant stakeholders. The CTMP would outline how construction activities would avoid, mitigate and manage risks involving construction activities, users of the traffic and transport network and residents.	Pre-construction
	As part of the Construction Traffic Management Plan (CTMP) to be prepared post-approval, a Vehicle Movement Plan will be included that clearly shows the construction vehicle routes and permitted movements, including restriction at the Ringwood Road/Golden Highway intersection (left in/left out movement permitted). The CTMP will also encompass a Drivers Code of Conduct that all construction phase vehicle drivers (including of light vehicles) would need to read and sign to confirm their responsibilities and reinforce correct behaviour.	*Pre-construction*
	Osborn's Transport, Merriwa Pre School, Scone Grammar School and Scone High School would be consulted on the proposed formalisation of the bus stop on Ringwood Road at the Golden Highway intersection and informed of the additional construction traffic that would be generated by the Project.	*Pre-construction*
	Additional signage and line marking is recommended at the Golden Highway and Barnett Street intersection and installation of warning signs ("Symbolic Truck") are recommended near the primary site access point.	*Pre-construction*
	The community would be notified in advance of proposed road and transport network changes through appropriate media and other forms of community liaison.	Construction
	Where relevant, Road Occupancy Licences (ROLs) and crane permits would be submitted and approved prior to the closure of any roads.	Construction
	Construction workers would be encouraged to carpool or use the shuttle buses to travel to and from the construction site.	Construction
	Parking requirements for the Project during construction and operation would be provided on-site, and parking would not be provided on public roads adjacent to the Project Area.	Life of Project (Construction, Operation and Decommissioning)
	Additional warning signs are recommended along sections of Ringwood Road and Wollara Road where the road narrows and near the site access points.	Construction

Aspect	Management/Mitigation Measure	Timing
	Swept paths of the proposed site access points with high resolution surveys/aerials would be developed as the project progresses to determine the most appropriate site access arrangements.	Construction
	A detailed Oversized Over Mass (OSOM) vehicle route assessment would be undertaken by the construction contractor and outlined in the Transport Management Plan. The Plan will detail OSOM route, duration, road closures, traffic closures, traffic detours, notifications and any required Traffic Guidance Schemes.	Pre-Construction
Water Resources	Solar panels will be designed to provide a minimum of 300 mm freeboard for the lowest edge above the maximum 1% AEP flood level.	Design
	Solar panel piles will be designed to withstand the 1% AEP flood velocities expected in the Project Area.	Design
	No sensitive infrastructure (e.g., substation, BESS, etc.) will be placed within 20 m of any Strahler 3 or above order streams.	Design
	All waterway crossings will be designed and constructed in compliance with DPI Water Guidelines.	Design and Construction
	Further flood investigations will be carried out where required during detailed design to confirm the flood immunity objectives and design criteria for the Project are met.	Design
	A Construction Soil and Water Management Plan (CSWMP) will be prepared to outline measures to manage soil and water impacts associated with the construction works.	Pre-construction
	Debris will be cleared from fencing following flood events.	Life of Project (Construction, Operation and Decommissioning)
	An Operational Environmental Management Plan (OEMP) will be developed for the Project to address potentially adverse impacts on the receiving environment surface water quality during the operational phase. This will include the development and appropriate maintenance of suitable ground cover around solar panels, and grassed table drains near access tracks to minimise the potential for erosion and export of sediment. Additional measures for the treatment of stormwater quality are not considered necessary.	Operation
	Water sources would be confirmed during the detailed design phase and in consultation with suppliers and landholders and be subject to availability.	Design

Aspect	Management/Mitigation Measure	Timing
	Post-construction, disturbed areas will be stabilised by the establishment and maintenance of a vegetated groundcover consisting of low-growing grasses.	Post-construction
	Road repairs and upgrades to Ringwood Road and culvert upgrades will include: • Appropriate scour protection will be designed for the road repairs and culvert upgrades • Road and culvert upgrades will be designed to maximise afflux at an acceptable level • Culverts will be designed to accommodate a 5% AEP event • Culverts will be constructed at existing invert levels or similar to maintain low flow conveyance in channel.	Pre-construction
	Works will be setback from the mapped watercourses in accordance with the Guidelines for Controlled Activities on Waterfront Land – Riparian Corridors (DPE 2022).	*Construction/Operation*
	A Construction Soil and Water Management Plan and an Erosion and Sediment Control Plan will be developed in consultation with and in accordance with industry standards including the guideline, Managing Urban Stormwater: Soils and Construction (Landcom 2004).	*Pre-construction*
	In the event of fish kills within the vicinity of the Project, DPI and the Environment Protection Authority will be contacted. All works other than emergency response procedures will cease until the issue is rectified.	*Life of Project (Construction, Operation and Decommissioning)*
Hazard, Risk and Bushfire Threat	Lightsource bp will implement a range of technical and non-technical risk mitigation and management measures including rigorous design standards and maintenance practices. Compliance with HIPAP 4 criteria is conditional on these technical and non-technical risk mitigation and management measures being implemented.	Design
	Electrical transformers to be designed, installed, operated and maintained in accordance with relevant Australian Standards.	Life of Project (Construction, Operation and Decommissioning)
	A Final Hazard Analysis and Emergency Plan will be developed as the Project design progresses toward completion to ensure the final Project design adheres to the risk management measures outlined in the PHA and that the separation distances to the site boundary/involved dwellings are appropriate for the specific battery cell type (i.e. chemistry and capacity) to be used.	Pre-construction

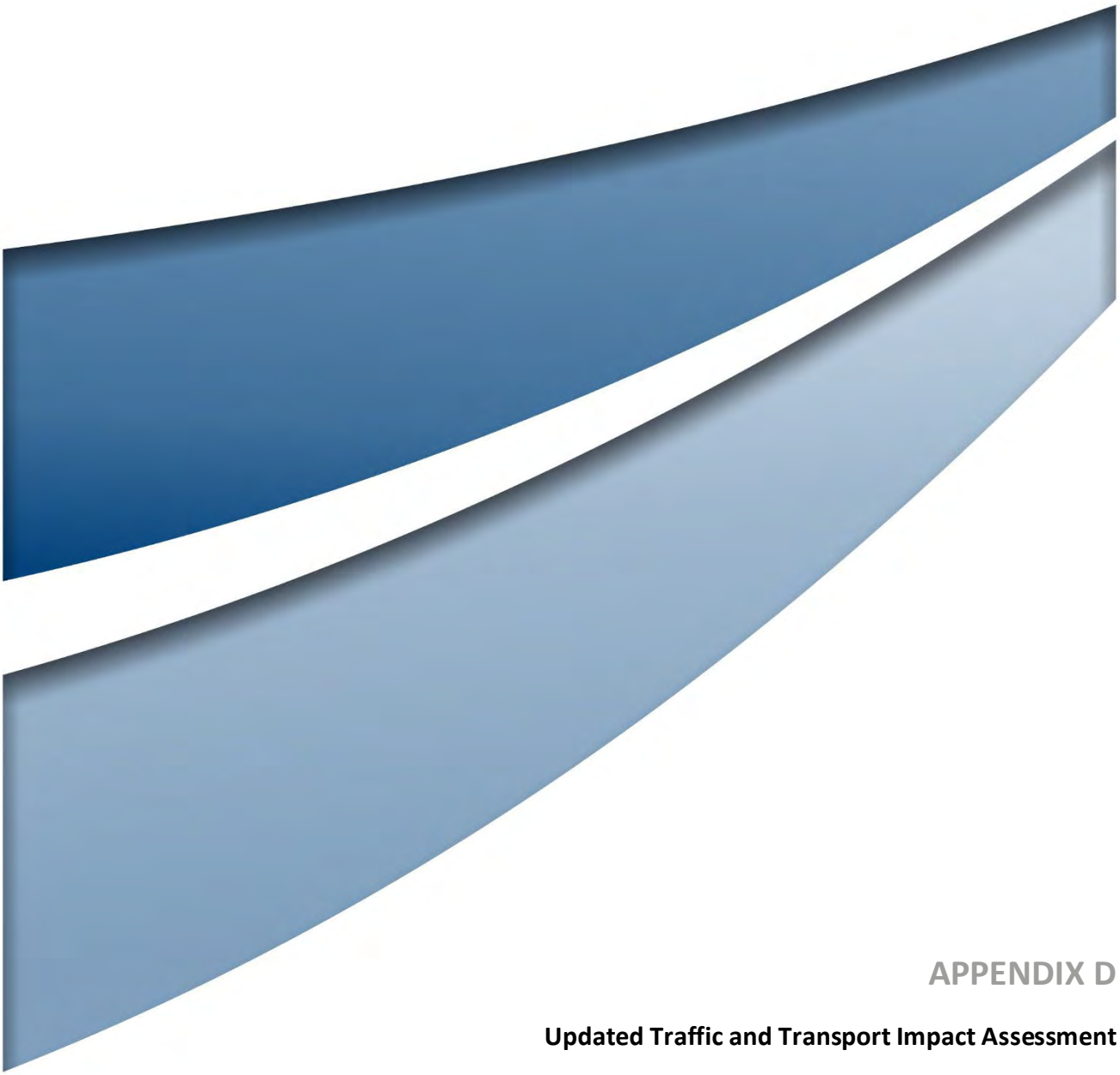
Aspect	Management/Mitigation Measure	Timing
	Asset protection zones will be implemented and maintained for the life of the Project.	Life of Project (Construction, Operation and Decommissioning)
	Roads and access points will be maintained throughout the Project life to allow for safe and accessible travel for emergencies (if required).	Life of Project (Construction, Operation and Decommissioning)
	An appropriate dedicated water supply for bushfire protection will be provided.	Life of Project (Construction, Operation and Decommissioning)
	All project infrastructure will be designed in accordance with relevant industry standards to manage any EMF risks.	Design
	All relevant procedures in relation to a high voltage installation will be adhered to throughout the life of the Project.	Life of Project (Construction, Operation and Decommissioning)
	Public access will be restricted throughout the life of the Project.	Life of Project (Construction, Operation and Decommissioning)
	The solar farm development footprint will be managed as an Asset Protection Zone in accordance with Appendix 4 of 'Planning for Bush Fire Protection 2019'.	*Construction/Operation*
	A dedicated water supply for bushfire protection will include a 10,000 litre water supply (tank) fitted with a 65mm storz fitting.	*Construction/Operation*
	APZ's will be maintained around the perimeter of the solar farm and associated infrastructure. All APZ's / defendable spaces will be in the order of at least 10m.	*Construction/Operation*
	• *The FSS will be developed in accordance with the requirements of Hazardous Industry Planning Advisory Paper (HIPAP) No.2 and will meet the operational requirements of FRNSW.* • *The FSS will consider:* • *The operational capability of local fire agencies and the need for the facility to achieve an adequate level of on-site fire and life safety independence.* • *A worst-case fire scenario including a full BESS unit fire. It will demonstrate no fire propagation within the facility.*	*Pre-construction*

Aspect	Management/Mitigation Measure	Timing
	• *the requirements of the Fire Management Plan (FMP) that would be prepared in consultation with NSW Rural Fire Service.* • *It is noted the FSS will also inform the requirements of the FMP including:* • *the methods and resources needed to manage and extinguish lithium battery fires* • *the management of a defendable Asset Protection Zone (APZ) as described in Planning for Bush Fire Protection 2019.* • *The FSS will inform the requirements of an Emergency Response Plan (ERP) that will be prepared in accordance with HIPAP 2 prior to commencing construction of the BESS. The ERP will inform the requirements of an Emergency Services Information Package (ESIP) that would be prepared in accordance with FRNSW fire safety guideline – Emergency services information package and tactical fire plans. Both the ERP and the ESIP will:* • *inform first responders of site-specific features and safety measures required to ensure they are able to undertake their duties effectively* • *include agency specific Standard Operational Guidelines.*	
	The FSS will consider fire propagation and a worst-case scenario will be considered within the FSS.	*Pre-construction*
	The Emergency Plan will be developed in accordance with the HIPAP No.1 and will be informed by the findings of the PHA.	*Pre-construction*
	An Emergency Services Information Package and an Emergency Responders Induction Package will be prepared for the site prior to construction. • *The Emergency Services Information Package (ESIP) will be prepared in accordance with FRNSW fire safety guideline – Emergency services information package and tactical fire plans.* • *The Emergency Responders Induction Package is developed for the site in consultation with, and to the satisfaction of FRNSW, NSW RFS and NPWS. The package will inform first responders in accordance with agency specific Standard Operational Guidelines.*	*Pre-construction*
Social Amenity	A Community Engagement Strategy will be prepared for the Project to include consistent, transparent and proactive information provision and consultation with stakeholders throughout Project development.	Pre-construction

Aspect	Management/Mitigation Measure	Timing
	A Community Benefit Sharing Strategy will be developed in consultation with local stakeholders to target investment to local needs and priorities and cognisant of activities/efforts of adjacent projects.	Pre-construction
	Measures to enhance positive social outcomes and mitigate negative social outcomes for the Project include: • *Limiting the number of existing short- term accommodation beds accessed to no more than 14 existing short term accommodation beds across the study area on any given night. This is designed to avoid 'crowding out' effects on other accommodation users. This figure could be re-assessed if substantial reductions in local occupancy rates are identified and recorded in the social locality.* • *Limit the use of existing rental accommodation as a housing source for the Amended Project by ensuring sufficient access to custom- built temporary workforce accommodation.* • *Work with the local accommodation providers to provide advanced notice of accommodation requirements and anticipate timing of key tourism events.* • *Consider partnering with or funding existing local accommodation providers to expand their accommodation capacity.* • *Establish, review, and maintain a LSbp Goods and Services Register database and make this available to head contractors to support local procurement.* • *Utilise Project newsletters, website, and media releases at key milestones throughout the Project development, construction and operation timeline to promote information on how local suppliers may become involved in the Project.* • *Promote and fund Apprenticeships and Traineeships as a key employment strategy and work with regional employment agencies, Training Services NSW, education providers and Group Training Organisations to develop strategies to enable apprentices to access experience across different infrastructure projects.*	*Pre-construction*

Aspect	Management/Mitigation Measure	Timing
	• *There are sufficient opportunities to house the anticipated construction and operational workforces, employ local workers, and procure local goods and services while also maximising social benefits to communities and reducing potential negative impacts. Proactive management and monitoring of outcomes will be achieved through post- approval management strategies and mechanisms.*	
Economic	A Community Benefits Sharing Strategy will be developed and implemented for the Project including a VPA with UHSC.	Pre-construction
Waste Management	Lightsource bp will prepare a Waste Management Plan, which will include a detailed breakdown of the waste types and quantities in accordance with relevant legislation and guidelines. Waste will be reused and recycled in accordance with a waste management hierarchy. The waste management plan will include the following: • a summary of the waste types, classification and estimated annual quantities of wastes produced during the construction of the Project • measures to manage waste disposal in accordance with the principles of the waste hierarchy, with emphasis on reducing, reusing and recycling wastes prior to disposal • the procedure for assessing, classifying and storing waste in accordance with EPA guidelines • procedures for storage, transport and disposal of waste • monitoring, record keeping and reporting, including the use of waste tracking data to demonstrate the lawful disposal of contaminated products, waste or residues generated by the Project (if any).	Construction
	Management of wastes generated during the operational phase of the Project will occur through a Waste Management Plan as part of the OEMP.	Operation
	A Decommissioning and Rehabilitation Management Framework has been prepared for the Project to demonstrate a commitment to ensuring appropriate environmental management is undertaken during decommissioning and rehabilitation phase in accordance with legislative requirements, conditions of consent, stakeholder interest and industry best practice. The Framework will be updated throughout the life of the Project as appropriate.	Decommissioning

Aspect	Management/Mitigation Measure	Timing
	The Waste Management Plan will be developed in consultation with the Upper Hunter Shire Council and surrounding LGAs including Mid-Western Regional Council.	*Pre-construction*
	A 94% recycling rate by weight will be achieved for the panels during each stage of the Project.	*Life of Project (Construction, Operation and Decommissioning)*
Air Quality	As part of the CEMP, protocols to minimise air emissions during construction will include: • water suppression on all exposed areas, unsealed roads and stockpile area when required (i.e. if visible dust emissions are observed) • the location and scale of activities which generate dust emissions would be modified and limited during periods of dry and windy weather • engines to switch off when not in use for prolonged periods • development of a complaints procedure to identify and respond to complaints.	Construction
	Areas within the Project Area which have been temporarily disturbed by construction and operational activities will be rehabilitated.	Life of Project (Construction, Operation and Decommissioning)
	Once construction has been completed, ground cover will be established and maintained in accordance with the OEMP.	Operations



APPENDIX D

Updated Traffic and Transport Impact Assessment

Goulburn River
Solar Farm

Amended Traffic and Transport Impact Assessment

turnbull

Document Information

Document Title	Goulburn River Solar Farm – Traffic and Transport Impact Assessment
Document Number	305GRSF Traffic and Transport Impact Assessment

Document Revisions

Revision	Description	Author	Reviewer	Approver	Date
1.0	Draft report	B. Meng E. Spiller	R. Banzon	D. Lowe	02/06/2022
2.0	Draft report	B. Meng E. Spiller	R. Banzon	D. Lowe	18/10/2022
3.0	Final report	B. Meng E. Spiller	R. Banzon	D. Lowe	31/10/2022
4.0	Final report	B. Meng E. Spiller	R. Banzon	D. Lowe	15/11/2022
5.0	Final report	B. Meng E. Spiller	R. Banzon	D. Lowe	18/11/2022
6.0	Final report	B. Meng E. Spiller	R. Banzon	D. Lowe	14/12/2022
7.0	Final report	B. Meng E. Spiller	R. Banzon	D. Lowe	31/01/2023
8.0	Final report	B. Meng E. Spiller	R. Banzon	D. Lowe	10/02/2023
9.0	Final report	B. Meng E. Spiller	R. Banzon	D. Lowe	01/05/2023
10.0	Amended TTIA – Draft 1	R. Banzon	D. Lowe	D. Lowe	30/11/2023
11.0	Amended TTIA – Draft 2	R. Banzon D. Shirokov	D. Lowe	D. Lowe	08/12/2023
12.0	Amended TTIA – Final	R. Banzon	D. Lowe	D. Lowe	12/12/2023

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Definitions and abbreviations

Definitions and abbreviations to be applied to the Traffic and Transport Impact Assessment (TTIA) are listed in the table below.

Abbreviation	Definition
95% back of queue	The length of vehicle queue at an intersection that is not exceeded in 95% of all cycles
Amended Project	The Amended Project includes the elements of the Project as described in the EIS as well as changes which have been made largely in response to submissions on the EIS. These include: Project site access/egress amendments, upgrades to additional sections of Wollara Road and Ringwood Road, increased BESS capacity and an option of a decentralised BESS, minor Project layout modifications, construction of an additional transmission tower and additional assessment and revised approach for workforce accommodation.
ARTC	Australian Rail Track Corporation
Auxiliary lane	A portion of the roadway adjoining the through traffic lanes, used for speed change or for other purposes supplementary to through traffic movement
B-double	A combination consisting of a prime mover towing two semitrailers, with the first semitrailer being attached directly to the prime mover by a fifth wheel coupling and the second semitrailer being mounted on the rear of the first semitrailer by a fifth wheel coupling on the first semitrailer.
BESS	Battery Energy Storage System
CRN	Country Regional Network
CTMP	Construction Traffic Management Plan
CWO REZ	Central West Orana Renewable Energy Zone. A group of new wind and solar power generation in the Central West Orana region so that it can be efficiently stored and transmitted across NSW
DOS	Degree of Saturation
DPE	Department of Planning and Environment
EIS	Environmental Impact Statement
EIS Project	The proposed Goulburn River Solar Farm. The Project includes the construction, operation and decommissioning of a solar farm with capacity of up to 550 MW, BESS and associated infrastructure. Including the various road repairs and upgrades to Ringwood Road.
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environmental Protection Authority
GAV	General Access Vehicles
Haulage routes	Roads designed for heavy or bulk transport of materials by heavy vehicles.
HML	NSW Combined Higher Mass Limits
km/h	Kilometres per hour
kV	Kilovolt
LOS	Level of Service
MWdc	Megawatt defined conditions
MWh	Megawatt hour
MWp	Megawatt peak
NSW	New South Wales
OSOM vehicle	Oversize Overmass. A vehicle or vehicle combination that exceeds any general access mass or dimension limits
Peak period	The period that has the highest demand volume of traffic and/or number of passengers during the day (peak hour, peak half hour, etc.)

Project construction vehicles	Standard construction vehicles generated by the Project including light vehicles, shuttle buses and heavy vehicles up to 19m semi-trailers.
RAV	Restricted Access Vehicles
ROL	Road Occupancy Licence
RUM	Road User Movement
SISD	Safe Intersection Sight Distance
SSD	State Significant Development
Swept path	The area bounded by lines traced by the extremities of the bodywork of a vehicle while turning.
Tie-in infrastructure	Operations and maintenance buildings, civil works and electrical components
TTIA	Traffic and Transport Impact Assessment
VMP	Vehicle Movement Plan

1. Introduction

1.1. Background

Lightsource Development Services Australia Pty Ltd (Lightsource bp) proposes to develop a solar farm in the Upper Hunter region of New South Wales (NSW), approximately 28 kilometres (km) southwest of Merriwa. The proposed Goulburn River Solar Farm (the Project) would be located on an agricultural parcel of land zoned RU1 – Primary Production (the Project Area), surrounded by the Goulburn River National Park.

The Project would involve the construction, operation and decommissioning of approximately 550-megawatt peak (MWp) of solar photovoltaic (PV) generation as well as a Battery Energy Storage System (BESS) with a combined 1,030 MWp / 2,060 megawatt hour (MWh) capacity. The Project would also include a substation and connection to an existing 500 kilovolt (kV) transmission line. The Project would include various associated infrastructure, including road repairs and upgrades to Ringwood Road and Wollara Road, temporary construction facilities, operation and maintenance buildings, internal access roads, civil works and electrical infrastructure to connect the Project to the existing transmission line which passes through the Project Area.

The Project Area covers an area of approximately 1,996.5 hectares with a development footprint of approximately 792.19 hectares. The Project Area encompasses two freehold properties and sections of Crown Roads.

The Project is considered a State Significant Development (SSD) under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and State Environmental Planning Policy (Planning Systems) 2021.

The objectives of the Project are to:

- Deliver affordable and sustainable renewable energy to business and communities within NSW
- Provide renewable energy that would contribute to the reduction of greenhouse gases across NSW, avoiding up to 705,000 tonnes per annum of carbon dioxide
- Support the local regional economy by preferencing local workers and businesses in the development, construction and operation of the Project
- Facilitate community engagement and participation in the design, development and operation of the Project
- Minimise environmental and heritage impacts to the Project Area through adaptive design.

Subject to planning approval, construction is proposed to commence in 2024.

1.2. Updates for Amendment Report

This TTIA report was prepared to support the Project Environmental Impact Statement (EIS). It has now been updated in response to the community and stakeholder submissions received on the EIS and to reflect the outcomes of ongoing engagement with the Department of Planning and Environment (DPE), Transport for NSW, Upper Hunter Shire Council and Mid-Western Regional Council throughout and/or post the Project exhibition period.

As a result, the following amendments to this TTIA report has been completed:

- Section 1.2 (this section) has been added to provide a summary of the updates to the document
- Section 2.3 has been added to include details on the proposed transport route
- Section 2.3.1 has been added to include discussion on the initial transport route options assessed
- Section 2.3.3 has been updated to include revised safe intersection sight distance checks at the Golden Highway / Ringwood Road intersection and addition of checks at the Wollar Road / Ringwood Road intersection and Golden Highway / Barnett Street intersection
- Section 2.3.5 has been added to include an analysis of speed surveys collected on the Golden Highway
- Section 2.4 has been added to include discussion on nearby turning areas
- Section 2.6 has been updated to include additional detail on school bus routes and bus stops
- Section 2.7 has been updated to reflect changes to Transport for NSW's definitions of the existing cycle network
- Section 2.8 has been updated to reflect more recent crash data available from the Centre for Road Safety
- Section 3.1 has been updated to include a figure showing the footprint of the Project
- Section 3.2.3 has been updated to reflect the proposed changes to Project construction vehicle routes and trip distribution, including management and mitigation measures required to enforce the proposed routes
- Section 3.2.4 has been updated to include additional detail on Oversize Overmass (OSOM) return routes, pull-over bay / rest area locations and reference to a Traffic Management Plan for a similar project
- Section 3.2.5 has been updated to include additional road upgrades proposed on Ringwood Road and Wollara Road to benefit the community, upgrades proposed at the Golden Highway / Ringwood Road intersection to accommodate construction vehicles, and additional signage and line-marking recommended at the Golden Highway / Barnett Street intersection
- Section 3.2.6 has been moved and updated to include revised or new swept paths tested at the Golden Highway / Ringwood Road intersection, Golden Highway / Barnett Street intersection, and the Barnett Street turnaround facility

- Section 3.3.2 has been updated to clarify the number of construction vehicle movements anticipated per day
- Section 3.3.3 has been updated to clarify the number of operational vehicle movements anticipated per day
- Section 3.4 has been added to include details on the use of the Barnett turnaround facility
- Section 3.6 has been updated to include details of the formalisation of a bus stop near the Golden Highway / Ringwood Road intersection
- Section 4.1.1 has been updated to reflect the inclusion of peak hour traffic volumes generated by other nearby projects in the intersection modelling assessment and turn warrants assessment for the cumulative base and cumulative construction scenario
- Section 4.1.3 has been updated to reflect the impacts on the bus and rail networks due to the change in proposed construction vehicle routes
- Section 4.1.5 has been updated to reflect any new publicly available information on the cumulative projects since the Project exhibition period
- Section 5 has been updated to include any new or revised mitigation and management measures proposed as a result of the changes to the project as described above
- Section 6 has been updated to include any new or revised outcomes of the assessment as a result of the changes to the project as described above
- Appendix A has been added to provide a summary of the submissions received related to traffic and transport and how this report addresses the submissions
- Appendix B has to include the construction assessment of Wollar Road / Ringwood Road, which is not proposed to be used construction vehicles
- Appendix C has been added to show the strategic design of the proposed upgrades at the Golden Highway / Ringwood Road intersection, including swept paths and sight distance checks
- Appendix D has been added to show the safe intersection sight distance checks carried out at the Wollar Road / Ringwood Road intersection
- Appendix E has been moved and updated to reflect more recent crash data available
- Appendix F has been moved and updated to show the specifications of the OSOM vehicles proposed for the Project
- Appendix G has been added to include the Traffic Management Plan for OSOM vehicles for the Avonlea Solar Farm
- Appendix H has been moved and updated to include the additional road upgrades proposed on Ringwood Road and Wollara Road
- Appendix J has been added to show the swept paths carried out at the Golden Highway / Barnett Street intersection and Barnett Street turnaround facility.

This updated report will be appended to the Amendment Report and submitted to DPE for review and planning approval.

Appendix A provides a summary of the submissions received related to the TTIA in the EIS and subsequent consultation with DPE and Transport for NSW, and how they have been addressed in this updated report.

1.3. Scope and objectives of this report

This report assesses the existing transport network conditions as well as the anticipated traffic and transport network impacts during construction and operation. Where feasible, mitigation and management measures to reduce the anticipated impacts of the Project have been identified. This report includes the consideration of the following:

- Existing traffic and transport surrounding the Project Site, including a review of:
  - The road network
  - Parking provision
  - Public transport
  - Pedestrians and bicycle users
  - Road safety.
- Construction traffic and transport associated with the Project
- Operational traffic and transport associated with the Project
- Potential mitigation measures that may be implemented to minimise traffic and transport impacts associated with the Project.

1.3.1. Secretary's environmental assessment requirements

The Secretary's environmental assessment requirements for the Project were issued on 1 February 2022. The requirements specific to transport, and where these requirements are assessed in this report, are outlined in Table 1-1.

Table 1-1: Secretary's environmental assessment requirements (transport)

Secretary's environmental assessment requirements		Where addressed
a.	An assessment of the peak and average traffic generation, including over-dimensional vehicles and construction worker transportation;	Section 3.2, Section 3.3 and Section 4.1.1
b.	An assessment of the likely transport impacts to the site access route(s), site access point(s), any Crown land, particularly in relation to the capacity and condition of the roads, road safety and intersection performance;	Section 3.2.3, Section 3.2.4, Section 3.2.5, Section 3.2.6 and Section 4
c.	A cumulative impact assessment of traffic from nearby developments; and	Section 4.1.1 and Section 4.1.5
d.	Provide details of measures to mitigate and / or manage potential impacts including a schedule of all required road upgrades (including resulting from heavy vehicle and over mass / over dimensional traffic haulage routes), road maintenance contributions, and any other traffic control measures, developed in consultation with the relevant road authorities;	Section 5

1.4. References

In preparing this report, reference has been made to the following:

- *Guide to Road Design Part 3: Geometric Design* (Austroads, 2021)
- *Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* (Austroads, 2021)
- *Guide to Road Traffic Management Part 6: Intersections, Interchanges and Crossings Management* (Austroads, 2020)
- *Austroads Design Vehicles and Turning Path Templates Guide* (Austroads, 2013)
- *Traffic Modelling Guidelines* (Roads and Maritime Services, 2013)
- *Guide to Traffic Generating Developments* (Roads and Traffic Authority, 2002)
- *Golden Highway Corridor Strategy* (Transport for NSW, 2016)
- *Goulburn River Solar Farm Scoping Report* (Umwelt (Australia) Pty Ltd, 2021).

1.5. Report structure

The report has the following structure:

- Chapter 1 (this chapter) provides an overview of the Project
- Chapter 2 details the existing traffic and transport environment
- Chapter 3 provides a description of the Project
- Chapter 4 provides an assessment of the potential traffic and transport impacts during the construction and operational phase of the Project
- Chapter 5 identifies traffic and transport mitigation and management measures
- Chapter 6 provides a summary of traffic and transport impacts due to the Project.

2. Existing conditions

2.1. Project location

The Project Site is located on Wollara Road, approximately 170 km northwest of Newcastle and is proposed to be constructed on 1,996.5 hectares of freehold land in the locality of Merriwa in the Upper Hunter Region of NSW. The Development Footprint occupies 792.19 hectares of the Project Site.

The Project is bounded by the Goulburn River National Park to the north, east and south, and by Wollara Road to the west. The location of the Project Site and surrounding roads, the rail line and nearby towns are shown in Figure 2-1.

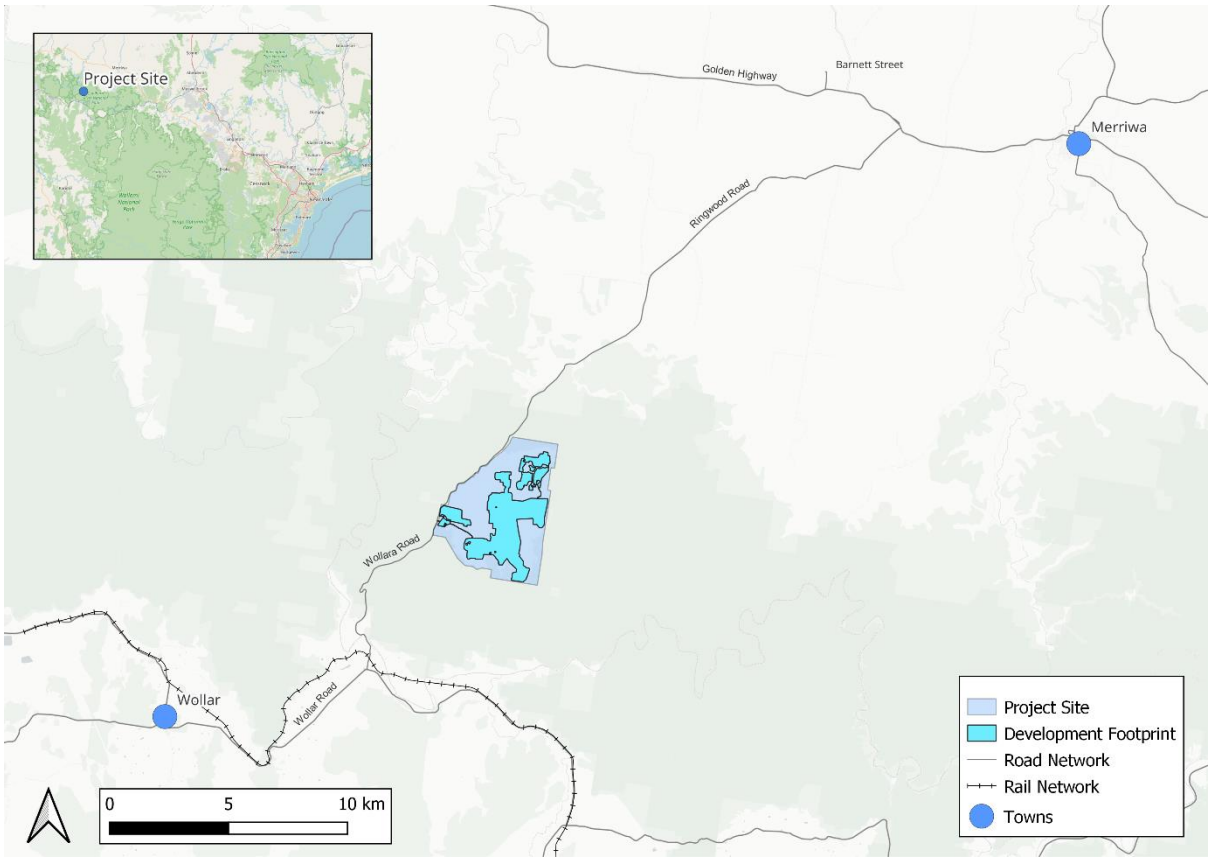


Figure 2-1: Project location

2.2. Road network

The local road network and key intersections for this Project are shown in Figure 2-2. Key roads that would provide access to the Project Site are described below, including Golden Highway, Ringwood Road, Wollar Road, Wollara Road and Barnett Street.

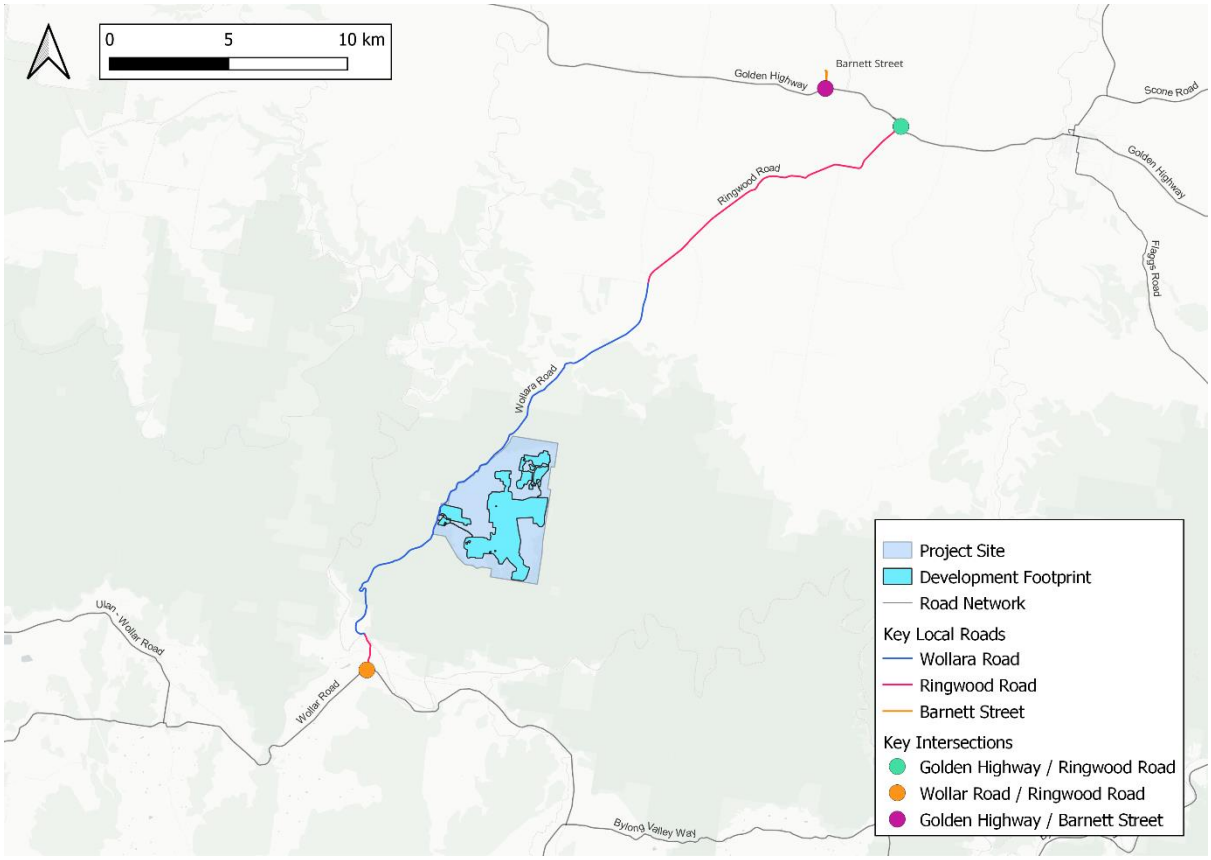


Figure 2-2: Local road network

- **Golden Highway**, which is a key east-west corridor located in the Hunter and Orana regions, connecting Newcastle and Dubbo. The highway is an approved B-double route. The highway is classified as a State road and has a posted speed limit of 100 km/h. Figure 2-3 shows the configuration of the Golden Highway at its intersection with Ringwood Road, as observed during a site visit carried out on 22 September 2021.

Figure 2-3: Golden Highway looking west (left) and east (right)

- **Ringwood Road**, which is a local road forming part of a continuous north-south road corridor with Wollara Road between the Golden Highway and Wollar Road. Ringwood Road is divided into two sections on this corridor, with the northern section running between the Golden Highway and Neverfail Road, and the southern section running between the Goulburn River and Wollar Road. Between these two sections, the road is designated as Wollara Road. Ringwood Road is sealed and generally flat with low vertical grades. The road operates under a default speed limit of 100km/h as there were no regulatory speed signs observed during a site visit carried out on 22 September 2021. However, advisory speed signs (35, 65 and 85km/h) were located at bends along the road alignment. Figure 2-4 shows a typical section of Ringwood Road as observed during the site visit.

Figure 2-4: Ringwood Road looking south (left) and north (right)

- **Wollara Road**, which is a local road forming part of a continuous north-south road corridor with Ringwood Road between the Golden Highway and Wollar Road. The Wollara Road section on this corridor runs between Neverfail Road and the Goulburn River. The road provides direct access to the Project and comprises a combination of sealed and unsealed sections north of the site and

unsealed sections south of the site. The road operates under a default speed limit of 100km/h, as there were no regulatory or advisory speed signs observed during a site visit carried out on 22 September 2021. Figure 2-5 shows a typical unsealed section of Wollara Road as observed during the site visit.

Figure 2-5: Wollara Road looking north (left) and south (right)

- **Wollar Road**, which is an east-west regional road between Bylong at its junction with Bylong Valley Way and Budgee Budgee at its junction with Ulan Road. The road is sealed and has a posted speed limit of 100km/h. Figure 2-6 shows the configuration of Wollar Road at its intersection with Ringwood Road, as observed during a site visit carried out on 22 September 2021. As discussed in Section 2.3, this road does not form part of the proposed transport route for the Project.

Figure 2-6: Wollar Road looking east (left) and west (right)

- **Barnett Street**, which is a north-south access road located approximately 3.8km west of the Golden Highway / Ringwood Road intersection. The road is unsealed and provides access to Lot 1 / DP 1108292. Figure 2-7 shows the configuration of Barnett Street at its intersection with Golden Highway, based on Google Maps imagery from August 2023.

Figure 2-7: Barnett Street view from the east on Golden Highway (left) and from the west (right)

2.2.1. Heavy vehicles

Golden Highway is an approved B-double route and has been identified in the *Golden Highway Corridor Strategy* (Transport for NSW, 2016) as an important connection between the Central West and the Port of Newcastle. There is also a State target to facilitate the movement of high productivity vehicles on the highway in the long term under a package of upgrades funded by the NSW Government's Regional Freight Pinch Point and Safety Program and the Australian Government's Heavy Vehicle Safety and Productivity Package. An overview of proposed upgrades along the Golden Highway to improve the heavy vehicle network is shown in Figure 2-8.

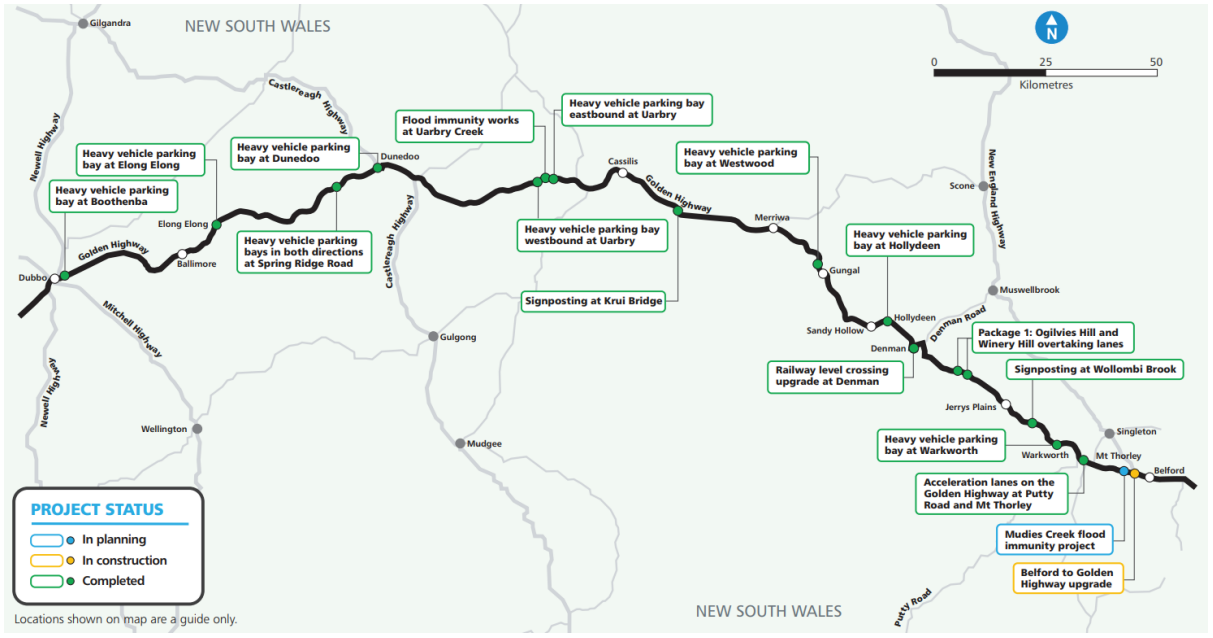


Figure 2-8: Golden Highway upgrades

Source: Golden Highway upgrades overview map (Transport for NSW, 2022)

Wollar Road is also an approved B-double route, however includes an 80km/hr B-double speed limit and may only be used by B-doubles outside of school bus operation times.

Wollara Road and Ringwood Road are not approved B-double routes and hence only heavy vehicles that are classified as a General Access Vehicle (GAV) may use these roads. GAVs include buses and semi-trailers up to 19 metres in length.

A map of the heavy vehicle network surrounding the Project site is shown in Figure 2-9.

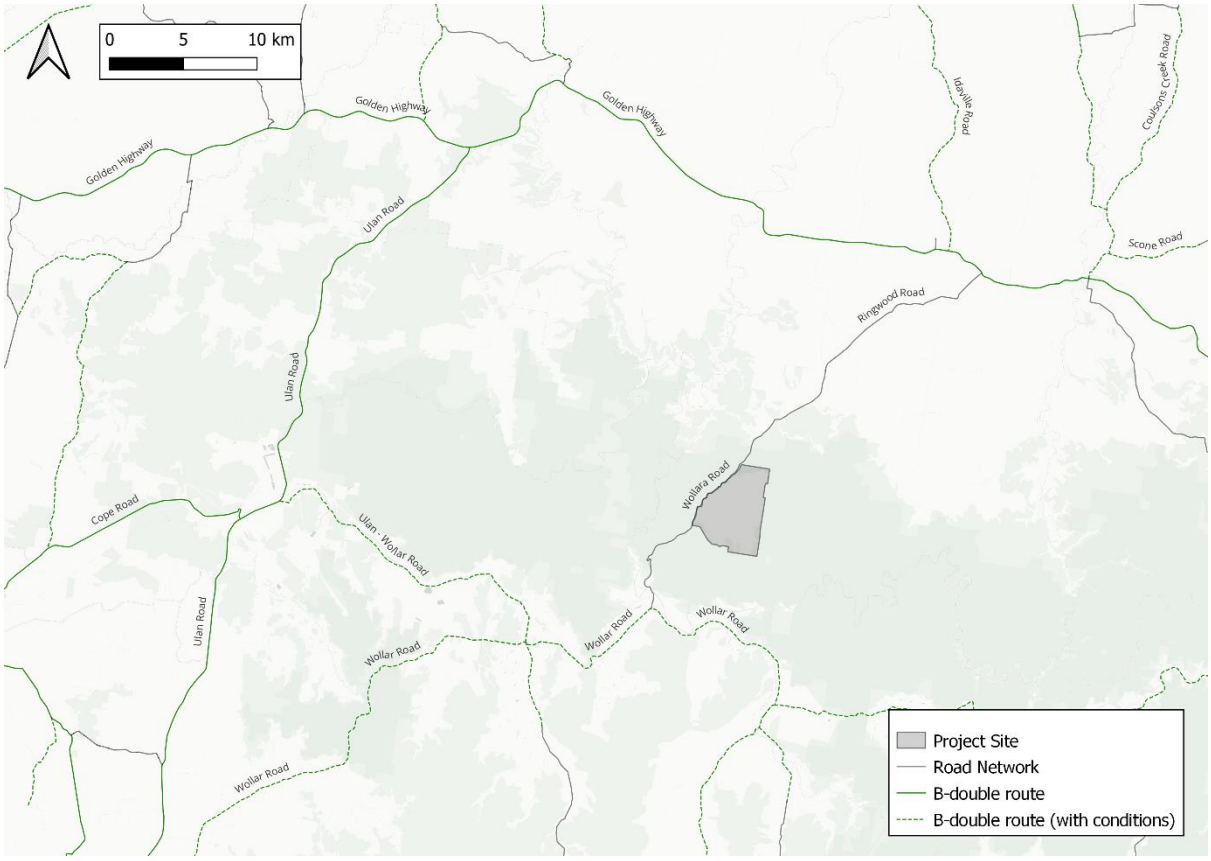


Figure 2-9: Heavy vehicle network

Source: NSW Combined Higher Mass Limits (HML) and Restricted Access Vehicles (RAV) Map (Transport for NSW, 2023)

2.3. Proposed transport route

The transport route for the Project is proposed from the north of the Project Site via the Golden Highway, Ringwood Road, Wollara Road and Barnett Street, with Project construction vehicles restricted to performing a left-in and left-out at the Golden Highway / Ringwood Road intersection which provides the main access to the site. This arrangement is proposed due to existing sight distance deficiencies at the intersection, particularly for vehicles turning right-out of Ringwood Road. Hence, egressing Project construction vehicles would be required to turn left at the intersection, using the proposed acceleration lanes, before utilising the turnaround facility on Barnett Street to return on the Golden Highway in the eastbound direction. Consent has been received from Upper Hunter Shire Council as the road authority, as well as adjacent private landowners for the intended use of the turnaround facility by Project construction vehicles.

The proposed transport route, including the turnaround facility on Barnett Street is shown in Figure 3-2.

An additional transport route for Project light vehicles from the south via Wollar Road, Ringwood Road and Wollara Road was assessed in the EIS. However, the Amended Project does not propose to use this route, given that the workforce is now proposed to originate predominately from accommodation in and around Merriwa. In addition, access from the south would not be suitable for Project heavy vehicles, due to:

- potential flooding issues at the Ringwood Road and Wollara Road junction over the Goulburn River
- steep grades
- tight turning curves through the National Park
- insufficient safe intersection sight distance (SISD) at the intersection of Ringwood Road and Wollar Road.

Although this route is not proposed for the Amended Project, an assessment of the Wollar Road / Ringwood Road intersection during construction is provided in Appendix B, in the unlikely event that a Project construction light vehicle travels to the site from the south (i.e., due to a worker that lives within the Mid-Western Regional LGA).

2.3.1. Justification of transport route

Due to its isolation, the Project Site can only be accessed via three routes either from the north via the Golden Highway / Ringwood Road intersection or Golden Highway / Redwell Road intersection, or from the south via the Wollar Road / Ringwood Road intersection. These three potential route options were assessed from a traffic compliance, road design suitability and construction practicality perspective in the early stages of the Project as follows:

- Option 1 via the Golden Highway Ringwood Road intersection: This is the proposed transport route for the Project, with Project vehicles using the Golden Highway, Ringwood Road, Wollara Road and Barnett Street. This route comprises primarily a sealed surface, gentle grade changes and wide carriageways. Upgrades required on this route to accommodate Project vehicles are discussed in Section 3.2.5.
- Option 2 via the Golden Highway / Redwell Road intersection: This route would require Project vehicles to travel on the Golden Highway, Redwell Road, Binks Road, Ringwood Road and Wollara Road. This route includes a 10km unsealed section of Redwell Road and Binks Road. Both these roads are also narrow in width. Use of this route for Project vehicles would require private land purchases, road widening and sealing the entire section of Redwell Road and Binks Road. Due to the capital upgrade costs and complexity in acquiring private land to widen these roads, this option was not recommended.
- Option 3 via the Wollar Road / Ringwood Road intersection: This route would require Project vehicles to travel on Wollar Road and Ringwood Road (discussed above). Furthermore, access to these roads from the west would require an

additional travel distance of 107km via the Golden Highway, Ulan Road and Ulan-Wollar Road (Option 3a). Access to these roads from the east would be via Bylong Valley Way (Option 3b). Due to the potential additional travel distance, the unsuitability of Ringwood Road and Wollara Road south of the Project Site for heavy vehicles as discussed in the previous section, and the capital upgrades required, this route was not recommended for heavy vehicles and was proposed for light vehicles only in the EIS.

An overview of the route options assessed is shown in Figure 2-10.

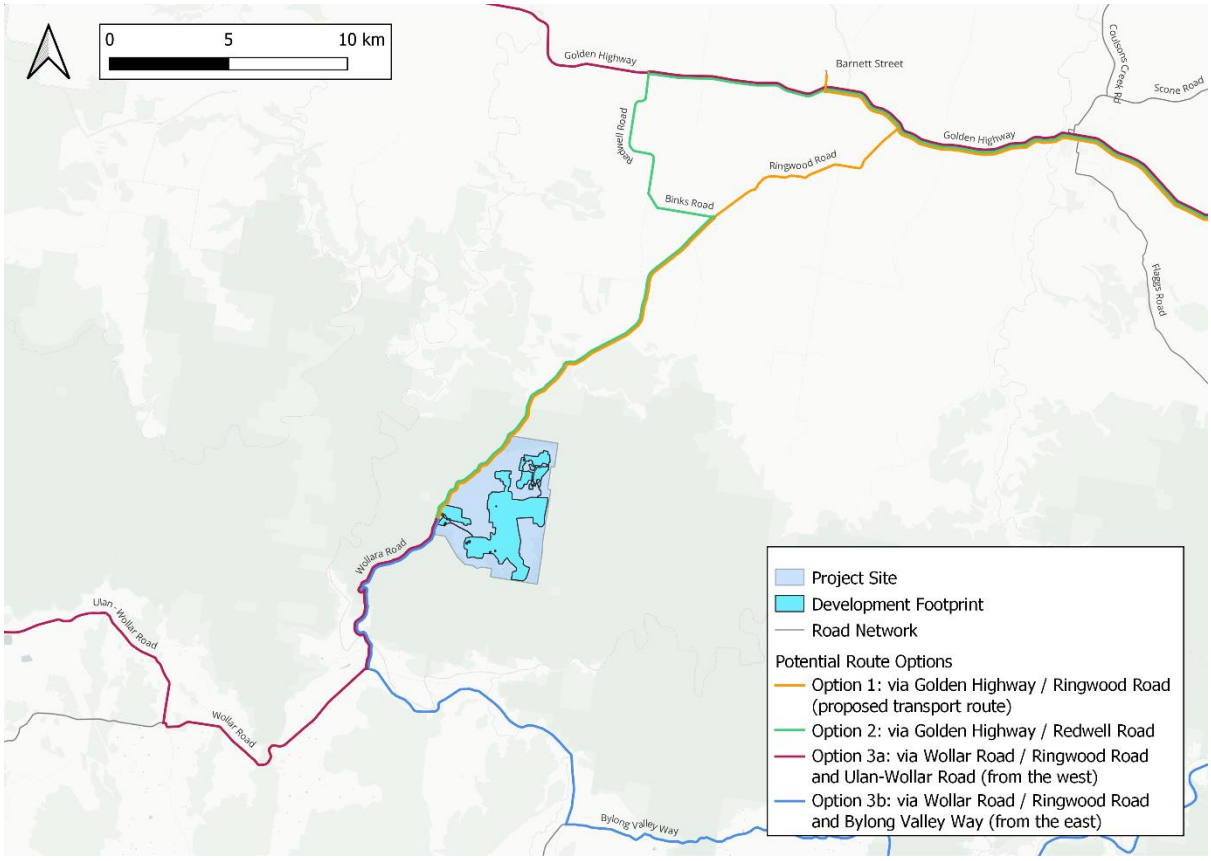


Figure 2-10: Potential route options assessed

2.3.2. Intersection layout and geometry

Intersections assessed include Golden Highway / Ringwood Road, Golden Highway / Barnett Street and Wollar Road / Ringwood Road. These intersections are priority controlled and include basic left turn and right turn treatments, except at the following:

- Golden Highway / Ringwood Road: existing auxiliary left turn lane on the Golden Highway in the westbound direction
- Golden Highway / Barnett Street: existing auxiliary right turn lane on the Golden Highway in the westbound direction

2.3.3. Safe intersection sight distance (SISD)

The SISD is the minimum sight distance which should be provided on the major road at any intersection.

Given that the Golden Highway / Ringwood Road and Golden Highway / Barnett Street intersections are proposed to be used by Project construction vehicles travelling to and from the site, an assessment of SISD was undertaken at these intersections and is shown in Table 2-1. Although Project construction vehicles would not be travelling through the Wollar Road / Ringwood Road intersection, for completeness, SISD checks were also undertaken at this intersection.

Table 3.2 of the *Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* (Austroads, 2021) outlines sight distance requirements for a variety of design speeds and was used to assess SISD.

Table 2-1: SISD checks

Intersection	Posted Speed (km/hr)	Design Speed (km/hr)	Reaction Time (sec)	Grade (%)	Required SISD (m)
Golden Highway / Ringwood Road	100	110	2*	2 (Golden Highway westbound) -2 (Golden Highway eastbound)	277m looking east from Ringwood Road 292m looking west from Ringwood Road
Golden Highway / Barnett Street	100	110	2.5	1 (Golden Highway westbound) -4 (Golden Highway eastbound)	296m looking east from Barnett Street 316m looking west from Barnett Street
Wollar Road / Ringwood Road	100	110	2.5	2 (Wollar Road westbound) -3 (Wollar Road eastbound)	294m looking east from Ringwood Road 313m looking west from Ringwood Road

*A two second reaction time has been applied, given that drivers would be alert near the intersection due to the road alignment, additional signage located on approach to the intersection and the speed survey results outlined in Section 2.3.5

At the Golden Highway / Ringwood Road intersection, the required SISD of 292 metres is achieved for a vehicle on Ringwood Road looking west. However, the required SISD of 277 metres is not achieved for a vehicle on Ringwood Road looking east. Currently an SISD of 180 metres is achieved, which is deficient by 97 metres. The non-compliant SISD to the east is due to the existing road geometry of the Golden Highway. The SISD checks at this intersection are provided in Appendix C (refer to drawings 0305-INF-LS-SIGHT_SISD-01 to

0305-INF-LS-SIGHT_SISD-04). As a result of the deficient SISD to the east, it is not proposed for Project construction vehicles to perform a right turn at the intersection.

Upgrades are proposed to accommodate Project construction vehicles performing a left turn at the Golden Highway / Ringwood Road intersection and are discussed in Section 3.2.5. The strategic design of the intersection, including swept paths and sight distance checks carried out, is provided in Appendix C.

At the Golden Highway / Barnett Street intersection, the required SISD of 296 metres for a vehicle on Barnett Street looking east and 316 metres for a vehicle on Barnett Street looking west are both achieved. Hence, no intersection geometry upgrades are required for the Project to use this intersection.

At the Wollar Road / Ringwood Road intersection, the required SISD of 294 metres is achieved for a vehicle on Ringwood Road looking east. The required SISD of 313 metres is not achieved for a vehicle on Ringwood Road looking west. Currently an SISD of 170 metres is achieved, which is deficient by 143 metres. Since Project construction vehicles would not be using this intersection, upgrades have not been proposed. Additional details on the SISD checks carried out at this intersection is provided in Appendix D.

2.3.4. Existing traffic volumes

Intersection turning movement volumes were collected at the Golden Highway / Ringwood Road intersection on Thursday, 31 March 2022, from 6:00am to 10:00am and 3:00pm to 7:00pm, and the Wollar Road / Ringwood Road intersection on Thursday, 7 April 2022, from 6:00am to 10:00am and 3:00pm to 7:00pm. On the surveyed day, the Golden Highway / Ringwood Road intersection experienced a morning peak hour from 7:15am to 8:15am and an evening peak hour from 3:00pm to 4:00pm, and the Wollar Road / Ringwood Road intersection experienced a morning peak hour from 6:00am to 7:00am and an evening peak hour from 5:30pm to 6:30pm. Peak hour traffic volumes at these intersections are shown in Figure 2-11 and Figure 2-12.

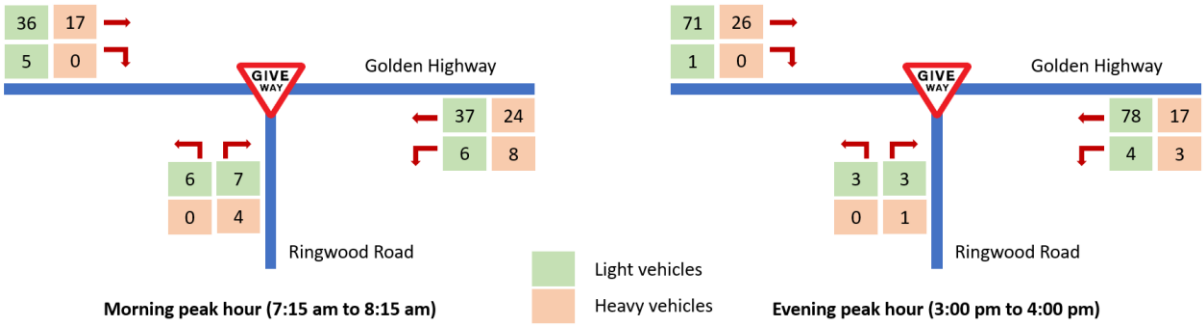


Figure 2-11: Peak hour traffic volumes at the Golden Highway / Ringwood Road intersection

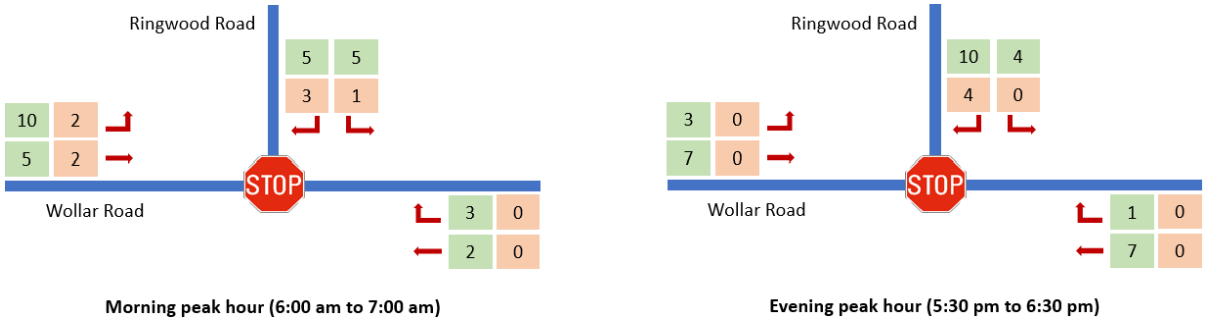


Figure 2-12: Peak hour traffic volumes at the Wollar Road / Ringwood Road intersection

At the Golden Highway / Ringwood Road intersection, evening peak hour volumes are generally higher than morning peak hour volumes. In addition, traffic volumes turning into and out of Ringwood Road are low, with Golden Highway eastbound and westbound through vehicles as the major movements at the intersection.

At the Wollar Road / Ringwood Road intersection, traffic volumes are low during both peak hours, with each movement being undertaken by 14 vehicles or less on the surveyed day.

Traffic volumes on the Golden Highway were also collected as part of the speed surveys carried out in 2023 as discussed in Section 2.3.5. A review of the 2023 volumes on the Golden Highway from the speed surveys for the same morning and evening peak hours showed a similar volume compared to the 2022 intersection counts.

Hourly traffic volumes in both directions along Ringwood Road were also collected over a one-week period from Thursday, 31 March 2022, to Wednesday, 6 April 2022. Figure 2-13 and Figure 2-14 show the bi-directional hourly average traffic volumes observed on Ringwood Road during the surveyed week on weekdays and weekends, respectively.

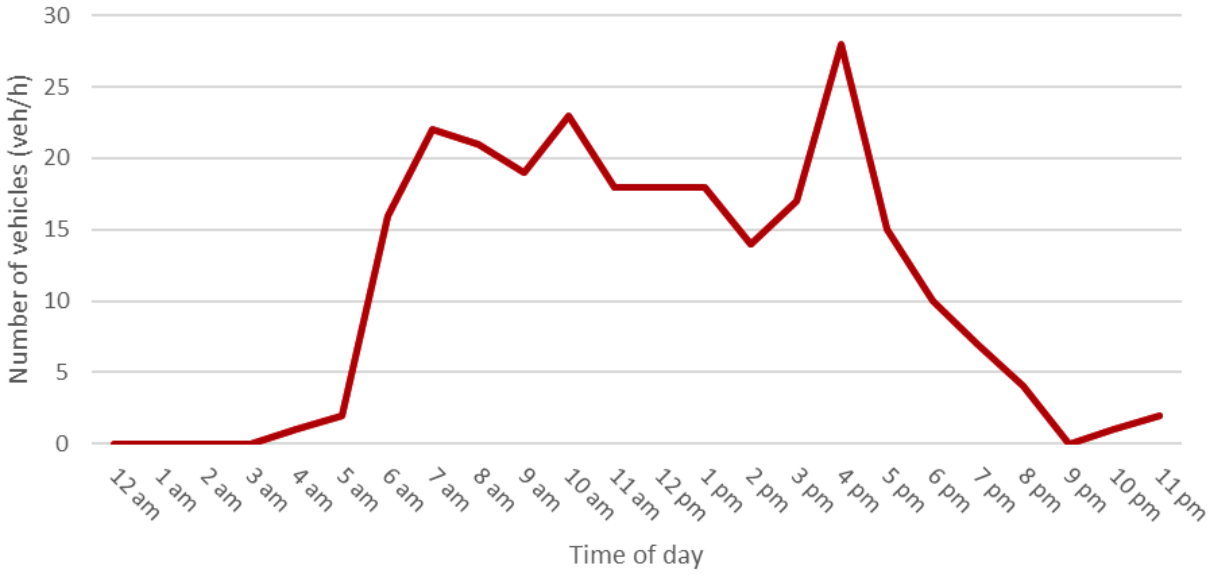


Figure 2-13: Average weekday traffic volumes on Ringwood Road

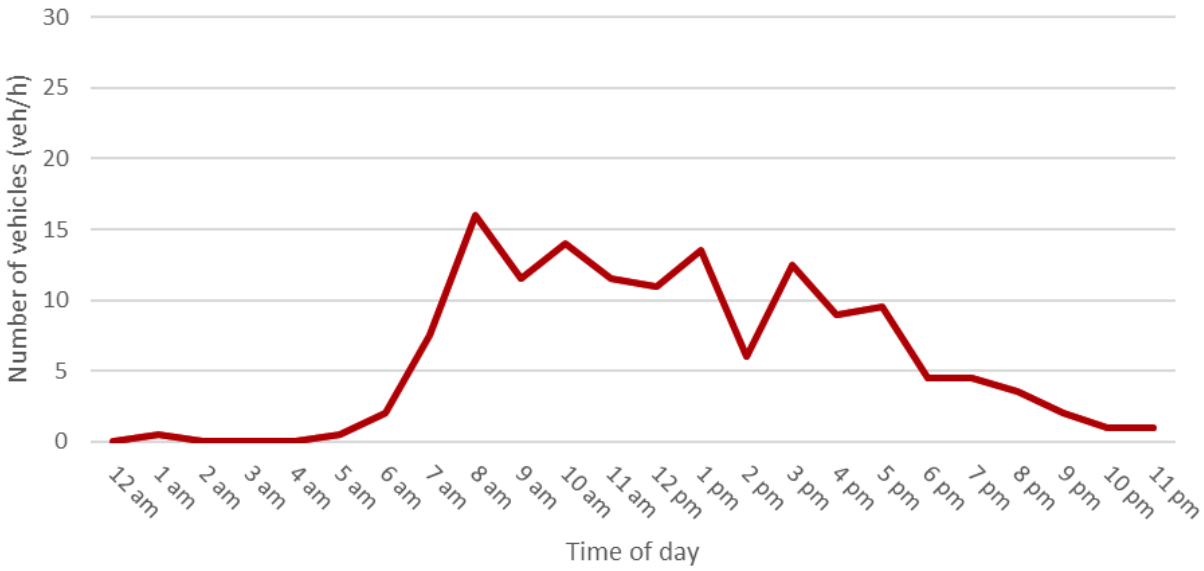


Figure 2-14: Average weekend traffic volumes on Ringwood Road

Ringwood Road carried low traffic volumes on the surveyed weekdays, with a maximum average hourly volume of 28 vehicles observed from 4:00pm to 5:00pm. Traffic volumes were lower on the surveyed weekend, with a maximum average hourly volume of 16 vehicles observed from 8:00am to 9:00am.

2.3.5. Existing speed

A speed survey on the Golden Highway approximately 70 metres east of Ringwood Road was carried out over a one-week period from Tuesday, 31 October 2023, to Monday, 6 November 2023. Table 2-2 shows the 85th percentile speed and average speed recorded on the Golden Highway in both directions over the survey period.

Table 2-2: Golden Highway speed summary (7-days)

Direction	Posted speed limit (km/hr)	85th percentile speed (km/hr)	Average speed (km/hr)
Golden Highway eastbound	100	98.8	84.9
Golden Highway westbound	100	99.9	81.1

As shown in Table 2-2, the 85th percentile speed on the Golden Highway in both directions was observed to be close to the posted speed limit, and may indicate that the majority of drivers ignore the advisory speed limit signage to reduce their speed to 75km/hr near the Golden Highway / Ringwood Road intersection. However, average speeds of approximately 85km/hr in the eastbound direction and 81km/hr in the westbound direction were closer to the advisory speed limit.

2.3.6. Existing intersection performance

An assessment of intersection performance has been based on criteria outlined in the *Guide to Traffic Generating Developments* (Roads and Traffic Authority, 2002). The average delay assessed for signalised intersections is for all movements, and for priority (sign-controlled) intersections is for the worst movements and is expressed in seconds per vehicle. Table 2-3 shows the criteria adopted for the intersection performance assessment.

Table 2-3: Intersection performance criteria

Level of service	Average delay per vehicle	Traffic signals and roundabouts	Give-way and stop sign
A	Less than 15	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity, required other control mode
E	57 to 70	At capacity; at signals, incidents will cause delays. Roundabouts	At capacity, required other control mode
F	Over 70	Extra capacity required	Extreme delay, traffic signal or other major treatment required

Golden Highway / Ringwood Road and Wollar Road / Ringwood Road were modelled using *SIDRA Intersection* modelling software. *SIDRA Intersection* is a micro-analytical tool for evaluation of intersection performance in terms of capacity, Degree of Saturation (DOS), Level of Service (LOS), average delay and queue length, and is an appropriate tool for modelling individual intersections.

The existing performance of the modelled intersections in SIDRA is shown in Table 2-4 and Table 2-5.

Table 2-4: Existing intersection performance (2022) – Golden Highway / Ringwood Road

Period	Approach	DOS	Average delay (sec/veh)	LOS	95% back of queue (m)
Weekday morning peak (7:15am to 8:15am)	Golden Highway eastbound	0.04	8	A	<5
	Golden Highway westbound	0.04	9	A	<5
	Ringwood Road northbound	0.02	7	A	<5
	Overall intersection	**0.04**	**9**	**A**	**<5**
Weekday evening peak (3:00pm to 4:00pm)	Golden Highway eastbound	0.06	8	A	<5
	Golden Highway westbound	0.06	9	A	<5
	Ringwood Road northbound	0.01	7	A	<5
	Overall intersection	**0.06**	**9**	**A**	**<5**

Table 2-5: Existing intersection performance (2022) – Wollar Road / Ringwood Road

Period	Approach	DOS	Average delay (sec/veh)	LOS	95% back of queue (m)
Weekday morning peak (6:00am to 7:00am)	Wollar Road eastbound	0.01	8	A	<5
	Wollar Road westbound	<0.01	8	A	<5
	Ringwood Road southbound	0.01	9	A	<5
	Overall intersection	**0.01**	**9**	**A**	**<5**
Weekday evening peak (5:30pm to 6:30pm)	Wollar Road eastbound	0.01	8	A	<5
	Wollar Road westbound	<0.01	8	A	<5
	Ringwood Road southbound	0.02	9	A	<5
	Overall intersection	**0.02**	**9**	**A**	**<5**

As shown in Table 2-4 and Table 2-5, both intersections operate at LOS A with spare capacity, low average delays and minimal queues on all approaches during the morning and evening peak hour.

2.4. Turning areas

Section 2.3 identifies that Project construction vehicles would be restricted to a left in, left out arrangement at the Golden Highway / Ringwood Road intersection. This would require the use of a turning area to enable Project construction vehicles to return east, where the majority of Project construction vehicle movements would originate from.

Project construction vehicles could use the turnaround facility located on Barnett Street, approximately 150 metres north of its intersection with Golden Highway. An alternative turning area is located approximately 40km further west at the Cassilis Park Rest Area. The Project has consent from Upper Hunter Shire Council and relevant private landowners to use the Barnett Street turnaround facility for Project construction vehicles. The Barnett Street turnaround facility has been assessed and does not require any changes to the intersection geometry to support Project construction vehicle movements.

East of the Golden Highway / Ringwood Road intersection, there are no formal turning areas. Hence, Project construction vehicles would need to use the local roads in Merriwa to perform a U-turn if they are required to access the Project Site from the west (i.e., due to a worker that lives west of Ringwood Road, or if a Project construction vehicle travelling from Merriwa misses the left-turn into Ringwood Road).

Figure 2-15 shows the location of the identified turning areas.

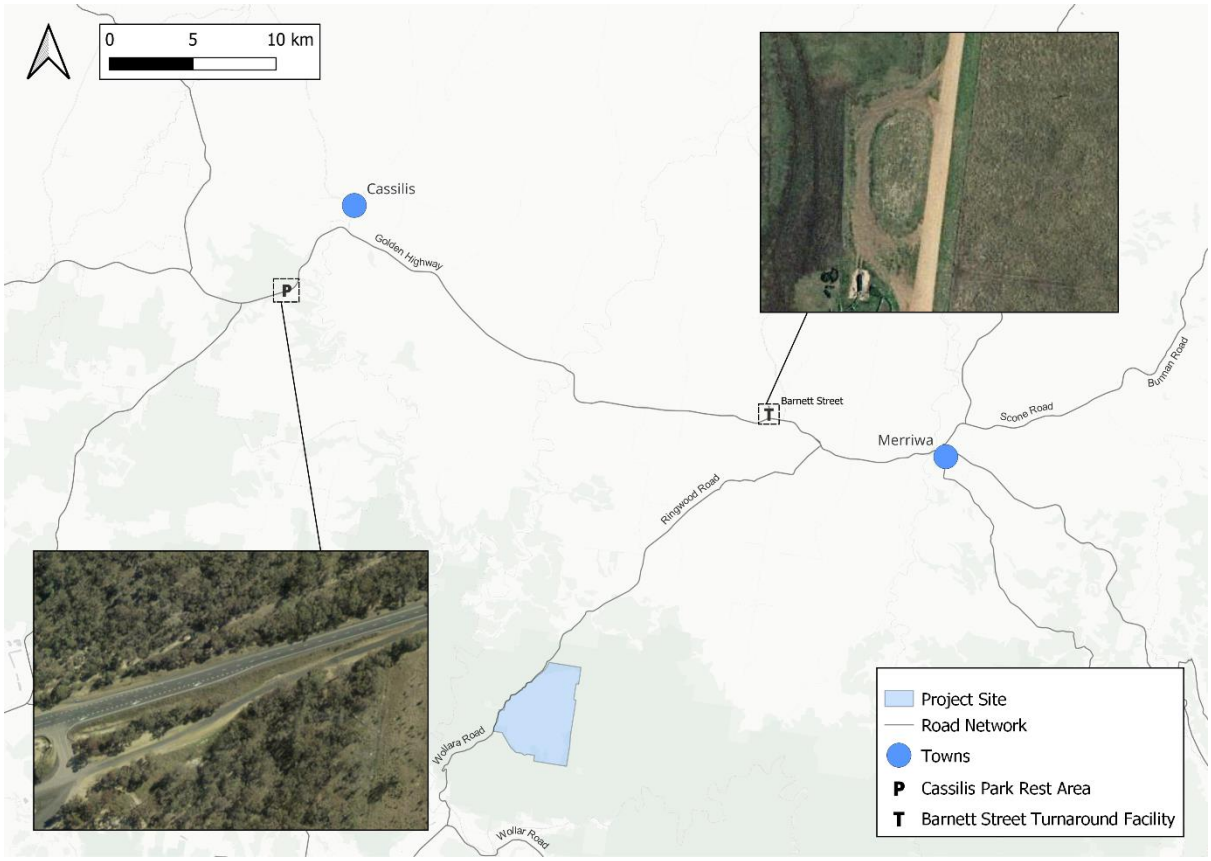


Figure 2-15: Turning area locations

2.5. Parking

There are no formal parking facilities located near the Project Site. A heavy vehicle rest area is located on the northern side of Golden Highway, approximately 300 metres west of the Ringwood Road / Golden Highway intersection, as shown in Figure 2-16. The Cassilis Park rest area shown in Figure 2-15 is also used for short-term parking, however is located a considerable distance from the Project Site.

The closest formal parking facilities are located in the towns of Merriwa and Wollar, both some 20-30 kilometres from the site.

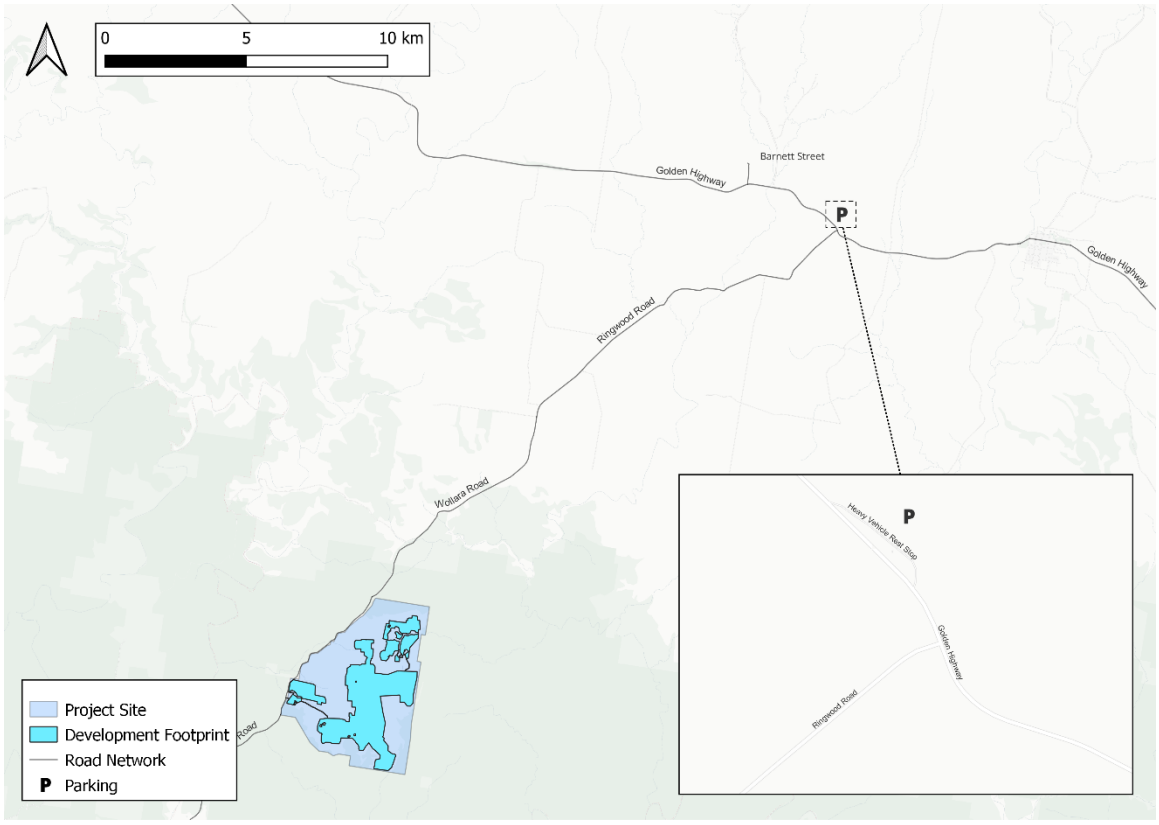


Figure 2-16: Heavy vehicle rest area

2.6. Public transport

2.6.1. Bus network

TransCare, a private bus operator, provides a weekday bus service between Merriwa and Scone via the Golden Highway. The bus route operates once per day, with an additional service between Merriwa and Singleton operating once a month. These private bus services connect Merriwa to the NSW rail network at Aberdeen, Scone, Muswellbrook and Singleton.

Merriwa is also served by another private bus operator, Sid Foggs, as part of its Dubbo to Newcastle route. This route operates three days per week. Figure 2-17 shows the bus routes operated by TransCare and Sid Foggs.

A school bus route operated by Osborn's Transport between Merriwa and Scone serves the Merriwa Pre-School, Scone Grammar School and Scone High School. This route runs along Ringwood Road, Golden Highway and the local road network in Merriwa before proceeding to Scone via Scone Road and Bunnan Road. One service is provided on school days in each direction, corresponding to the school start and finish times.

South of the Project Site, a school bus route operated by Ogden's Coaches runs on the local road network in Wollar before proceeding to Mudgee via Wollar Road and Ulan Road. This route serves students and staff from Cudgegong Valley Public School, Mudgee High School,

Mudgee Public School and St Matthews Catholic School. One service is provided on school days in each direction, corresponding to the school start and finish times.

On the proposed transport route, informal bus stops that serve the Merriwa to Scone school bus route are located on Ringwood Road east of Flight Springs Road, at the intersection of Golden Highway and Ringwood Road, and on Golden Highway near Avocado Road. A bus stop which serves the routes operated by Transcare and Sid Foggs is also located on the Golden Highway in the Merriwa town centre near the Post Office.

The Project is committing to improving the bus stop at the Golden Highway / Ringwood Road intersection. Details on the proposed upgrades for the Merriwa-Scone school bus stop area are detailed in Section 3.6.

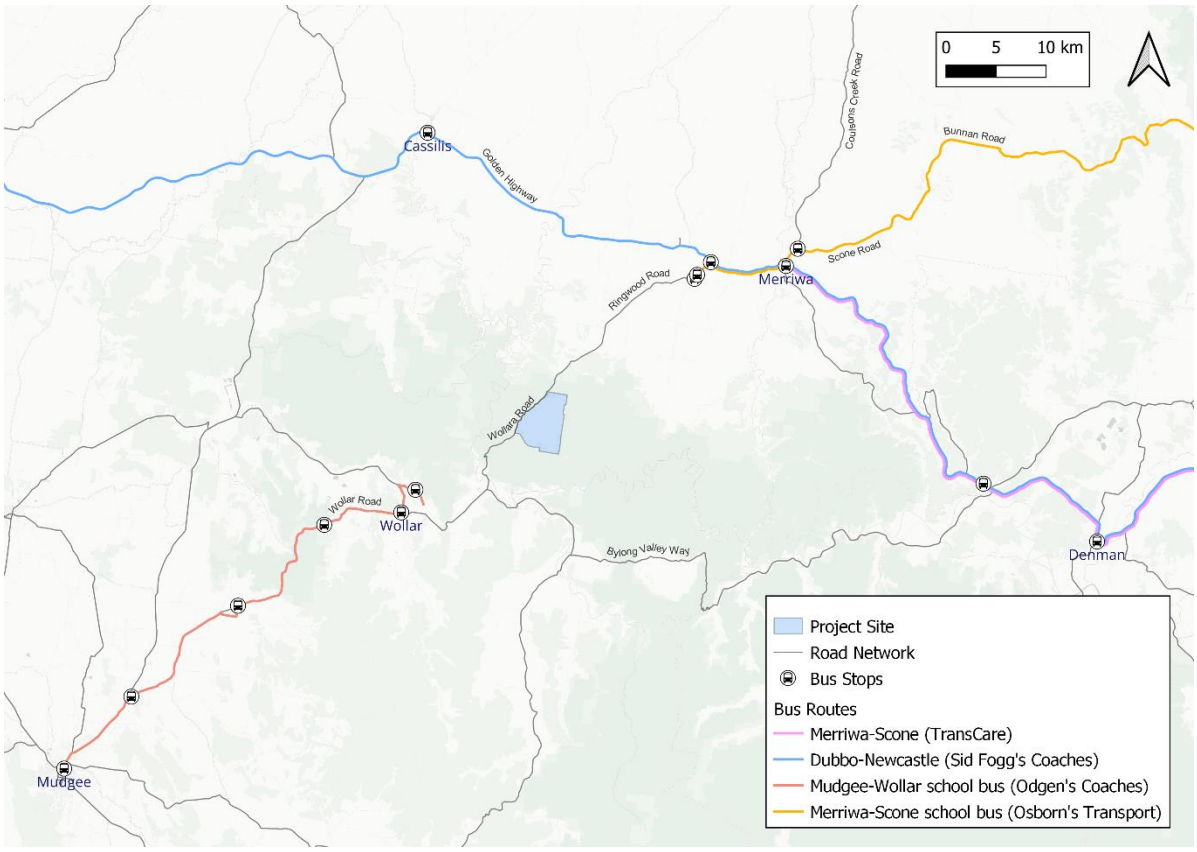


Figure 2-17: Bus routes

Source: Merriwa – Sandy Hollow – Denman – Muswellbrook Bus Timetables (Transcare, 2023), Dubbo to Newcastle Express Coach Services (Sid Foggs, 2023), S823 Merriwa to Scone School via Bunnan Rd (Transport for NSW, 2023) and Mudgee school route – Wollar (Ogden's Coaches, 2023)

2.6.2. Rail network

The Sandy Hollow – Gulgong rail line, primarily used to transport coal from the Ulan mines, passes through Wollar (Figure 2-1). This rail line is owned by Transport for NSW and is operated by the Australian Rail Track Corporation (ARTC). The rail line has multiple level crossings on Ulan Road, Wollar Road and Ringwood Road, south of the site.

Another rail line exists between Merriwa and Sandy Hollow and is part of the Country Regional Network (CRN), owned by Transport for NSW. However, this line is currently non-operational.

2.7. Active transport

The pedestrian and cycle network surrounding the Project Site is limited. There are no formal pedestrian and cycle facilities provided on Golden Highway, Ringwood Road, Wollara Road and Wollar Road. The closest pedestrian facilities are provided at Merriwa town centre. An off-road 700m long shared path is located in Merriwa and passes underneath the Golden Highway, providing a connection between the Merriwa Showgrounds and Dutton Street.

Sections of the Golden Highway are defined cycle routes by using the road shoulder or parking lane (in Merriwa). There is also a short, shared path in Merriwa along the eastern side of the Merriwa River. Figure 2-18 shows the cycle network surrounding the site.

Bicycle NSW identifies a scenic cycle route between Bylong and Merriwa. The recommended route travels along Golden Highway, Forest Reserve Road, Killoe Road, Ringwood Road, Wollara Road, Wollar Road and Bylong Valley Way. An additional four scenic cycle routes (Merriwa to Sandy Hollow, Muswellbrook Explorer Loop, Merriwa to Scone and Merriwa to Willow Tree) are also identified. However, these routes travel away from Merriwa and the Project site to the east. These scenic cycle routes are also shown in Figure 2-18.

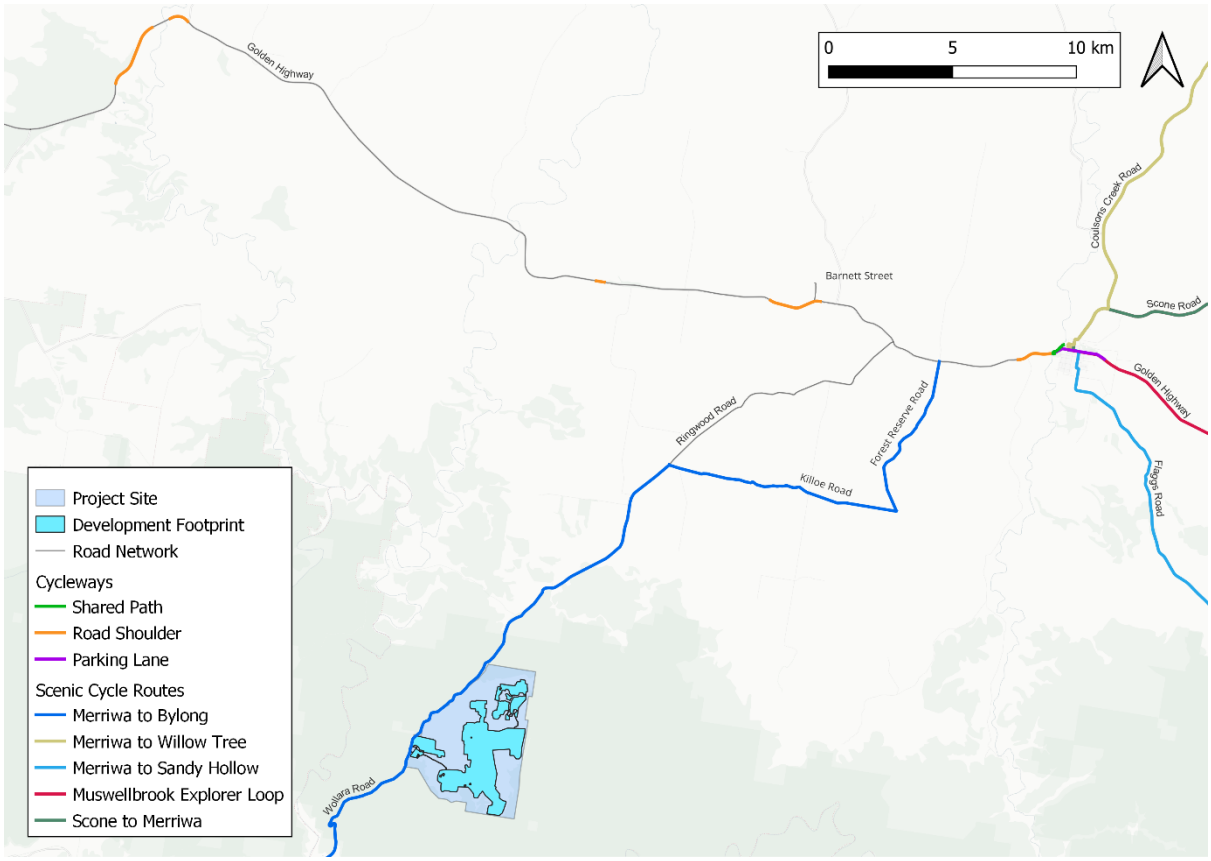


Figure 2-18: Cycle network

Source: Cycleway finder (Transport for NSW, 2023) and NSW Riding Map – Hunter Valley & Northern Tablelands (Bicycle NSW, 2023)

2.8. Road safety

A summary of crash data on roads surrounding the Project Site for the most recent five-year period with available data (2018 to 2022) from Transport for NSW's *Centre for Road Safety* is shown in Figure 2-19.

In the five-year period from 2018 to 2022, a total of 70 crashes were recorded on roads shown in Figure 2-19. This includes 37 crashes in Merriwa and one crash in Wollar. Three crashes occurred on Wollara Road and Ringwood Road, with two of these crashes resulting in moderate injury. Crashes along the Golden Highway were generally dispersed with increased occurrences in and around the Merriwa town centre. Five crashes occurred on the Golden Highway between Ringwood Road and Barnett Street, with three crashes resulting in moderate or serious injury. One crash occurred at the Wollar Road / Ringwood Road intersection resulting in a serious injury. Of the 37 crashes that occurred in Merriwa, 26 resulted in at least one injury and an additional three crashes result in a fatality.

Crash data by Road User Movement (RUM) code is provided in Appendix E.

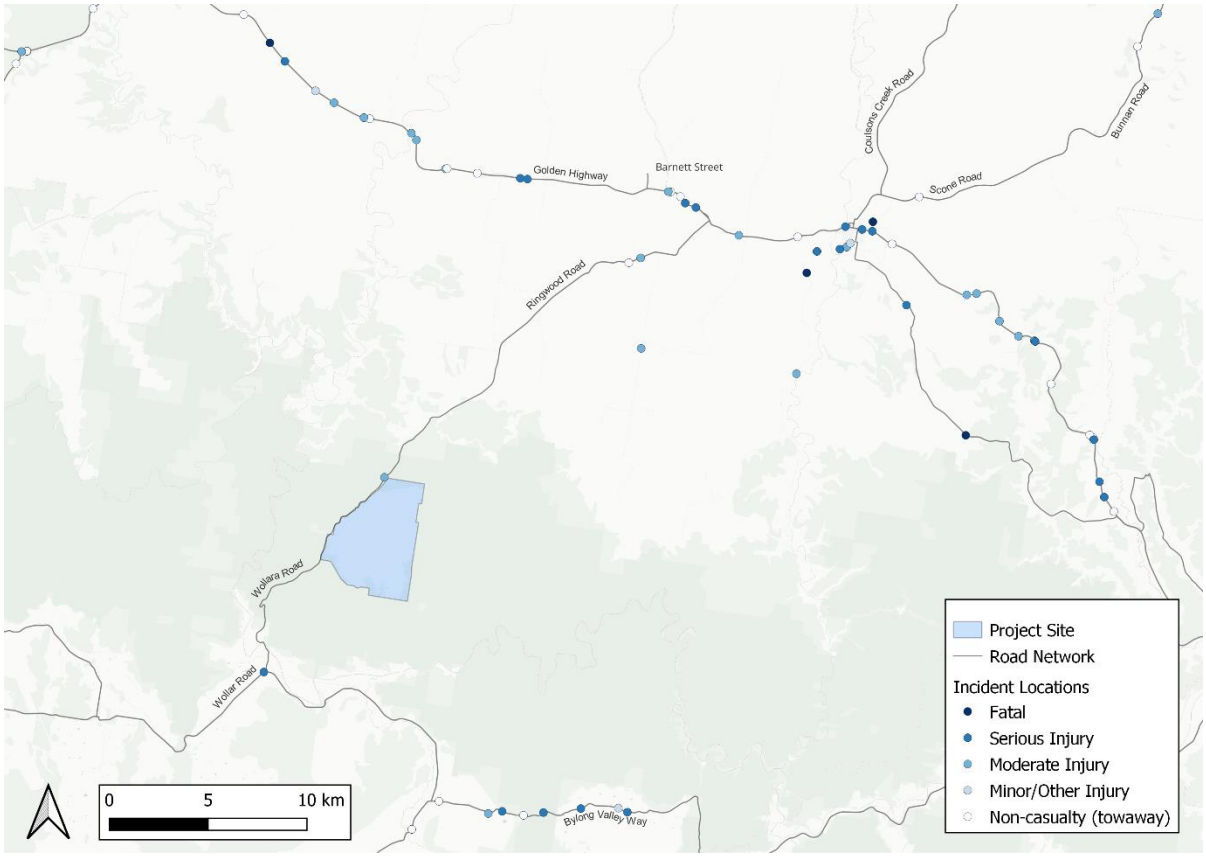


Figure 2-19: Vehicle incident locations

3. Proposed development

3.1. Goulburn River Solar Farm

Key components of the Project are proposed to include:

- Approximately 1 million bifacial solar PV modules in an east-west single-axis tracking arrangement with an approximate height of five metres above ground level
- A centralised BESS with an approximate 450 MWp and 900 MWh capacity or a decentralised BESS with an approximate 580 MWp and 1160 MWh capacity. The BESS would be housed in a series of outdoor containers grouped together adjacent to the substation
- Onsite 500 kV switchyard and substation, with underground electrical conduits and cabling leading into the yard and overhead lines reaching above to the existing transmission line. An additional tower may be erected on the current line to accommodate the grid connection
- Onsite power line connection via underground electrical conduits and cabling
- Communications tower, up to 30 metres high, providing communications, radio and cellular services to the site and wider region
- Internal and perimeter access allowing for site maintenance
- Site office and operations and maintenance building with parking for the operations team
- A primary solar farm site access point off Wollara Road at an existing driveway to the south. Two emergency access points are proposed off Wollara Road (for emergency and National Parks and Wildlife Service access only), one opposite the White Box Trail and one north of the White Box Trail
- Drainage line crossings if and where required to manage existing surface water flows (to be determined during further design development) and access points for construction purposes
- Perimeter security fencing, crossing gates, water tanks or dams, and potential alternate internal secondary access points (within the Project site) to facilitate sheep grazing.

An overview of the footprint for the EIS Project compared to the Amended Project is shown in Figure 3-1.

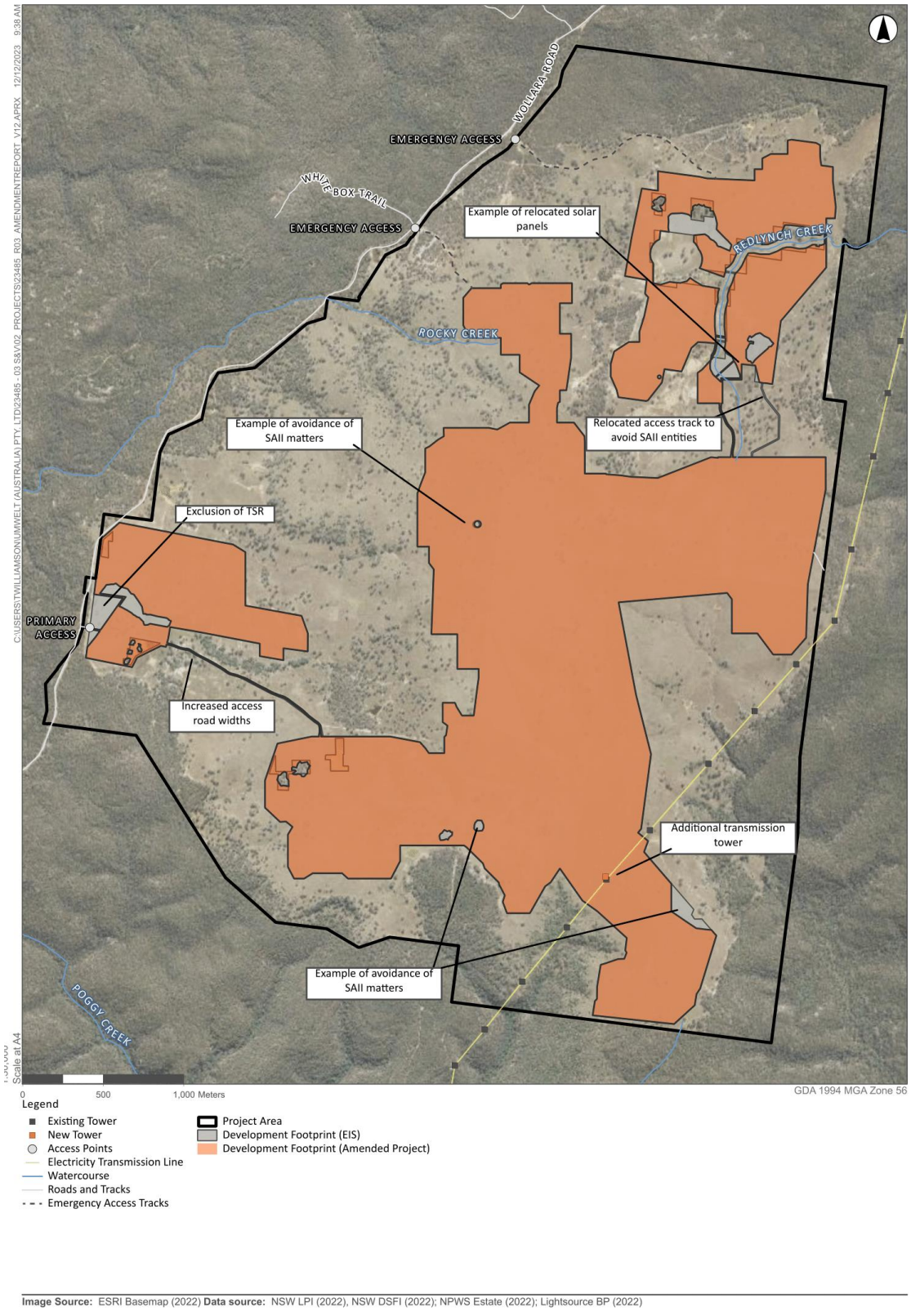


Figure 3-1: Project footprint

3.2. Construction activities

3.2.1. Working hours

Subject to approval, construction is expected to commence in 2024 and take up to 27 months to complete.

Construction activities would mostly occur from 6:00am to 6:00pm, Monday to Saturday.

3.2.2. Construction compound areas

Construction compound areas (including laydown areas, security hut and temporary parking) are proposed within the Project Site as shown in Figure 3-1.

3.2.3. Construction vehicle routes

As discussed in Section 2.3, roads forming part of the construction vehicle route for light vehicles and heavy vehicles include the Golden Highway, Ringwood Road, Wollara Road and Barnett Street as follows:

- Ingress: Golden Highway westbound, left-turn onto Ringwood Road southbound, continue straight onto Wollara Road southbound, left-turn into site
- Egress: Right-turn out of site onto Wollara Road northbound, continue straight onto Ringwood Road northbound, left-turn onto Golden Highway westbound, right-turn onto Barnett Street northbound, U-turn via turnaround facility approximately 190 metres north and continue onto Barnett Street southbound, left-turn onto Golden Highway eastbound.

Standard Project construction vehicles, including light vehicles, shuttle buses and heavy vehicles, are anticipated to originate from the Golden Highway east of Ringwood Road. This is due to the Port of Newcastle being the main receival port for the Project, the presence of industry and services to the east (Merriwa, Scone, Muswellbrook etc) and the absence of population centres to the west along the Golden Highway.

The majority of light vehicle and shuttle bus trips would be to and from accommodation in and around Merriwa. Merriwa is identified as the preferred option to house the construction workforce in the Project's Accommodation and Employment Strategy (submitted as part of the Amendment Report, Umwelt 2023).

Upgrades are proposed to facilitate the left-in, left-out arrangement for Project construction vehicles at the Golden Highway / Ringwood Road intersection, and include a 325m acceleration lane in the westbound direction. This will ensure a compliant intersection arrangement for these movements. The proposed intersection upgrade is discussed in Section 3.2.5.

To ensure that Project vehicles are only performing a left-in, left-out at the intersection, management and mitigation measures would be required, as discussed in Section 5.

All deliveries to site (excluding oversized loads discussed in Section 3.2.4 and Section 3.3.2) would be carried out by 19 metre semi-trailers to comply with heavy vehicle restrictions on Wollara Road and Ringwood Road. These deliveries would be conducted via the Hunter Expressway, New England Highway, Golden Highway, Ringwood Road, Wollara Road and Barnett Street. One primary access point is proposed on Wollara Road. The proposed construction vehicle routes and site access are shown in Figure 3-2.

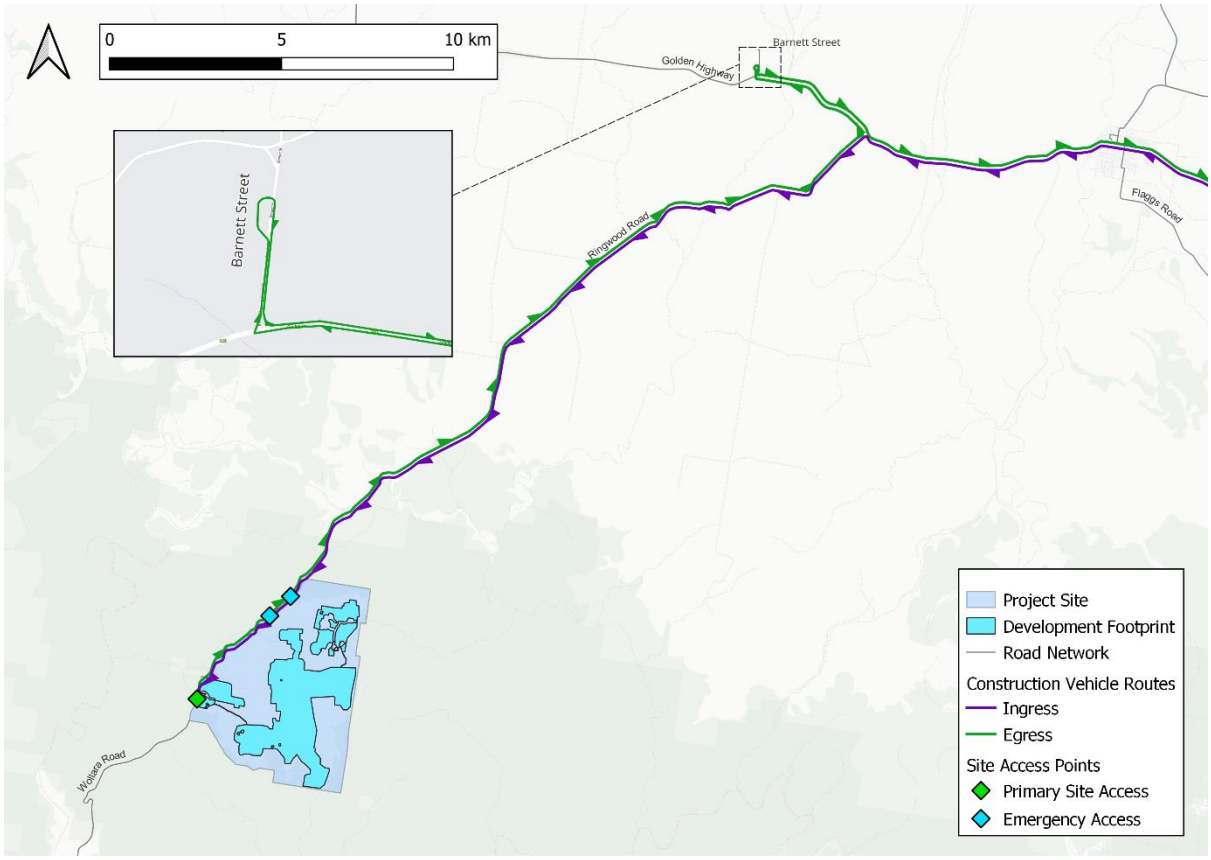


Figure 3-2: Construction vehicle routes and site access

3.2.4. Oversize overmass vehicle routes

Transportation of large Project infrastructure would require OSOM vehicles exceeding the regulatory limits of standard vehicle dimensions of 19m in length, 2.5m in width, 4.3m in height and 42.5t in weight (depending on axle groups). OSOM vehicles are expected to travel to the site from Port of Newcastle via Industrial Drive, Pacific Highway, Newcastle Inner City Bypass, Newcastle Road, Hunter Expressway, New England Highway and Golden Highway, as shown in Figure 3-3. These are all approved B-double roads and are suitable for the OSOM vehicles considered for this project.

OSOM vehicles would return via the same roads in the reverse direction. Contrary to standard Project construction vehicles, egressing OSOM vehicles are proposed to perform a right-turn from Ringwood Road to the Golden Highway in the eastbound direction, as these movements would be undertaken outside of peak periods and under additional traffic control and management.

A review of the OSOM vehicle route shown in Figure 3-3 was undertaken with the infrastructure in its current condition. The causeways at Bow River and Killoe Creek require upgrades (discussed in Section 3.2.5) to facilitate the swept path of the OSOM loads, as shown in Appendix F. At other locations along the route, traffic management measures (such as those identified in Section 5) are necessary, and would be outlined in a Construction Traffic Management Plan (CTMP), to be developed by the construction contractor during detailed investigation of the OSOM vehicle route at a later stage of the Project. To inform the OSOM vehicle route assessment, Lightsource bp has obtained a Transport Management Plan developed by Rex J Andrews for a project located further west of the Project Site (see Appendix G). The Transport Management Plan includes an assessment of the same OSOM vehicle to be used by this Project and OSOM vehicle route from the Port of Newcastle to the Golden Highway / Ringwood Road intersection. Hence, the required traffic management measures to accommodate OSOM vehicles for this Project would be the same (up until the Golden Highway / Ringwood Road intersection) and include:

- Pacific Highway / Newcastle Inner City Bypass – Due to the intersection geometry, traffic management may be required so that OSOM vehicles can negotiate the left turn from Pacific Highway onto Newcastle Inner City Bypass.
- Newcastle Inner City Bypass in Sandgate and Jesmond – Due to vertical limitations at four overpasses along the Bypass, OSOM vehicle loads may need to be lowered to ensure enough clearance is provided.
- New England Highway / Golden Highway – The NSW Government is currently upgrading this intersection as part of the New England Highway Upgrade between Belford and Golden Highway, which is scheduled for completion in late 2024. A review of available public information shows that the existing and proposed intersection design could accommodate OSOM vehicles. As part of the detailed OSOM route assessment, the progress of the New England Highway Upgrade project would be checked to determine if traffic management measures are required.
- Golden Highway / Putty Road / Mount Thorley Road intersection – Due to the intersection geometry, traffic management may be required so that OSOM vehicles can negotiate the right turn from Golden Highway/Putty Road onto Golden Highway/Mount Thorley Road.
- Golden Highway near Ogilvies Hill and Winery Hill – Due to some steep grades, additional pull trucks may be required to assist OSOM vehicle movements through this area.
- Golden Highway at Denman Bridge – Due to vertical and horizontal limitations at the Denman Bridge truss structure, OSOM vehicle loads may need to be lowered to ensure enough clearance is provided.
- Golden Highway / Ringwood Road intersection – Due to the intersection geometry, traffic management may be required so that OSOM vehicles can turn into and out of Ringwood Road.
- Ringwood Road and Wollara Road – The causeways at Bow River and Killoe Creek were identified as inadequate to accommodate OSOM vehicles. Hence, culvert upgrades (discussed in Section 3.2.5) are proposed and would be

designed and constructed to be able to accommodate the OSOM vehicles generated by the Project (see Appendix F).

Parking bays for fatigue breaks that can accommodate the proposed OSOM vehicles are located near the New England Highway / Golden Highway interchange in Whittingham (115m x 9m clearance), near the Golden Highway / Putty Road intersection in Mount Thorley (100m x 10m clearance), on the Golden Highway west of the United Colliery Mine in Warkworth (100m x 8m clearance), near the Golden Highway / Honey Lane intersection in Sandy Hollow (50m x 4m clearance), near the Golden Highway / Westwood Road intersection in Gungal (70m x 6m clearance) and near the Golden Highway / Brisbane Street intersection in Merriwa (100m x 5m clearance).

Swept paths of the OSOM vehicles at the Golden Highway / Ringwood Road intersection and at the site access is discussed in Section 3.2.6, and when combined with the Transport Management Plan by Rex J Andrews, provides an assessment of the entire OSOM route proposed for this Project.

The movement of OSOM vehicles would require a permit to access public roads with escort vehicles as part of a convoy. In obtaining a permit, a CTMP, as discussed above, would need to be prepared by the construction contractor and include details such as the route, duration, road closures, traffic detours, notifications and any required Traffic Guidance Schemes.

Details of the proposed OSOM vehicle dimensions including swept paths along sections of Wollara Road and Ringwood Road are provided in Appendix F.

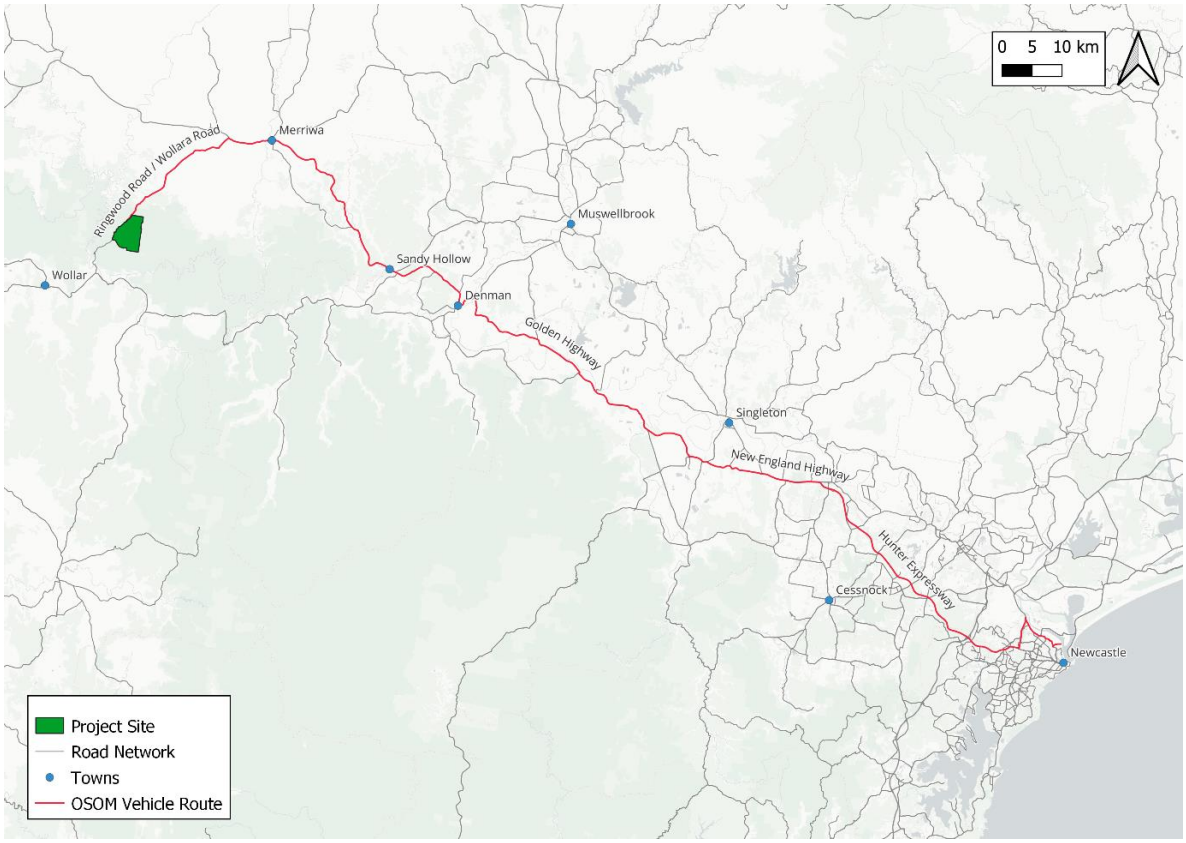


Figure 3-3: Indicative OSOM vehicle route

3.2.5. Intersection, road and culvert upgrades

A summary of the proposed intersection, road and culvert upgrades are shown in Table 3-1 and would be undertaken in consultation with Upper Hunter Shire Council, Transport for NSW and National Parks and Wildlife Service. These upgrades are discussed in further detail in the sections below.

Table 3-1: Schedule of intersection, road and culvert upgrades

Works to be carried out	Reason	Timing
Upgrade of Ringwood Road north of the National Park including a 1.8km section to be widened and resealed between Bow River and Killoe Creek and a 1.6km section to be realigned, widened and sealed between Killoe Creek and Binks Road	Community benefit	Prior to construction of the Project
Upgrade of Wollara Road with realignment, widening and resealing of a 4.7km unpaved section between the National Park and 1621 Wollara Road	Community benefit	Prior to construction of the Project
Intersection upgrades at Golden Highway / Ringwood Road with a compliant left-turn in and left-turn out arrangement, and pruning and vegetation removal to improve sight lines	Improve safety	Prior to construction of the Project
Additional signage and linemarking at the Golden Highway / Barnett Street intersection	Improve safety	Prior to construction of the Project

Additional signage at the primary site access	Improve safety	Prior to construction of the Project
Installation of a culvert on Ringwood Road at Bow River	Accommodate construction vehicles including OSOM loads	Prior to construction of the Project
Installation of a culvert on Ringwood Road at Killoe Creek	Accommodate construction vehicles including OSOM loads	Prior to construction of the Project

Culvert upgrades

As discussed in Section 3.2.4, upgrades to the two water crossings on Ringwood Road at Bow River and Killoe Creek are required to accommodate the loading from Project construction vehicles. Improvements to road flood immunity are an expected auxiliary benefit of the proposed culvert upgrades. These upgrades include:

- Installing culverts designed to accommodate two-way heavy vehicles, including B-doubles and various farm machinery over the Bow Creek and Killoe Creek
- Culvert width of 7 m (3.5 m lane width) with a sealed carriageway, guardrails, signage and associated drainage works
- Stockpile site to be located on disturbed land within the road reserve, in consultation with Upper Hunter Shire Council
- Temporary side track at both locations to facilitate access during construction.
- All culvert upgrades designed to B-double standards. However, the Project would only use 19 metre semi-trailers, with the exception of OSOM loads under permit.

Road upgrades

A review of the roads forming part of the transport route was undertaken based on a drive-through visual inspection. This inspection identified that sections of Ringwood Road and Wollara Road had poor pavement condition and poor drainage. Upper Hunter Shire Council were contacted to determine the existing pavement profile of these roads and if any works had been carried out on these roads with available design drawings. Since conducting the initial inspection, Upper Hunter Shire Council has conducted repairs to the road pavement to reduce the surface defects. While the roads have surface defects in sections, they are sufficient to accommodate the 19 metre semi-trailers proposed for the Project.

The proponent has committed to further road upgrades which are not required for the Project but are a benefit to the community under a Voluntary Planning Agreement with Upper Hunter Shire Council as follows:

- Widening and resealing of a 1.8km section of Ringwood Road between Bow River and Killoe Creek.
- Realignment, widening and sealing of an additional 1.6km section of Ringwood Road between Killoe Creek and Binks Road.
- Realignment, widening and sealing of a 4.7km unpaved section of Wollara Road between the Goulburn River National Park boundary and 1621 Wollar Road.

These upgrades would include 8m bitumen-sealed formation with a minimum of 500mm unsealed shoulders. The horizontal and vertical alignment of the proposed road would ensure safe sight distance, safe movement of longer vehicles, and an improved road network for the users. All road upgrades have been designed to B-double standards. However, the Project would use 19 metre semi-trailers, with the exception of OSOM loads.

The footprint of the proposed road and culvert upgrades are shown in Figure 3-4 and Figure 3-5. Drawings of these upgrades are provided in Appendix H.

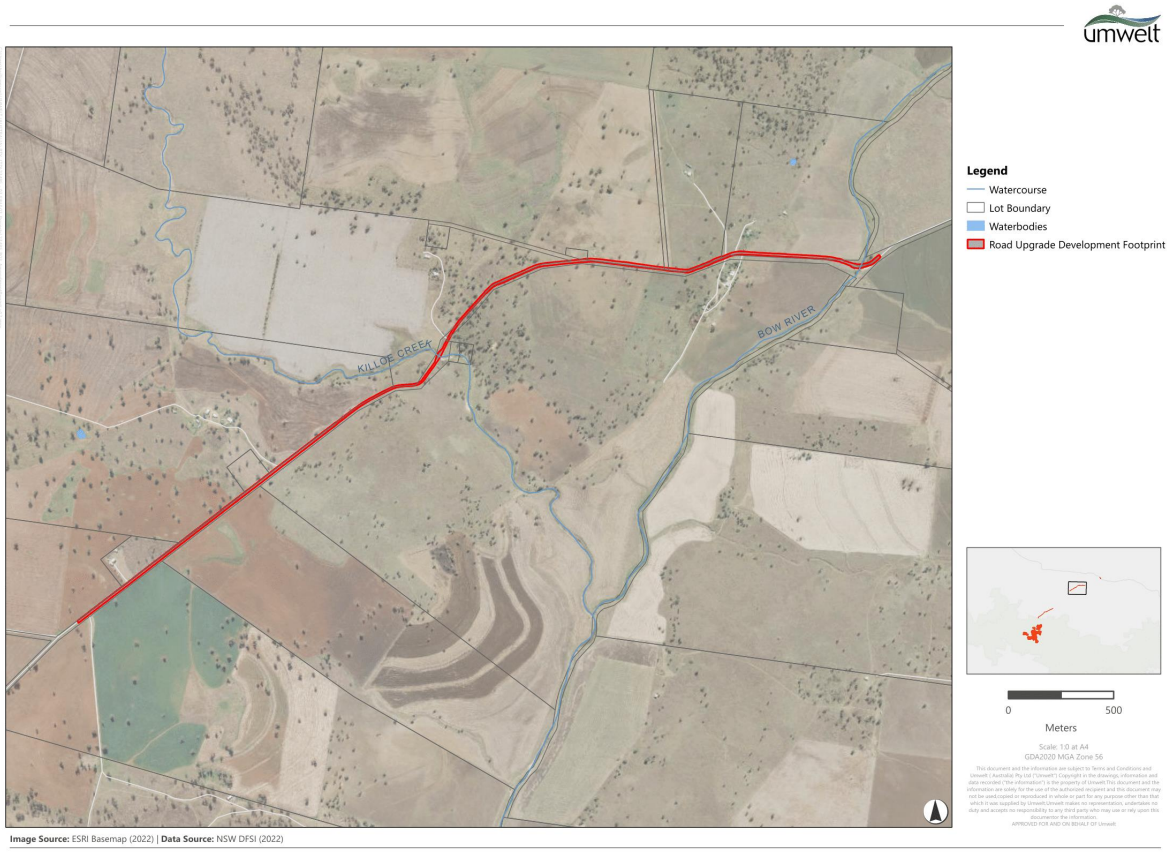


Figure 3-4: Road and culvert upgrade footprint along Ringwood Road

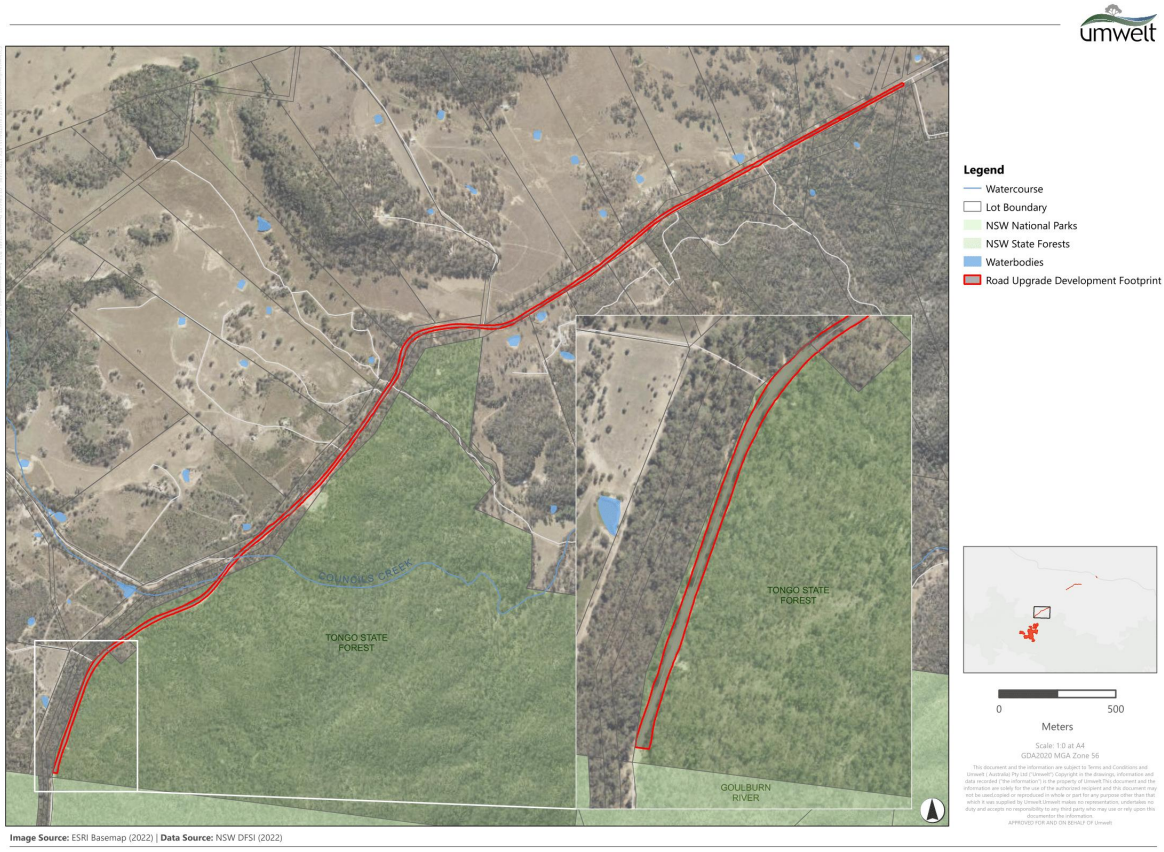


Figure 3-5: Road upgrade footprint along Wollara Road

Intersection upgrades

As discussed in Section 2.3.3 and as observed during the site inspection, existing sight distance at the intersection of Ringwood Road and Golden Highway is restricted. To provide a safe intersection arrangement for the Project, DPE and Transport for NSW were consulted and a number of investigations were carried out. The development of the intersection design is summarised in Table 3-2.

Table 3-2: Golden Highway and Ringwood Road intersection design development

Design item	Investigations carried out	Outcome
SISD from Ringwood Road looking east to westbound traffic on Golden Highway	• Speed survey on Golden Highway to confirm the 85th percentile speed (99.9 km/h as outlined in Section 2.3.5). • Investigations to modify Ringwood Road vertical alignment. • Investigations to modify the horizontal and vertical alignment of Golden Highway.	It was not possible to provide adequate sight distance for this movement that would be practical for the Project. To overcome this, a new acceleration lane for the left turn from Ringwood Road onto Golden Highway westbound was proposed. Project construction vehicle movements (left-in, left-out only) would be enforced as per the management and mitigation measures outlined in Section 5.
Acceleration lane out from Ringwood Road into Golden Highway	• Review of traffic volumes (to provide an appropriate treatment). • Entry speed into acceleration. • Safety of motorists.	A 325m acceleration lane, which meets the requirements for a light vehicle was implemented in the design. It would be impractical to provide a compliant acceleration lane for a heavy vehicle (lane length required would be in excess of 1km) A painted median to facilitate the left turn has been proposed rather than a kerb median which would not fit the character of the intersection arrangement and potentially introduce a new hazard to motorists.
Deceleration lane into Ringwood Road from Golden Highway	• Reverse engineering of the deceleration lane design. • Review of traffic volumes (to provide an appropriate treatment).	The existing deceleration lane taper was found to be non-compliant in length for the design speed along Golden Highway. The line marking was amended to provide a compliant taper.

Following the design development process and discussions with DPE and Transport for NSW, upgrades proposed at the Golden Highway / Ringwood Road intersection include:

- Pruning and removal of vegetation and select trees on Lot 1 / DP 34496. Currently estimated at 6 established trees to be removed.
- Construction of a 325m acceleration / merge lane to allow vehicles to safely turn left onto the Golden Highway from Ringwood Road. Potential earthworks on Lot 1 / DP 34496 and potential realignment of the existing low voltage power line to provide clearance to the acceleration lane.
- Extension of the existing Golden Highway westbound and Ringwood Road left-in deceleration lane taper to 30m.
- Formalisation of the informal bus stop on Ringwood Road at the intersection with Golden Highway (Lot 7303 / DP 1146691).

The intersection upgrade footprint is shown in Figure 3-6. Drawings of the proposed intersection upgrades are provided in Appendix C.

Figure 3-6: Intersection upgrade footprint at Golden Highway / Ringwood Road

As discussed in Section 3.2.3, Project construction vehicles would use the turnaround facility on Barnett Street to return on the Golden Highway in the eastbound direction. No intersection geometry changes are required to accommodate these movements on Barnett Street. Notwithstanding, the addition of a give-way line and associated signage on Barnett Street is recommended to indicate that vehicles exiting Barnett Street are to provide right of way to vehicles on Golden Highway. Additional signage on both Golden Highway approaches to the intersection is recommended to warn general traffic that trucks are turning at the intersection.

Installation of warning signs (“Symbolic Truck”) are recommended near the primary site access point. These are shown in Appendix I.

3.2.6. Swept paths

Swept paths along the proposed construction vehicle route were assessed and are provided in Appendix C, Appendix F, Appendix I and Appendix J.

A review of the swept paths for a low loader / semi-trailer (19 metre length as per *Austroads Design Vehicles and Turning Path Templates Guide* (Austroads, 2013)) showed the following:

- At the upgraded Golden Highway / Ringwood Road intersection (Section 3.2.5), semi-trailers can safely perform a left-turn into and out of Ringwood Road and light vehicles (non-project related traffic) can safely perform a right-turn into and out of Ringwood Road
- At the Golden Highway / Barnett Street intersection, semi-trailers can safely perform a right-turn into and left-turn out of Barnett Street, with no intersection upgrades required
- At the turnaround facility on Barnett Street approximately 190 metres north of the Golden Highway, semi-trailers can safely perform a U-turn, with no road upgrades required
- The primary site access point in its current configuration may only be able to accommodate one vehicle in or out at a time due to the density of surrounding vegetation. Hence, single vehicle entry/exit would be provided at the primary access, with no vegetation removal required. Traffic management would be used to control vehicle movements at the site access by managing vehicles leaving the site and giving right-of-way to vehicles entering the site, as outlined in a CTMP to be prepared prior to the commencement of construction, as discussed in Section 5.

The two emergency access points (existing tracks) would be used for site emergency access and egress, and as general access for National Parks and Wildlife Service only, and not for construction access.

3.3. Traffic generation

3.3.1. Workforce

The workforce anticipated during construction of the Project includes an approximate 350 construction jobs created during peak construction. This would comprise licensed electrical and mechanical trade personnel, machinery operators, riggers and labourers. The breakdown of workforce personnel during the construction program is shown in Figure 3-7.

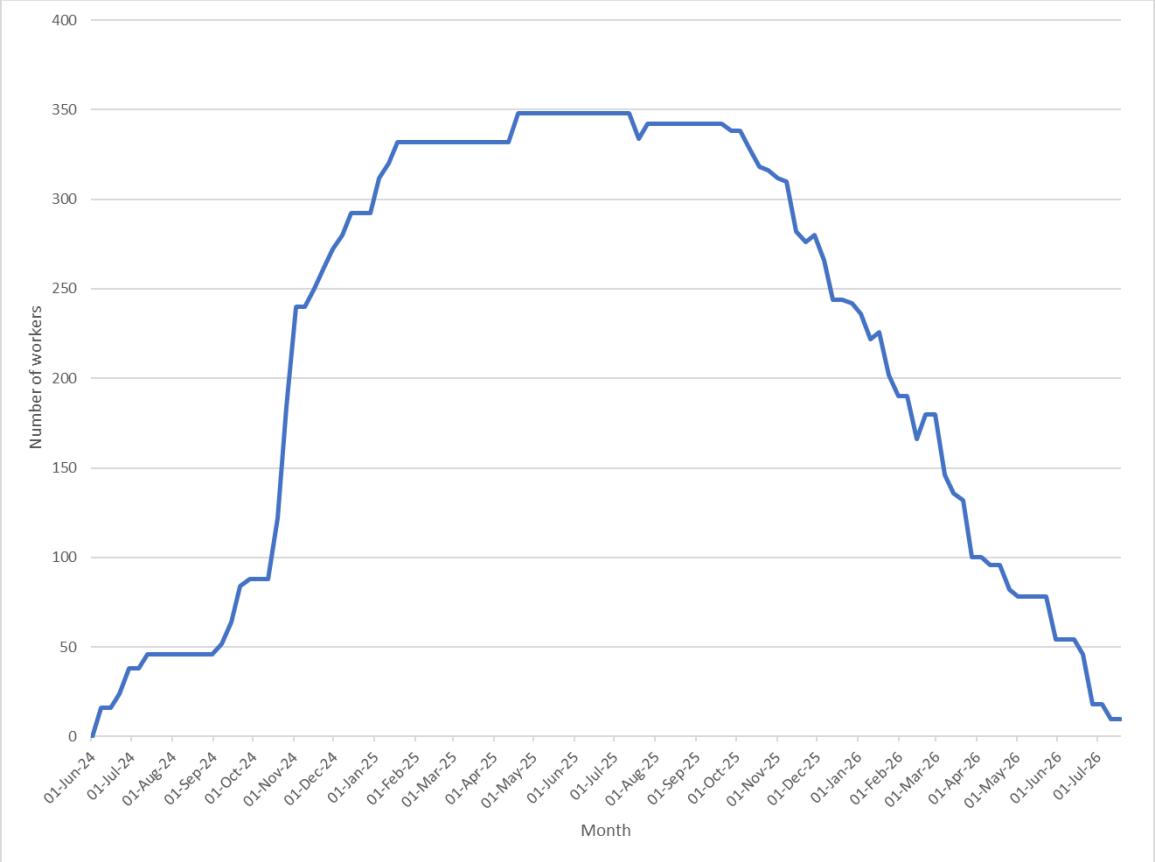


Figure 3-7: Workforce breakdown

3.3.2. Construction traffic

During peak construction, the following trips are anticipated to be generated by the Project:

- Light vehicles – 60 two-way trips per day (120 light vehicle movements per day)
- Shuttle buses – 15 two-way trips per day (30 shuttle bus movements per day)
- Heavy vehicles – 55 two-way trips per day (110 heavy vehicle movements per day).

It is noted that the number of light vehicle movements may decrease where the geographic location of workers enables additional shuttle bus movements to be facilitated. This is likely, given that the Project Accommodation and Employment Strategy (supporting the Amendment Report, Umwelt 2023) recommends that construction accommodation be centred in Merriwa.

As discussed in Section 3.2.3, egressing Project construction vehicles would use the Barnett Street turnaround facility to return east on the Golden Highway. There would be shuttle bus use from 6:00am and delivery (light vehicle) use periodically throughout the day. The majority of use will be for construction workers at the end of their shift, likely between 5:30pm and 6:30pm.

In addition, 6 to 12 oversized loads (OSOM vehicles) are expected throughout the construction period, with a maximum of two loads per day. Hence, the Project would generate a maximum total of 12 inbound and 12 outbound OSOM vehicle movements, with no more than 2 inbound and 2 outbound OSOM vehicle movements in one day. As discussed in Section 3.2.4, these movements would only occur during off-peak periods when traffic volumes are low and under additional traffic control and management.

Mobilisation would occur during the first months of the construction program, with more intense construction occurring during mechanical completion. Following this, the Project would move into the commissioning phase during the final months of the construction program.

3.3.3. Operational traffic

During operation, it is likely that up to 10 staff would be on-site concurrently. Staff travelling to and from the site during operation of the Project would generate on average, 10 two-way trips per day (20 light vehicle movements per day).

3.4. Turning areas

As outlined in Section 2.4, the Barnett Street turnaround facility would be used by egressing construction vehicles.

Additionally, while not proposed as part of the Project, should any Project construction vehicles originate from west via the Golden Highway in the eastbound direction, they would be restricted from a right turn into Ringwood Road from the Golden Highway. These vehicles would be directed to Merriwa and use the local road network to turn around and travel on the Golden Highway in the westbound direction to access the site. This would enable a left in movement to be undertaken at the Golden Highway / Ringwood Road intersection.

A suitable turn around route in Merriwa could include Dutton Street, Mackenzie Street and Bow Street. As shown in Figure 2-9, Dutton Street south of the Golden Highway is an approved B-double route. Turn around options in Merriwa have been identified for contingency use only, with no Project construction vehicles anticipated to use this route unless they miss the Ringwood Road and Golden Highway intersection and need to re-approach the Project Site from the east. Use of these local roads by construction vehicles (excluding OSOM vehicles) would be subject to swept paths and sight distance checks, to be carried out as part of the CTMP. Furthermore, Upper Hunter Shire Council would be consulted if regular use of the local road network in Merriwa is required.

3.5. Parking

On-site parking would be provided for all vehicles during construction and operation of the Project.

3.6. Public transport

As part of the proposed intersection upgrade of Golden Highway / Ringwood Road discussed in Section 3.2.5, the existing informal bus stop on Ringwood Road at the intersection with Golden Highway would be formalised. This bus stop is used by one school bus route operated by Osborn's Transport, with one service in the morning and afternoon during school drop off and pick up.

3.7. Active transport

It is not anticipated that any movements associated with the Project would be facilitated via active transport modes.

4. Transport impact assessment

4.1. Construction impacts

4.1.1. Impacts on the road network

Intersection performance

The peak construction year as assessed is expected to occur in 2025, representing a worst-case scenario when background traffic volumes and construction volumes are at their highest. A two per cent per year background traffic growth rate has been applied to the 2022 traffic volumes collected, based on corridor growths outlined in the *Golden Highway Corridor Strategy* (Transport for NSW, 2016).

In addition to background traffic growth, peak hour traffic volumes generated by other nearby projects were included in the modelling assessment. EIS as well as TTIAs for the projects outlined in Section 4.1.5 were reviewed on the DPE Major Projects website. This review was undertaken to determine the likely peak hour volumes generated by transport movements through the Golden Highway / Ringwood Road intersection.

These individual project volumes are shown in Table 4-1 and provide an indicative cumulative total for transport movements on the Golden Highway.

Table 4-1: 2025 peak hour volumes from other projects

Project name	Light vehicles	Heavy vehicles	Assumptions
Stubbo Solar Farm	N/A	6	• Light vehicle routes do not overlap with Project
Liverpool Range Wind Farm	10	26	• Derived from peak daily volumes • 16 per cent of daily volume to occur during peak hours, as per Austroads Guide to Road Traffic Management Part 6 • One third of daily light vehicle trips to/from Merriwa via Golden Highway, as outlined in planning documents
Valley of the Winds Wind Farm	N/A	4	• Light vehicle routes do not overlap with Project
Tallawang Solar Farm	75	15	• A quarter of light vehicle trips to/from Merriwa via Golden Highway, as outlined in planning documents • 10 per cent of daily heavy vehicle volume to occur during peak hours, as outlined in planning documents
Birriwa Solar Farm	N/A	14	• Light vehicle routes do not overlap with Project
Spicers Creek Wind Farm	N/A	27	• Light vehicle routes do not overlap with Project
Bowdens Silver Project	N/A	5	• Light vehicle routes do not overlap with Project

Project name	Light vehicles	Heavy vehicles	Assumptions
			• Heavy vehicles derived from peak daily volumes • 16 per cent of daily volume to occur during peak hours, as per Austroads Guide to Road Traffic Management Part 6
Cumulative total	**85***	**97****	

*85 inbound trips during the morning peak hour and 85 outbound trips during the evening peak hour
**97 inbound and 97 outbound trips during the morning peak hour and evening peak hour

Peak hour construction volumes used in this assessment have been determined by applying the following assumptions to the daily construction volumes outlined in Section 3.3.2:

- All light vehicle and shuttle bus trips assumed to travel inbound during the morning peak hour and outbound during the evening peak hour to represent a worst-case scenario. In reality, the majority of light vehicle and shuttle bus trips would likely occur before the morning peak hour and after the evening peak hour
- All inbound construction vehicles assumed to originate north of the site from Golden Highway east of Ringwood Road
- All outbound construction vehicles assumed to travel north of the site towards destinations accessible from Golden Highway east of Ringwood Road
- Ten percent of daily heavy vehicle trips to occur during the peak hours
- Inbound and outbound heavy vehicle trips to occur during both peak hours
- Oversized vehicle trips would not occur during the peak hours
- Shuttle buses have been classified as a heavy vehicle for modelling purposes.

Construction peak hour volumes for the Project and adopted for the intersection performance assessment are shown in Figure 4-1. The Project peak hour volumes include:

- Light vehicles: 60 inbound trips during the morning peak hour and 60 outbound trips during the evening peak hour
- Shuttle buses: 15 inbound trips during the morning peak hour and 60 outbound trips during the evening peak hour
- Heavy vehicles: 6 inbound and 6 outbound trips during the morning and evening peak hour.

The peak hours modelled represent the road network peak hour (when background traffic volumes are highest), with peak Project construction vehicle hourly volumes, representing a worst-case scenario.

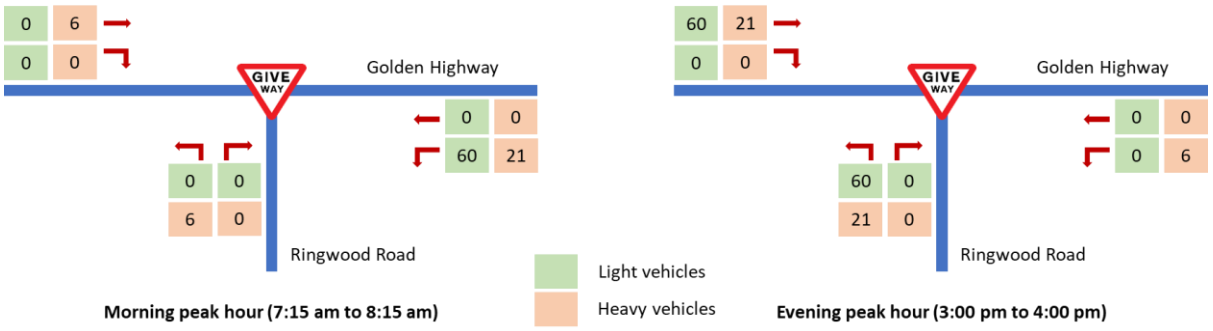


Figure 4-1: Goulburn River Solar Farm Project construction peak hour traffic volumes at the Golden Highway / Ringwood Road intersection

The performance of the modelled Golden Highway / Ringwood Road intersection in SIDRA with and without Project construction vehicles in 2025 is shown in Table 4-2 (Project only) and Table 4-3 (cumulative construction).

Table 4-2: Intersection performance during construction (Project only) – Golden Highway / Ringwood Road

Approach and peak period	2025 base				2025 construction			
	DOS	Average delay (sec/veh)	LOS	95% back of queue (m)	DOS	Average delay (sec/veh)	LOS	95% back of queue (m)
Weekday morning peak (7:15am to 8:15am)								
Golden Highway eastbound	0.05	8	A	<5	0.05	8	A	<5
Golden Highway westbound	0.05	9	A	<5	0.07	9	A	<5
Ringwood Road northbound	0.02	7	A	<5	0.02	8	A	<5
Overall intersection	**0.05**	**9**	**A**	**<5**	**0.07**	**9**	**A**	**<5**
Weekday evening peak (3:00pm to 4:00pm)								
Golden Highway eastbound	0.07	8	A	<5	0.12	8	A	<5
Golden Highway westbound	0.06	9	A	<5	0.06	10	A	<5
Ringwood Road northbound	0.01	7	A	<5	0.06	9	A	<5
Overall intersection	**0.07**	**9**	**A**	**<5**	**0.12**	**10**	**A**	**<5**

Table 4-3: Intersection performance during construction (cumulative) – Golden Highway / Ringwood Road

Approach and peak period	2025 cumulative base				2025 cumulative construction			
	DOS	Average delay (sec/veh)	LOS	95% back of queue (m)	DOS	Average delay (sec/veh)	LOS	95% back of queue (m)
Weekday morning peak (7:15am to 8:15am)								
Golden Highway eastbound	0.15	9	A	<5	0.15	10	A	<5
Golden Highway westbound	0.19	9	A	<5	0.19	9	A	<5
Ringwood Road northbound	0.03	12	A	<5	0.04	13	A	<5
Overall intersection	**0.19**	**9**	**A**	**<5**	**0.19**	**13**	**A**	**<5**
Weekday evening peak (3:00pm to 4:00pm)								
Golden Highway eastbound	0.21	8	A	<5	0.26	8	A	<5
Golden Highway westbound	0.16	9	A	<5	0.16	10	A	<5
Ringwood Road northbound	0.01	12	A	<5	0.07	15	B	<5
Overall intersection	**0.21**	**12**	**A**	**<5**	**0.26**	**15**	**B**	**<5**

As shown in Table 4-2, the addition of Project only construction traffic on the road network would result in minimal impacts, with average delay and increasing by up to one second and no change to LOS.

As shown Table 4-3, the addition Project construction traffic with cumulative volumes generated by other projects on the road network would result in a minor increase in the average delay at the Golden Highway / Ringwood Road intersection. The increase in delay is calculated to be 4 seconds during the morning peak hour and 3 seconds during the evening peak hour.

As a result of increased traffic volumes on the Golden Highway, vehicles turning right from Ringwood Road to Golden Highway would wait slightly longer at the intersection prior to completing the turning manoeuvre. It is noted that construction vehicles would not be undertaking this movement.

Although there is a minor increase in the average delay, the intersection would still operate with spare capacity and at an acceptable LOS A during the morning peak hour and LOS B during the evening peak hour.

Overall impacts on intersection performance during construction are anticipated to be minor.

Intersection, road and culvert upgrades

Prior to the commencement of construction of the Project, the proposed intersection, road and culvert upgrades on the Golden Highway, Ringwood Road and Wollara Road north of the National Park would impact vehicles that travel on these roads. These upgrades are discussed further in Section 3.2.5.

Impacts are anticipated to be minor given the low volume of traffic using Ringwood Road and Wollara Road, short term and temporary nature of the works, and the spare capacity available on the Golden Highway. Furthermore, the number of construction vehicles generated during the upgrades would be significantly lower than the number of construction vehicles generated during construction of the Project. The community would be notified of any works proposed and changed road conditions, so that impacted road users can plan their trips well in advance of the proposed changes.

Warrants for intersection improvements

The *Guide to Road Traffic Management Part 6: Intersections, Interchanges and Crossings Management* (Austroads, 2020) specifies warrants for additional turning bays at an intersection, based on a combination of peak hour through and turning traffic movements. Figure 4-2 and Figure 4-3 show the warrants for turn treatments at unsignalised intersections and the approach to calculate major road traffic volumes, respectively.

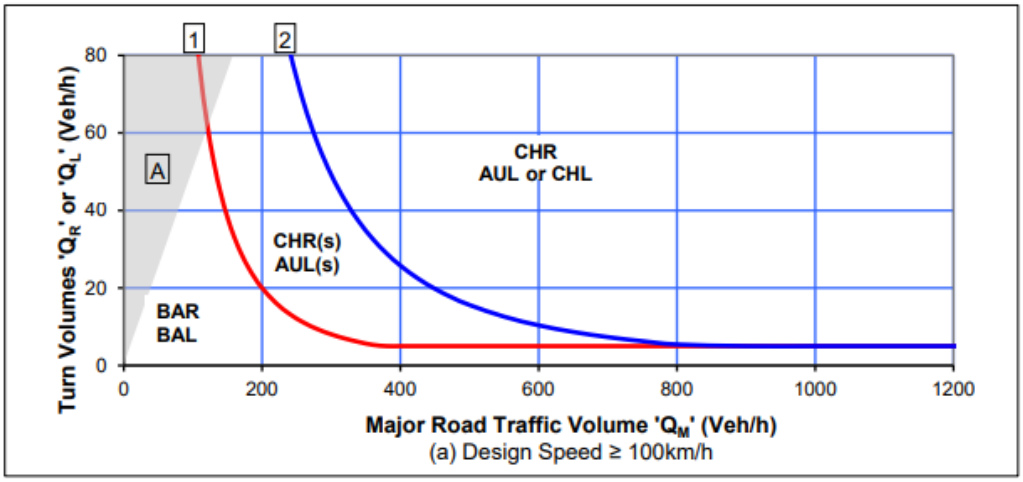
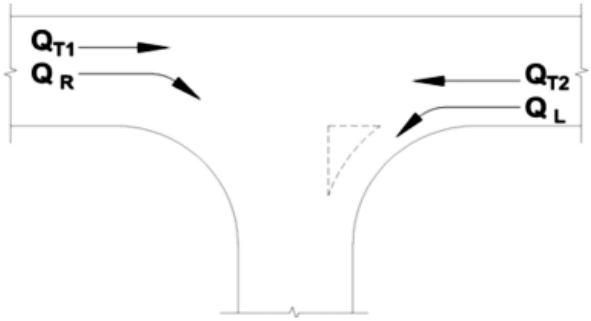


Figure 4-2: Warrants for turn treatments on the major road at unsignalised intersections



Road type	Turn type	Splitter island	Q_M (veh/h)
Two-lane two-way	Right	No	= Q_{T1} + Q_{T2} + Q_L
		Yes	= Q_{T1} + Q_{T2}
	Left	Yes or no	= Q_{T2}
Four-lane two-way	Right	No	= 50% x Q_{T1} + Q_{T2} + Q_L
		Yes	= 50% x Q_{T1} + Q_{T2}
	Left	Yes or no	= 50% x Q_{T2}
Six-lane two-way	Right	No	= 33% x Q_{T1} + Q_{T2} + Q_L
		Yes	= 33% x Q_{T1} + Q_{T2}
	Left	Yes or no	= 33% x Q_{T2}

Figure 4-3: Calculation of major road traffic volume

Approach traffic volumes at the Golden Highway / Ringwood Road intersection in 2025 with and without construction traffic are shown in Table 4-4 (Project only) and Table 4-5 (cumulative construction). The peak hour volumes in Table 4-5 include those generated by other projects, as outlined in Table 4-1.

Table 4-4: Traffic volumes for turn treatments analysis (Project only)– Golden Highway / Ringwood Road

Movement	2025 base		2025 construction	
	Morning peak hour	Evening peak hour	Morning peak hour	Evening peak hour
Major road traffic volume (Q_M) for left turn	64	101	64	101
Major road traffic volume (Q_M) for right turn	145	211	232	298
Left turn volume (Q_L)	14	7	95	13
Right turn volume (Q_R)	5	1	5	1

Table 4-5: Traffic volumes for turn treatments analysis (cumulative) – Golden Highway / Ringwood Road

Movement	2025 base		2025 construction	
	Morning peak hour	Evening peak hour	Morning peak hour	Evening peak hour
Major road traffic volume (Q_M) for left turn	246	198	246	198
Major road traffic volume (Q_M) for right turn	424	490	511	577
Left turn volume (Q_L)	14	7	95	13
Right turn volume (Q_R)	5	1	5	1

The turn warrants assessment with Project only volumes at the Golden Highway / Ringwood Road intersection is shown in Figure 4-6 and Figure 4-7.

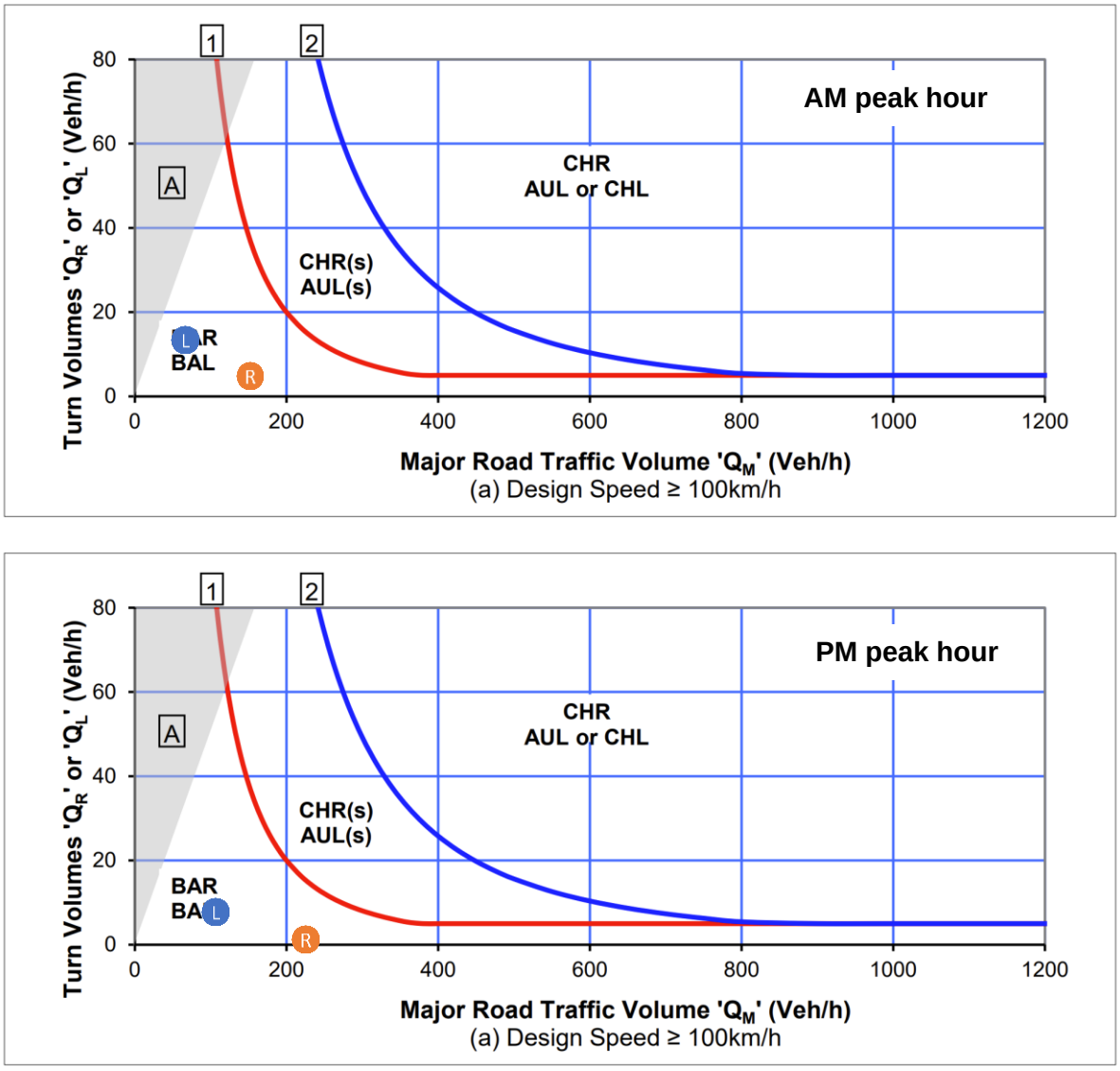


Figure 4-4: Golden Highway / Ringwood Road 2025 base turn warrants assessment

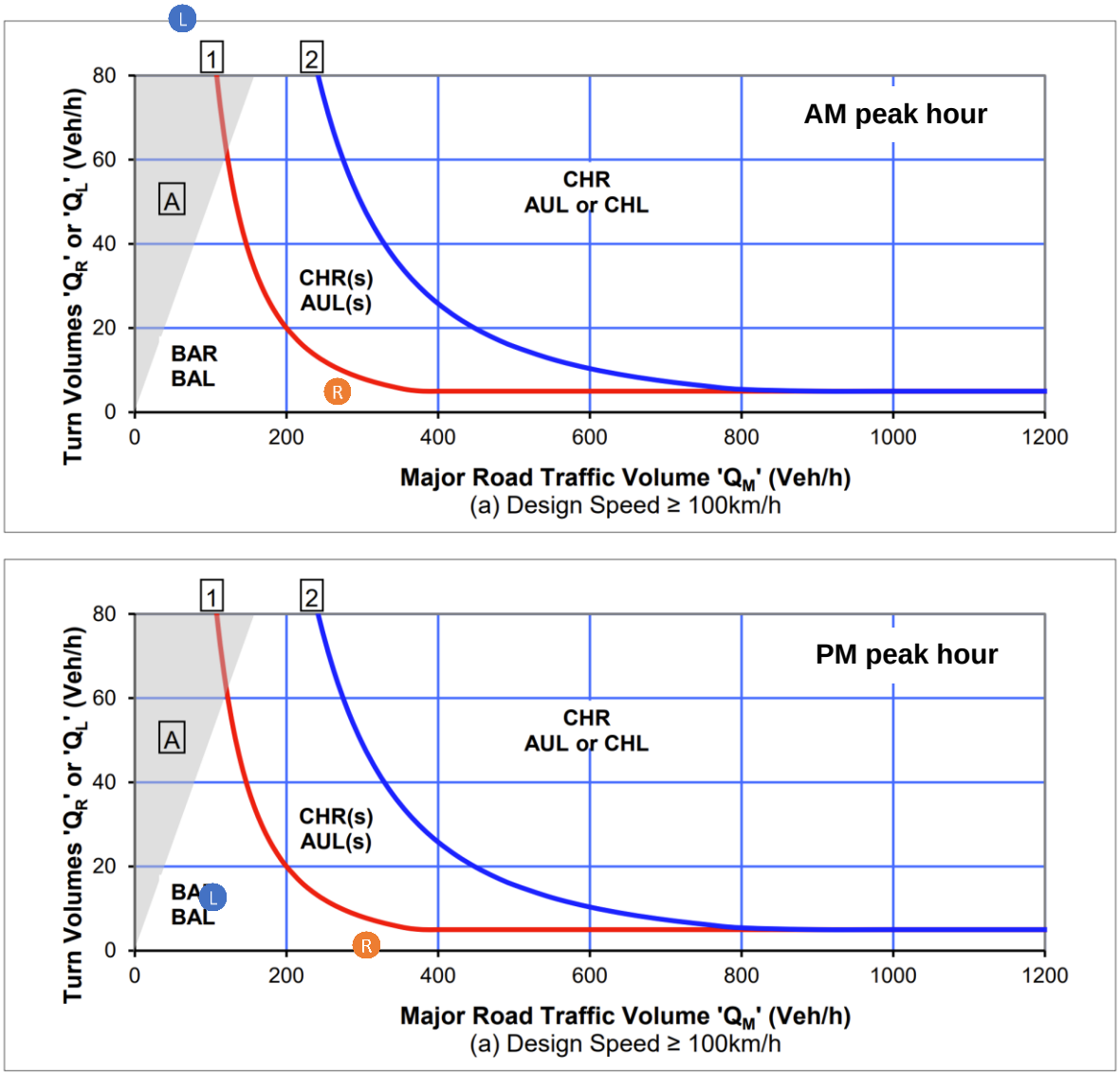
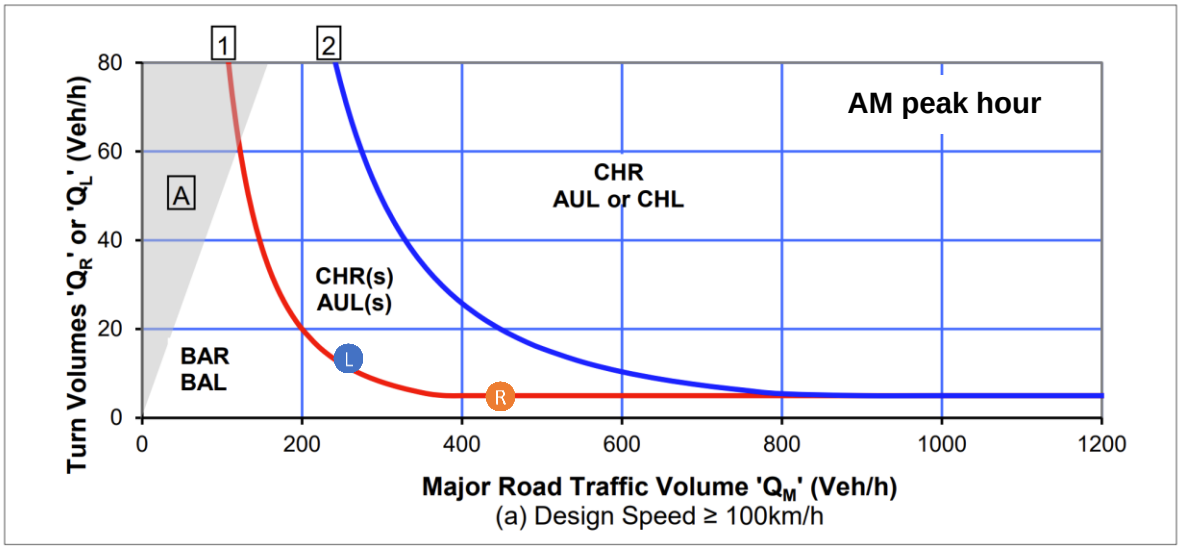


Figure 4-5: Golden Highway / Ringwood Road 2025 construction turn warrants assessment

The assessment found that with and without Project only vehicles and no additional traffic generated by other projects, the intersection should have at minimum basic left and basic right turn treatments. Given that the intersection currently has an auxiliary left turn lane and a basic right turn treatment, no additional changes to the existing intersection arrangement would be required.

The turn warrants assessment for the Project inclusive of cumulative totals at the Golden Highway / Ringwood Road intersection is shown in Figure 4-6 and Figure 4-7.



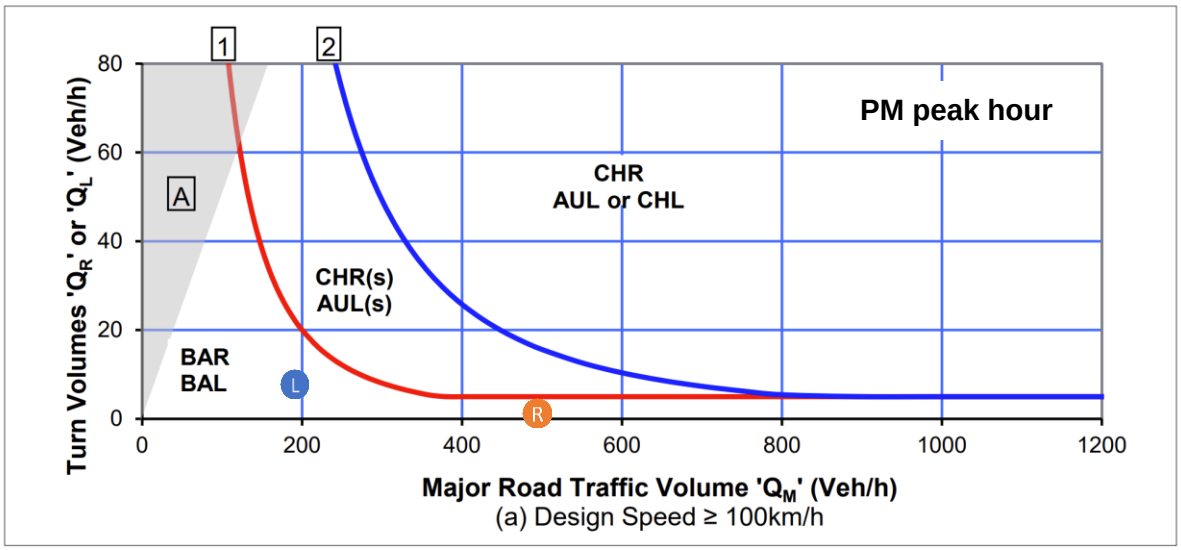


Figure 4-6: Golden Highway / Ringwood Road 2025 cumulative base turn warrants assessment

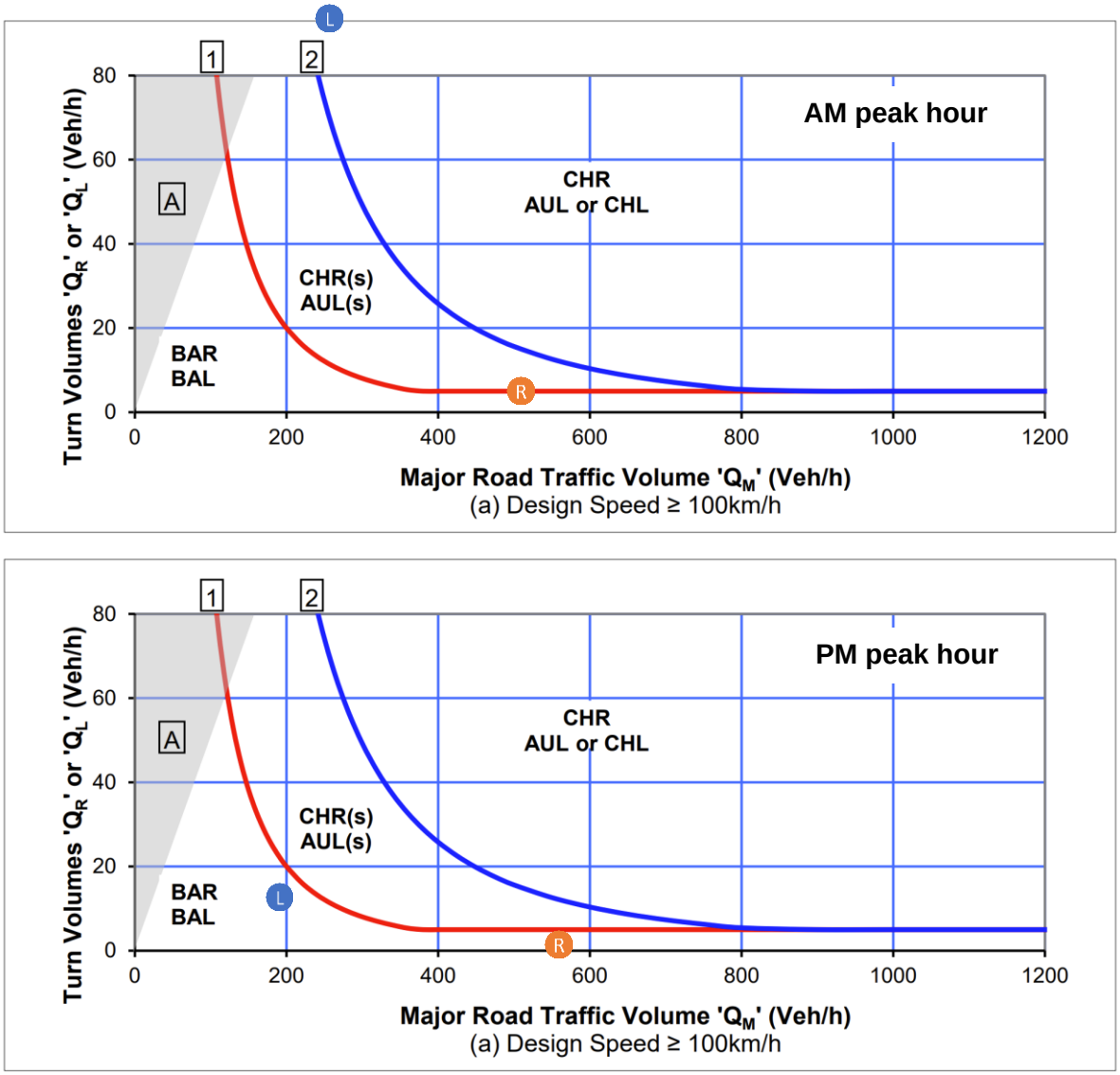


Figure 4-7: Golden Highway / Ringwood Road 2025 cumulative construction turn warrants assessment

The assessment found that an auxiliary left turn lane (full or short) is required and a channelised right turn lane (short) may be required to meet the turn warrants assessment for the morning peak hour. A basic left turn lane and right turn lane is required to meet the turn warrants assessment for the evening peak hour. The intersection currently has an auxiliary left turn lane (short) and a basic right turn lane.

The turn warrants assessment with cumulative construction traffic is marginally above the threshold for a full auxiliary left turn lane however the cumulative volumes used in the assessment are a worst-case scenario. The likely volumes would be lower and within the threshold for a short auxiliary left turn lane.

This conclusion is based upon the following:

- The assumed 16 per cent of daily construction vehicles generated by the Liverpool Range Wind Farm and Bowdens Silver Project to occur during the peak hours is the upper percentage of the recommended range specified in the Austroads Guide to Road Traffic Management Part 6
- The 75 inbound light vehicles during the morning peak hour generated by the Tallawang Solar Farm assumes that all workers from Merriwa travel to the site by car. The Traffic Impact Assessment for this project states that there is potential for staff to travel by buses from off-site hubs which would reduce the peak staff traffic generation
- The 97 heavy vehicles generated by other projects have been assumed to originate and terminate in areas east of the Golden Highway / Ringwood Road intersection. In reality, a portion of these trips would not travel through the intersection, particularly for the Liverpool Range Wind Farm, where the assumed 26 heavy vehicles include internal trips between site access points, quarries and batch plants proposed for the project further west of the intersection
- Peak construction of the Stubbo Solar Farm is anticipated in 2024. Hence, the six heavy vehicles generated during peak construction of this project would likely be lower in 2025.
- Construction of the Birriwa Solar Farm is anticipated to commence in late 2025. Hence, the 14 heavy vehicles generated during peak construction of this project would likely be lower in 2025.
- The Project would likely generate a higher number of shuttle buses due to the accommodation proposed in Merriwa, resulting in a lower number of light vehicles and an overall lower number of total vehicles.

In addition, a number of constraints exist on the Golden Highway on approach to Ringwood Road, and the extension of the existing short auxiliary left-turn lane to a full length would require extensive design development and construction works resulting in additional environmental impacts and significant capital expenditure to conduct the road upgrade. It is noted that this section of Golden Highway is on an incline, and the speed survey measured an 85th percentile speed of 99.9km/h on the Golden Highway on approach to Ringwood Road. Hence, it is more than likely that a motorist would be travelling slower than 100km/h at the taper of the deceleration lane. Due to this, it has been deemed that the implementation of a full length auxiliary left turn lane is not necessary. Notwithstanding, to improve safety at the intersection, a review of existing advisory signage on approach to the intersection would be undertaken and modifications or additional signage would be installed, in line with Australian Standards 1742.2.

As mentioned in Section 3.2.5, the design of the proposed intersection upgrade would implement an extension to the existing taper to be compliant.

Given that project construction vehicles are not proposed to perform a right turn at the intersection and the assessed cumulative volumes are on the threshold of a basic right turn and channelised right turn (short), the existing basic right turn treatment was retained.

This proposed intersection arrangement is supported by the 2025 intersection performance results where the intersection would operate with spare capacity and at a good LOS during construction.

4.1.2. Impacts on parking

During construction, impacts on parking are not anticipated given that on-site parking would be provided for all vehicles generated by the Project. Furthermore, no formal parking facilities are located within close proximity to the site.

4.1.3. Impacts on public transport

Bus network

Minimal impacts are anticipated on bus services that travel on the Golden Highway given the infrequency of these bus services, the low volume of peak hour construction traffic generated by the Project, and the ample spare capacity available on the road network.

The school bus route that operates on Ringwood Road towards Merriwa and Scone would experience minor impacts due to the additional construction traffic using this road and the increase in left-in and left-out movements at the Golden Highway / Ringwood Road intersection. As discussed in Section 3.6, the informal bus stop at this intersection would be formalised as part of the proposed intersection upgrade, improving amenity for school students and parents/carers that use this bus stop. Furthermore, the school bus service during the morning and afternoon (one service in each direction during school days) would not coincide with peak construction vehicle movements. Hence, restrictions to heavy vehicle movements would not be required. Notwithstanding, mitigation measures are recommended to minimise the impact on students and parents/carers that use the bus stops on Ringwood Road and are discussed in Section 5.

Rail network

The level rail crossings located on Ulan Road, Wollar Road and Ringwood Road south of the site would not be traversed by construction vehicles. Hence, no impacts are anticipated on the rail network.

4.1.4. Impacts on active transport

No impacts on the pedestrian network are anticipated during construction given the limited pedestrian infrastructure that surrounds the Project Site.

Impacts on the cycle network would be limited to the potential interaction of cyclists with Project construction vehicles on the Golden Highway, Ringwood Road or Wollara Road and during intersection, culvert and road upgrades at these locations.

Given that sections of the Golden Highway are designated cycle routes via the road shoulder or parking lane, cyclists that currently travel on the Golden Highway would be experienced riders. In addition, Ringwood Road and Wollara Road form part of a recommended scenic cycle route. However, no formal cycle infrastructure is provided. Therefore, cyclist volumes on the Golden Highway, Ringwood Road and Wollara Road would likely be low and hence, the overall impact on cyclists is anticipated to be minor.

4.1.5. Cumulative construction impacts

Projects within proximity to the Project site that have construction programs that overlap with construction of this Project may present cumulative impacts relating to the combined increased demand on local infrastructure, transport, and services. Projects that have been considered for the cumulative construction impact assessment are shown in Table 4-6.

Table 4-6: Relevant projects in proximity to site

Project	Status	Proximity and location	Key project details
Stubbo Solar Farm	Approved but currently seeking a modification related to the access road	50 kilometres west	• Planning approval for a 400 MW AC Solar farm • Construction commenced 2023 • 24-26 month construction program • Peak workforce of approx. 400 workers • Located within the Central West Orana Renewable Energy Zone (CWO REZ)
Wollar Solar Farm	Approved	22 kilometres south-west	• Planning approval for a 290MW AC Solar Farm • Construction commenced Q3 2022 • 12-18 month construction program • Peak workforce of approx. 400 workers
Dunedoo Solar Farm	Approved	70 kilometres north-west	• Planning approval for a 55MW AC Solar farm • Construction commencement: 2023 • 12 Month construction program • Peak workforce of approx.100 – 125 workers • Located within the CWO REZ
Liverpool Range Wind Farm	Approved but currently seeking a modification	55 kilometres north-west	• Planning approval for up to 282 wind turbines • Modification Application submitted • Construction commencement: TBC • 36 month construction program • Located within the CWO REZ
Valley of the Winds Wind Farm	Proposed	57 kilometres north-west	• Proposal for up to 131 wind turbines • Response to Submissions phase • Construction commencement: Q1 2024 • 24-42 month construction program • Peak workforce of approx. 400 workers • Located within the CWO REZ
Bowdens Silver Project	Approved	45 kilometres south-west	• Planning approval for an open cut silver mine • Construction commencement: TBC • 18 month construction program • Peak workforce of approx. 180 workers

Barneys Reef Wind Farm	Proposed	50 kilometres west	• Proposal for up to 69 wind turbines • Environmental Impact Statement being prepared • Construction commencement: Q3 2024 • 28 month construction period • Located within the CWO REZ
Tallawang Solar Farm	Proposed	50 kilometres west	• Proposal for a 500MW solar farm • Response to Submissions phase • Construction commencement: Mid 2024 • 34 month construction period • Located within the CWO REZ
Birriwa Solar Farm	Proposed	60 kilometres north-west	• Proposal for a 600MW solar farm • Response to Submissions phase • Construction commencement: Late 2025 • 28 month construction period • Located within the CWO REZ
Merriwa Solar Farm	Proposed	30-kilometres north-west	• Proposal for a 550MW solar farm and 400MW battery • Environmental Impact Statement being prepared • 18 month construction period and 2025 completion
Spicers Creek Wind Farm	Proposed	80 kilometres west	• Proposal for up to 1117 wind turbines • Response to Submissions phase • Construction commencement: Within 1 to 5 years following approval • 40-48 month construction period • Located within the CWO REZ
Sandy Creek Solar Farm	Proposed	83 kilometres west	• Proposal for a 750MW solar farm • Environmental Impact Statement being prepared • Located within the CWO REZ
Cobbora Solar Farm	Proposed	82 kilometres west	• Proposal for a 700MW solar farm • Environmental Impact Statement being prepared • Located within the CWO REZ

Construction vehicle routes for the Stubbo Solar Farm that overlap with the construction vehicle routes for the Goulburn River Solar Farm include the Golden Highway. A review of the proposed construction program indicates that the project would be completed in 2025 and may overlap with the construction program of this Project. Peak construction for the Stubbo Solar Farm is anticipated in 2024, with 230 light vehicle and 60 heavy vehicle two-way trips forecast per day. Given that peak construction of Stubbo Solar Farm would occur prior to peak construction of this Project and that light vehicles would not travel on the Golden Highway near Merriwa, cumulative vehicle generation during the period when construction overlaps between the two projects is anticipated to be lower than the peak construction vehicles generated by this Project.

Construction vehicle routes for the Wollar Solar Farm that overlap with the construction vehicle routes for the Goulburn River Solar Farm include the Golden Highway, Ringwood Road and Wollara Road for light vehicles and heavy vehicles. No road upgrades are proposed as part of this project along Ringwood Road and Wollara Road, with the majority of

vehicles accessing the Wollar Solar Farm further west via Ulan Road, Wollar Road and Barigan Road. Peak construction for the Wollar Solar Farm is anticipated in 2023, with 100 light vehicle and 72 heavy vehicle two-way trips per day. Given that peak construction of the Wollar Solar Farm would occur prior to peak construction of this Project and that construction of the Wollar Solar Farm may be completed by 2025, cumulative vehicle generation in the event that construction is delayed and there is an overlap between the two projects is anticipated to be lower than the peak construction vehicles generated by this Project.

Construction vehicle routes for the Dunedoo Solar Farm that overlap with the construction vehicle routes for the Goulburn River Solar Farm include the Golden Highway for heavy vehicles. Peak construction for the Dunedoo Solar Farm is anticipated in 2024, with 24 light vehicle and 80 heavy vehicle two-way trips per day. Given that peak construction of the Dunedoo Solar Farm would occur prior to peak construction of this Project, light vehicles would not travel on the Golden Highway near Merriwa, and that construction of the Dunedoo Solar Farm may be completed by 2025, cumulative vehicle generation in the event that construction is delayed and there is an overlap between the two projects is anticipated to be lower than the peak construction vehicles generated by this Project.

Construction vehicle routes for the Liverpool Range Wind Farm, Valley of the Winds Wind Farm, Bowdens Silver Project, Tallawang Solar Farm, Birriwa Solar Farm and Spicers Creek Wind Farm include the Golden Highway. A review of available construction information for these projects indicates that if approved, construction of the Valley of the Winds Wind Farm, Tallawang Solar Farm and Birriwa Solar Farm would coincide with the construction program for this Project. The construction commencement year for the Liverpool Range Wind Farm, Bowdens Silver Project and Spicers Creek Wind Farm is not known. The forecast peak daily construction volumes for these projects include:

- Liverpool Range Wind Farm: 178 light vehicle and 160 heavy vehicle two-way trips
- Valley of the Winds Wind Farm: 253 light vehicle and 36 heavy vehicle two-way trips
- Bowdens Silver Project: 100 light vehicle and 31 heavy vehicle two-way trips
- Tallawang Solar Farm: 300 light vehicle and 135 heavy vehicle two-way trips
- Birriwa Solar Farm: 373 light vehicle and 120 heavy vehicle two-way trips
- Spicers Creek Wind Farm: 295 light vehicle and 48 heavy vehicle two-way trips.

Although peak construction for these projects may occur at the same time, the Golden Highway is the only common construction vehicle route and has sufficient spare capacity to accommodate the construction vehicles generated by these projects. Furthermore, light vehicles generated by the Valley of the Winds Wind Farm, Bowdens Silver Project, Birriwa Solar Farm and Spicers Creek Wind Farm would not travel on the Golden Highway near Merriwa.

Projects that are currently in the planning and approval stage with limited available construction information include:

- Barneys Reef Wind Farm
- Merriwa Solar Farm
- Sandy Creek Solar Farm
- Cobbora Solar Farm.

Cumulative construction impacts are anticipated to be minor given the following:

- A number of projects identified in Table 4-6 are either in the early planning stages or would be completed prior to the commencement of construction of this Project
- Those in the early planning stages do not have sufficient construction and traffic information available and if approved are likely to commence after this Project and as such the peak traffic periods would not intersect
- Peak construction of Stubbo Solar Farm, Wollar Solar Farm and Dunedoo Solar Farm would occur prior to peak construction of this Project
- Golden Highway forms part of the construction vehicle routes for the Wollar Solar Farm, Stubbo Solar Farm, Dunedoo Solar Farm, Liverpool Range Wind Farm, Valley of the Winds Wind Farm, Bowdens Silver Project, Tallawang Solar Farm, Birriwa Solar Farm and Spicers Creek Wind Farm. This road has spare capacity (as shown in Section 4.1.1) and would be able to accommodate the additional through movement vehicles generated by these projects
- During peak construction of this Project and non-peak construction of other projects, the surrounding road network would be able to accommodate the additional construction vehicle volumes due to the spare capacity available.

4.2. Operational impacts

Operation of the solar farm would require up to 10 concurrent staff members on-site, with 10 two-way light vehicle trips anticipated per day. In addition, infrequent heavy vehicle deliveries may be required during this phase. Parking would be provided on site for operational staff and heavy vehicle deliveries. Due to the low volumes of operational traffic and provision of parking on-site, minimal impacts on the road network, parking, public transport network and active transport network are anticipated.

5. Mitigation and management measures

Most long-term impacts of the Project would have been addressed through the design process. However, residual impacts that arise from engineering constraints or from construction activities, and which cannot be removed through the design could be managed through mitigation measures.

Mitigation and management measures recommended to minimise impacts on the traffic and transport during construction and/or operation of the Project are shown in Table 5-1.

Table 5-1: Traffic and Transport mitigation and management measures for the Project

Aspect	Mitigation and/or management measures	Timing
Intersection, road and culvert upgrades	Upgrades to Ringwood Road and Wollara Road (including culverts) and the Golden Highway / Ringwood Road intersection, as described in this TTIA	Early construction
Project vehicles at Golden Highway / Ringwood Road	The left-in, left-out arrangement for Project construction vehicles at the Golden Highway / Ringwood Road intersection would be enforced by implementing the following: • Periodic monitoring camera to be installed at the intersection, with footage to be reviewed to ensure necessary corrective measures are taken to ensure compliance • Traffic controllers to undertake spot checks at the intersection for compliance • Site inductions and daily toolbox talks for drivers to include return route identification • Installation of additional signage on Ringwood Road stating that “site traffic must turn left” • As part of the CTMP to be prepared post-approval, a Vehicle Movement Plan (VMP) that clearly shows the construction vehicle routes and permitted movements. The CTMP would also include a Drivers Code of Conduct that construction vehicle drivers would need to read and sign to confirm their responsibilities and reinforce correct behaviour	Construction
CTMP	Prior to the commencement of construction, a CTMP would be prepared in accordance with relevant guidelines and in consultation with Transport for NSW, Upper Hunter Shire Council, National Parks and Wildlife Service and any other relevant stakeholders. The CTMP would outline how construction activities would avoid, mitigate and manage risks involving construction activities, users of the traffic and transport network (including impacted students and parent/carers that use the school bus service on Ringwood Road) and residents. The CTMP would include: • Driver Code of Conduct requirements for all heavy vehicle operators and construction workers. • Traffic Guidance Schemes to alert road users to changed traffic conditions as a result of roadworks or increased traffic activity as a result of the Amended Project.	Pre-construction

	• Vehicle Movement Plans to indicate preferred travel paths for construction vehicles entering, leaving or crossing traffic streams, where required. • Traffic Staging Plans, where required including drawings, that show how traffic will pass safely through or around road construction work sites during various work stages. • Measures to ensure access to adjacent properties during road construction activities are maintained. • Details of any proposed detours. • Details of persons responsible for specific traffic management operations.	
OSOM vehicles	A detailed OSOM vehicle route assessment would be undertaken by the construction contractor and outlined in the CTMP. The CTMP would discuss any traffic management measures required and include details on the OSOM vehicle route, duration, road closures, traffic detours, notifications and any required Traffic Guidance Schemes. This is expected to include: • using spotters at pinch points • limiting OSOM movements to off-peak periods • undertaking OSOM movements under police escort • the use of manual traffic control at specific locations in accordance with an appropriately designed Traffic Guidance Scheme are required.	Construction
Heavy vehicles	Deliveries to site (excluding oversized loads) would be carried out by 19 metre semi-trailers to comply with heavy vehicle restrictions on Wollara Road and Ringwood Road	Construction
Permits and licences	Where relevant, Road Occupancy Licences (ROLs) and crane permits would be submitted and approved prior to the closure of any roads	Construction
Community consultation	The community would be notified in advance of proposed road and transport network changes through appropriate media and other forms of community liaison	Pre-construction Construction Operation
Shuttle buses	Shuttle buses will operate between accommodation sites in Merriwa and site, and construction workers would be encouraged to carpool or use the shuttle buses	Construction
Project parking	Parking requirements for the Project during construction and operation would be provided on-site, and parking would not be provided on public roads adjacent to the site	Construction Operation
Signage and linemarking	Additional signage and linemarking is recommended at the Golden Highway / Barnett Street intersection and installation of warning signs (“Symbolic Truck”) are recommended near the primary site access point	Early construction
Transport for NSW	Transport for NSW would continue to be consulted on upgrades required at the Golden Highway / Ringwood Road intersection	Pre-construction Construction
National Parks and Wildlife Service	National Parks and Wildlife Service would continue to be consulted on road upgrades required near the Goulburn River National Park	Pre-construction Construction
Upper Hunter Shire Council	Upper Hunter Shire Council would continue to be consulted on upgrades required on Golden Highway,	Pre-construction

	Ringwood Road and Wollara Road and if regular use of the local road network in Merriwa is required	Construction
School buses	Osborn's Transport, Merriwa Pre School, Scone Grammar School and Scone High School would be consulted on the proposed formalisation of the bus stop on Ringwood Road at the Golden Highway intersection and informed of the additional construction traffic that would be generated by the Project.	Pre-construction Construction

6. Summary and conclusions

The key findings of the traffic and transport impact assessment of the Project include the following:

- The Project is proposing significant road upgrades to the Golden Highway / Ringwood Road intersection and along Ringwood Road and Wollara Road to accommodate the project and enhance the road infrastructure for the benefit of the local community
- The upgrade of the Golden Highway / Ringwood Road intersection would contribute to the safety of the community and project related traffic using the intersection during construction, while ensuring intersection use by Project vehicles is compliant with the guidelines. This includes restricting Project construction vehicles to performing a left-in, left-out at the intersection, implementing a compliant taper for the left-in deceleration lane and a new acceleration lane for the left-out.
- The Bow River and Killoe Creek culvert upgrades would facilitate the delivery of the OSOM loads to the site and improve existing deficiencies on the road network.
- The widening and sealing of 3.4km of Ringwood Road and 4.7km of Wollara Road would benefit the community and reduce impacts on residents
- Additional trips generated by the Project during construction would have a minor impact on road network performance
- Additional trips generated by the Project during operation of the Project would not have a material impact on road network performance
- No impacts are anticipated on parking and the pedestrian network
- Minor impacts are anticipated on the bus network and would be limited to the potential interaction of bus services with construction vehicles on Ringwood Road and the Golden Highway. These impacts are offset by the formalisation of some bus stops.
- Minimal impacts are anticipated on the cycle network and would be limited to the potential interaction of cyclists with construction vehicles on surrounding roads
- Cumulative construction impacts are anticipated to be minor given that the Golden Highway is the only common construction vehicle route for the majority of nearby relevant projects and has spare capacity to accommodate cumulative construction vehicle volumes. In addition, peak construction of some projects would not coincide with peak construction of this Project.
- Minimal impacts are anticipated on the traffic and transport network during operation of the Project, due to the anticipated low traffic volumes generated
- Prior to the commencement of construction and following engagement of the engineering, procurement and construction contractor, a detailed CTMP would be prepared, including an OSOM vehicle route assessment.

Appendix A Response to submissions on the traffic and transport assessment

Agency or user group	Response to submission	Where addressed in Amended Traffic and Transport Assessment
Transport for NSW	***Submission:*** *The Traffic Impact Assessment proposes to use the Ringwood Road/Golden Highway intersection as a construction route for light and heavy vehicles. TfNSW notes that safe intersection sight distance (SISD) at this intersection does not comply with Austroads requirements. TfNSW does not support the proposed use of this route for the development without compliant SISD, alternative access options need to be investigated.* **Response:** Lightsource bp propose changes to the proposed Project transport route and upgrades to the intersection of the Golden Highway and Ringwood Road. The Project transport route changes and upgrades to the Ringwood Road / Golden Highway intersection have been designed in accordance with Austroads standards and in consultation with Transport for NSW.	Section 2.3.2 and Appendix C
	Submission: *Provide or update information related to cumulative impacts of traffic on the classified road network:* *• The cumulative impacts from traffic generated from the construction workforces in terms of the origin-destination routes, access, AM/PM peaks where there is overlap with other projects.* *• The cumulative impacts of heavy vehicle movements in terms of AM/PM peaks and routes where there is an overlap with other projects.* *• Cumulative impacts and consideration in relation to the timing of movements of OSOMs where other projects will be utilising the same routes as proposed for this development.* *• The background traffic volumes identified within the TIA for the Golden Highway/Ringwood Road intersection are to be reflective of the cumulative traffic volumes associated with the other projects occurring concurrently that will be utilising this route for OSOM/LV/HV movements.* **Response:** Anticipated construction vehicle routes were assessed in the TTIA for the EIS and compared with relevant projects in proximity to the site. In the construction traffic modelling assessment, light vehicle and shuttle bus trips were assumed to be evenly distributed on the road network, with equal proportions travelling to and from the site from the north (via Golden Highway) and the south (via Wollar Road). As a result of changes to the transport route and location of workers accommodation (to the east, centred around Merriwa), trip distribution has also been updated and cumulative impacts re-assessed within this report.	Section 3.2.3, Section 3.2.4, Section 3.3, Section 4.1.1 and Section 4.1.5

	Cumulative impacts from heavy vehicles during AM/PM peaks relating to other Projects were also raised. This updated report considers cumulative traffic volumes for heavy vehicles. This has also informed the design of upgrades proposed at the Golden Highway / Ringwood Road intersection. As outlined in the TTIA for the EIS and this report, due to the spare capacity at the Golden Highway / Ringwood Road and Wollar Road / Ringwood Road intersections, the addition of cumulative traffic volumes in the traffic models would likely have minor impact on the intersection performance reported.	
	Submission: *Provide or update information related to heavy vehicle and OSOM routes:* *• Identify the return routes for OSOMs.* *• National Heavy Vehicle Regulator (NHVR) approved routes identified on the Restricted Access Maps (RAV MAP) are to be utilised for the heavy vehicle routes for the proposed development.* *• The TIA is required to include details on the number of OSOM movements, the types of OSOM (escort by pilot or police), the intended time for OSOM movements to occur and identify the location of pullover bays / rest areas (including identification of the sufficient widths, lengths to accommodate the largest OSOM vehicles within the rest areas) along the OSOM routes.* *Due to the significant scope of the transport logistics for OSOM transit, a concept-level route analysis is required to be provided with the SSD application based on high-level swept path analysis to generally indicate locations where civil works are likely to be required.* **Response:** This report provides further information and analysis of the OSOM route including the return route and number of OSOM movements. The OSOM load will be under permit, utilising the Golden Highway, Ringwood Road and Wollara Road. No other projects are proposing to use Ringwood Road and Wollara Road. OSOM movements can be facilitated without additional civil works (as shown in the swept paths appended to this report) beyond those described within the Amended Project and no changes to the OSOM route described within the EIS Project are proposed. A Transport Management Plan has been provided (Appendix G) for the same OSOM configuration utilising the same proposed OSOM route from Newcastle Port (Mayfield Berth) to the intersection of Golden Highway. Individual assessments of the OSOM swept paths along Ringwood Road and Wollara Road have been provided in Appendix F and formed the basis of design for the road upgrades. Hence, an OSOM route assessment of the entire route has been carried out.	Section 3.2.4, Section 3.2.5, Appendix F and Appendix G
	Submission: *Provide or update information related to:* *• Traffic volumes and characteristics* *• Origins, destinations and routes for all vehicle types* *• Access and infrastructure upgrades*	Section 2.2, Section 2.3, Section 2.8, Section 3.2.3,

	• *Road safety assessment* • *Local climate conditions* • *Internal road network* • *Impact on rail corridors and public transport* **Response:** This report provides updates to all components of the TTIA impacted by the Amended Project and in response to the TfNSW submission.	Section 3.2.4, Section 3.2.5, Section 3.3 and Section 4.1
	Additional TfNSW comments on the Golden Highway / Ringwood Road design *Provide longitudinal section for the SISD compliance accounting for grade variation and measured in accordance with distance of 7.0 m (minimum of 5.0 m) from the conflict point on the major road and identify the measures proposed to achieve compliance.* *A seven-day count at the intersection of Ringwood Road/Golden Highway to determine the 85th percentile speed may be an option for reviewing the applicable reaction time. The data collected will have to be reviewed by the design team to ensure the accuracy of the data and to determine if we would consider the 85th percentile as the design speed.* *I would review Austroads Part 3 Geometric Design for further information regarding 85th percentile design speed.* *The reaction time identified is incorrect for the design speed. The required reaction time is 2.5sec (see austroads supplement to part 3 above).* *Have grade corrections have been applied to the calculation of SISD* *No swept paths provided to identify the compliance of the acceleration lane to the east with the design vehicle and the OSOM design vehicle.* *No swept paths identifying the OSOM design vehicle, or the heavy vehicle can be entirely accommodated within the AUL(s).* *The consultants identified the acceleration lane to facilitate left turns out of Ringwood Road have been designed for light vehicles and only achieves 90km/hr and not the design speed for the road this is required to be reviewed to ensure compliance with the design speed.* *The acceleration lane to facilitate the left turn out of Ringwood Road has not been assessed or designed for the Heavy vehicles that do not require escort but an NHVR permit. These vehicles are required to achieve the design speed when merging into the through lane.* *Left in and Left out (LILO) would be the only method to prevent the requirement for the SISD compliance to the east. Project*	Section 2.3, Section 3.2.5, Section 3.2.6, Section 4.1.1, Appendix C and Appendix H

	Response: The intersection has been designed in accordance with the relevant standards and guidelines as specified by Transport for NSW. Project construction vehicles would only perform a left-in and left-out at the intersection due to the sight distance issues from Ringwood Road looking east. The left-out movement would only be undertaken by standard Project construction vehicles and not by OSOM vehicles which require a permit. Speed surveys were collected, however the 85th speed was found to be 99.9km/hr in the westbound direction. Hence, the proposed left-in, left-out arrangement was retained as the preferred intersection design to minimise safety risks. A reaction time of 2 seconds was used at the Golden Highway / Ringwood Road intersection, with justification of this reaction time added to the amended TTIA. Notwithstanding, calculation of SISD using a 2.5 second reaction time was undertaken and would not change the proposed intersection design. Grade corrections have also been applied to the sight distance checks. Swept paths for all movements at the intersection have been appended to the amended TTIA.	
	Additional TfNSW comments on speed survey requirements *Location of tube counts must be at the location of the intersection of Ringwood and Golden Highway and must have been collected in accordance with Austroads Guide to Road Design Part 3.* **Response:** The tubes used for the speed survey were installed in accordance with Austroads and at a location on the Golden Highway approximately 70m east of Ringwood Road. The traffic survey company advised that the placement of the tubes closer to the intersection would likely compromise the results of the speed surveys.	Section 2.3.3
	Additional TfNSW comments on the proposed movements at the Golden Highway / Ringwood Road intersection *It is unclear if the measures proposed would be in place for the life of the development? and how the TMP would be enforced for the life of the development?* *Do light vehicle and heavy vehicle construction routes still require a right in and out of Ringwood Road?* *Revisit the turn warrant assessment due to the potential prohibition on the left in from eastern direction (Merriwa).* *Need to consult with any impacted landowners along the Ringwood Road section that may be impacted by changes to the turning movements at the Ringwood Road/Golden Highway intersection.*	Section 2.3, Section 3.2.3, Section 3.2.4 and Section 4.1.1

	Identify the preference being the physical treatments to ensure the left turn prohibition is enforced. *Review if the left turn prohibited how the transformer movement will be achieved and provide strategic design or traffic control measures for how the transformer movement will be facilitated at this intersection.* *I have been discussing the prohibition on the turning movements and noted that the isolation of the site means that prohibition on turning movements are difficult to achieve.* *The painted median is not a sufficient deterrent to prohibit the right turn out of Ringwood Road.* *Is there still a turn around site to be able to permit the vehicles to pass the intersection turn around and turn left into the site at the intersection?* *There is a rest area within the village of Elong Elong that is within Dubbo Regional Council LGA (this is the closest from the rest area review that we have identified) and the Cassilis Rest Area (this rest area is closer to the site and has existing intersection treatments identified on HV rest area map as TfNSW managed). There may be options to consider use of a local road connection to Golden Highway that has sufficient SISD and existing intersection treatments to facilitate the turn movements.* *Month eight of construction requires 280 staff which is proposed to transport via 60 two-way trips per day, 15 two-way trips per day and 55 two-trips per a day, there is minimal information as to how the shuttle buses and light vehicle numbers will be achieved with strategies/protocols for the 280 staff required to access the intersection at the Ringwood Road/Golden Highway.* **Response:** The proposed measures (left-in, left-out) would be in place for the duration of construction where significant increase in traffic movements would occur. Operational movements would be minimum (up to 10 movements/day) Only OSOM vehicles would perform a right turn from Ringwood Road to the Golden Highway. These movements would be undertaken under traffic management and during off-peak periods. The Project team considered the potential banning of right turn movements at the Golden Highway / Ringwood Road intersection for all traffic (Project and non-Project vehicles) due to the existing sight distance issues. This arrangement would include additional signage, a barrier or median across the intersection, and reconfiguration of the intersection arrangement. However, this proposal was not recommended due to the isolation of the site and the need for general traffic (particularly residents that live along Ringwood Road) to be able to perform right turns at the intersection as there would not be an	

	appropriate alternative route for the community if the right-turn bans were implemented. A turnaround facility on Barnett Street is located near the intersection and is proposed to be used by egressing Project construction vehicles to return on the Golden Highway in the eastbound direction. Since the EIS, the Project has entered into an MOU with a proposed accommodation provider in Merriwa to secure up to 350 beds during Project construction. This would enable the Project to provide additional shuttle bus movements, reducing the number of light vehicle numbers and enabling an increased level of control/compliance for left in/left out traffic movements.	
	Additional TfNSW comments on the turn warrants and/or traffic modelling assessment *No further assessment of the construction traffic volumes has been assessed in relation to the change to the intersection turning movements from all movements to a LILO, arrangement. A further assessment scenario with all vehicles turning left in via the existing AUL(s) is required as the "with development scenario" for SIDRA and turn warrants assessment. The base case is to be reviewed as the existing background traffic at the AM/PM peak+ annual growth rate applied to peak of construction+ any other major projects with cumulative timing passing the intersection of Ringwood Road/Golden Highway.* *The proponents/consultants are required to reassess the change to the traffic distribution and implications with compliance with the existing AUL(s) treatment given the traffic LV/OSOM/HV are required to turn left into the project access. Reassess turn warrants and assess queue length analysis and storage requirements (See Figure 6.4: 95th percentile queue lengths and Figure 6.5: Storage requirements of Guide to Traffic Management Part 3: Traffic Studies and Analysis) of the existing AUL(s).* **Response:** The construction modelling and turn warrants assessment has been updated to include the proposed left-in, left-out arrangements for Project construction vehicles and cumulative peak hour construction volumes generated by other project that travel through the Golden Highway / Ringwood Road intersection.	Section 4.1.1 and Section 4.1.5
	Additional TfNSW comments on OSOM vehicle route assessment *Identify the route from the Port of Newcastle to the site as per SEARs and submission for the EIS exhibition.* *There is an anticipated 6-10 OSOM vehicles a day. It is not known the size of the OSOM vehicles and will have implications to the intersection design. As is standard with any renewable development and requested in the response to the EIS for Goulburn River Solar Farm, TfNSW requires the information in terms of dimensions and type of heavy vehicles (exempt from*	Section 3.2.4 and Section 3.3.2

	escort requirements but requiring an NHVR permit) termed OSOM in the current TIA as a part of the RTS. This is important as it will have a bearing on the scope of the intersection treatments. *It is unclear within the current TIA the LV/Shuttle buses/OSOM/HV/HV exempt from escort and requiring NHVR permit will occur during the AM/PM peak.* **Response:** The return OSOM route has been identified in the amended TTIA. All standard Project construction vehicles would not require a permit as these vehicles are classified as GAV's. OSOM vehicle specifications have been added to the amended TTIA.	
Upper Hunter Shire Council	***Submission:*** *Safety concerns for Golden Highway / Ringwood Road intersection* *Safe intersection sight distance (SISD) of the Golden Highway/ Ringwood Road intersection. Council is concerned that the sight distances along the Golden Highway at the intersection are inadequate to enable vehicles associated with the project, particularly heavy vehicles, to safely negotiate the intersection. Therefore, it is recommended that further investigations be undertaken into upgrading the intersection to improve safety including reviewing speed limits, installing additional warning signs, physical alterations to the intersection (eg. provision of turning lanes), removing roadside vegetation, widening of roadside cuttings or relocating the intersection to improve sight distances.* *Consider the crash data on this location of road within the SISD.* **Response:** Lightsource bp propose changes to the proposed transport route and upgrades to the intersection of the Golden Highway and Ringwood Road. The transport route changes and upgrades to the Ringwood Road / Golden Highway intersection have been designed in accordance with Austroads SISD standards and in consultation with Transport for NSW. This report includes an updated crash analysis and speed surveys, which has informed the development of the proposed intersection upgrade.	Section 2.3.3 and Appendix C
	Submission: *Traffic numbers, considering location of workforce accommodation.* *The assumption that light vehicle and shuttle bus trips will be evenly distributed on the road network, with equal proportions travelling to and from the site from the north and south during construction peak hour is unrealistic for the purpose of assessing intersection performance. It is likely that the majority of vehicles will be travelling between the site and the larger centres of Merriwa and Mudgee.*	Section 2.3, Section 3.2.3 and Section 3.3

	It is recommended that a revised traffic and transport impact assessment be submitted following the completion of a workforce and accommodation strategy. **Response:** Lightsource bp has prepared an Accommodation and Employment Strategy to support the Amendment Report (Umwelt 2023). The strategy identifies locations for workforce accommodation, providing clearer detail on likely traffic movements of the construction workforce. As part of the accommodation strategy, Lightsource bp have signed an MOU with a local developer who are proposing the development of 500 fully furnished, self-contained ensuite units within the township of Merriwa. Lightsource bp has an option in place to rent up to 300 rooms during the construction period of the Project, with potential to increase the number of rooms if required. This has resulted in amendments to the trip distribution utilised in the TTIA for the EIS, with the revised trip distribution included in this report. As outlined in the EIS, shuttle buses are proposed to be utilised for the majority of the workforce to reduce the number of cars on the road. Based on the proposed accommodation in Merriwa, these shuttles would operate to/from the Merriwa accommodation and the Project. This report addresses the above in further detail.	
General public	***Road use safety submissions*** *The existing gravel road is very narrow with some tight dangerous corners which need to be navigated cautiously - SE-59347494* *I am usually driving in dangerous times such as early in the mornings and late at night, this road is already dangerous with narrow areas of the road, sharp bends and causeways which often become flooded. - SE-59342745* *The main access road to this project is ringwood/wollara road. This road is a typical country road, narrow in places and in poor condition. Many areas of this road need attention and specific areas of concern were highlighted to lsbp at community meetings. - SE-59975243* **Response** In addition to road repairs and upgrades outlined in the EIS, Lightsource bp has committed to upgrading additional sections of Wollara Road and Ringwood Road to improve the safe movement of vehicles, as a component of the Amended Project. The additional road upgrades proposed under the Amended Project include: • Realignment, widening and sealing an additional 1.6 km section of Ringwood Road between Killoe Creek and Binks Road.	Section 3.2.5, Appendix C and Appendix H

	• Realignment, widening and sealing a 4.7 km unpaved section of Wollara Road between the Goulburn River National Park boundary and 1621 Wollara Road. • An acceleration lane allowing vehicles turning left from the Ringwood Road / Golden Highway intersection to safely merge with traffic traveling along Golden Highway. • Formalising the bus layover area at the Ringwood Road / Golden Highway intersection. No upgrades are proposed in the portion of Wollara Road within the Goulburn River National Park, at the request of National Parks and Wildlife Service. It is also reiterated (as outlined in the EIS) that, prior to the commencement of construction, a CTMP would be prepared in accordance with relevant guidelines and in consultation with Transport for NSW, Upper Hunter Shire Council, National Parks and Wildlife Service, Forestry Corporation of NSW and any other relevant stakeholders. The CTMP would outline how construction activities would avoid, mitigate and manage risks involving construction activities, users of the traffic and transport network and residents. Typical measures to be provided in the CTMP include: • Driver Code of Conduct requirements for all heavy vehicle operators and construction workers. • Traffic Guidance Schemes to alert road users to changed traffic conditions as a result of roadworks or increased traffic activity as a result of the Amended Project. • Vehicle Movement Plans to indicate preferred travel paths for construction vehicles entering, leaving or crossing traffic streams, where required. • Traffic Staging Plans, where required including drawings, that show how traffic will pass safely through or around road construction work sites during various work stages. • Measures to ensure access to adjacent properties during road construction activities are maintained. • Details of any proposed detours. • Details of persons responsible for specific traffic management operations. It is also expected that auditing of traffic control measures by suitably qualified persons will be undertaken following implementation to ensure traffic control measures are effective and are not compromising road safety.	
	Road widening and sealing submissions *The existing dirt road MUST be sealed prior to any works commencing on the project. Reasons for this is… Safety for workers and resident whom will be directly impacted by the significant increase in traffic flow and heavy vehicle movements. - SE-59569209* *…the risks and dangers of Bow Crossing & Killoe crossing (2 separate vehicle accidents into the river this year) and that Ringwood Road and Wollara Road are already in poor condition*	Section 3.2.5, Appendix C and Appendix H

	with increased erosion and corrugating being unacceptable and dangerous. The only option for "The Project" must be to redevelop and tar seal these crossings and roads. - SE-59340957 **Response** It is acknowledged that there are narrow sections along these roads, and in order to improve traffic safety, road upgrades were proposed as part of the EIS, including: • Culvert upgrades along Ringwood Road at Bow River and Killoe Creek. • Road repairs along Ringwood Road, including a 1.8 km section to be widened and resealed between Bow River and Killoe Creek. The Amended Project includes additional road upgrades, including: • Realignment, widening and sealing an additional 1.6 km section of Ringwood Road between Killoe Creek and Binks Road. • Realignment, widening and sealing a 4.7 km unpaved section of Wollara Road between the Goulburn River National Park boundary and 1621 Wollara Road, and • An acceleration lane allowing vehicles turning left from the Ringwood Road / Golden Highway intersection to safely merge with traffic traveling along Golden Highway. These upgrades will further improve road safety for existing road users as well as Project-related construction vehicles. Further consideration and assessment of the additional road upgrades proposed under the Amended Project has been undertaken within this report.	
	Increases in traffic submissions *This entire road is already under stress due to increased traffic, this being an arterial road to Bylong and the National Park and now with this "Project" the increase in heavy vehicle traffic poses a huge risk… - SE-59340957* **Response** The number of truck movements and size of vehicles will change during the labour-intensive construction period between months three (3) and 20 of the broader 27-month construction period. As discussed in the EIS, overall impacts on road network performance during construction are anticipated to be minor, with both the Golden Highway / Ringwood Road and Ringwood Road / Wollara Road intersections able to continue to operate with spare capacity, low average delays and minimal queues during the morning and evening peak periods. It is noted that the proposed construction-related traffic increases are temporary in nature and will be substantially reduced during the operations and maintenance phase of the Project, with an anticipated generation of 10 two-way light	Section 3.3, Section 4.1.1 and Section 4.1.5

	vehicle trips per day (on average). Nevertheless, appropriate mitigation measures will be implemented under the CTMP to maintain the safe operation of the road network for all users.	

Appendix B Wollar Road / Ringwood Road construction impact assessment

Intersection LOS

The performance of the modelled Wollar Road / Ringwood Road intersection in SIDRA with and without Project construction vehicles in 2025 is shown in Table B-1.

Table B-1: Intersection performance during construction – Wollar Road / Ringwood Road

Approach and peak period	2025 base / 2025 cumulative base				2025 construction / 2025 cumulative construction			
	DOS	Average delay	LOS	95% back of queue (m)	DOS	Average delay	LOS	95% back of queue (m)
Weekday morning peak (6:00am to 7:00am)								
Wollar Road eastbound	0.01	8	A	<5	0.01	8	A	<5
Wollar Road westbound	0.01	8	A	<5	0.01	8	A	<5
Ringwood Road southbound	0.01	9	A	<5	0.01	9	A	<5
Overall intersection	**0.01**	**9**	**A**	**<5**	**0.01**	**9**	**A**	**<5**
Weekday evening peak (5:30pm to 6:30pm)								
Wollar Road eastbound	0.01	8	A	<5	0.01	8	A	<5
Wollar Road westbound	0.01	8	A	<5	0.01	8	A	<5
Ringwood Road southbound	0.02	9	A	<5	0.02	9	A	<5
Overall intersection	**0.02**	**9**	**A**	**<5**	**0.02**	**9**	**A**	**<5**

Given that Project construction vehicles are not anticipated to travel to the site from the south, the performance of the Wollar Road / Ringwood Road intersection would remain the same with and without construction. As shown in Table B-1, the intersection would operate at LOS A and with ample spare capacity.

There would be no impact on intersection performance during construction.

Notwithstanding, in the event that a light vehicle travels to the site from the south (would be a very low volume, if any, for a worker that lives in a town within the Mid-Western Regional LGA), there would be negligible impacts on intersection performance.

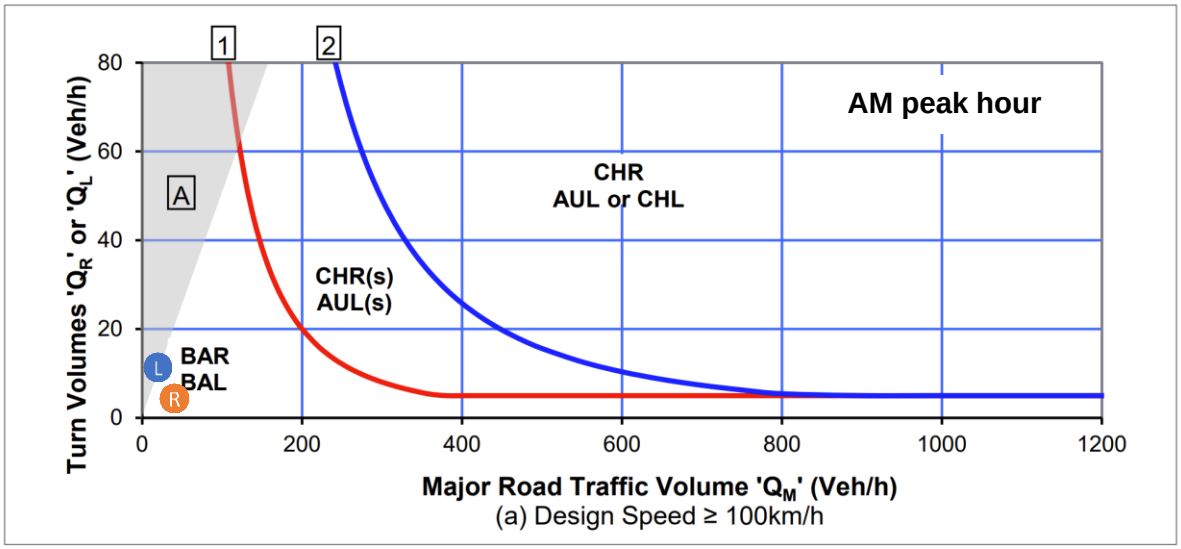
Turn Warrants

Approach traffic volumes at the Wollar Road / Ringwood Road intersection in 2025 with and without construction traffic is shown in Table B-2.

Table B-2: Traffic volumes for turn treatments analysis – Ringwood Road / Wollar Road

Movement	2025 base / 2025 cumulative base		2025 construction / 2025 cumulative construction	
	Morning peak hour	Evening peak hour	Morning peak hour	Evening peak hour
Major road traffic volume (Q_M) for left turn	7	7	7	7
Major road traffic volume (Q_M) for right turn	22	17	22	17
Left turn volume (Q_L)	13	3	13	3
Right turn volume (Q_R)	3	1	3	1

The turn warrants assessment for the Wollar Road / Ringwood Road intersection is shown in Figure B-1. Project construction vehicles are not proposed to use this intersection and no additional turn treatments would not be required to accommodate the base and construction volumes.



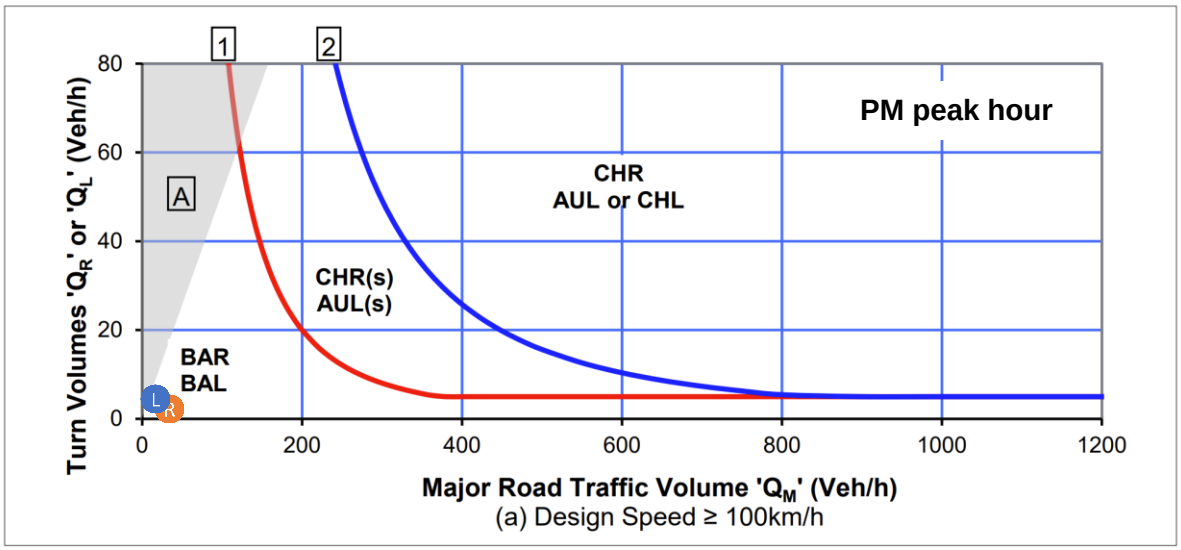


Figure B-1: Wollar Road / Ringwood Road 2025 base and construction turn warrants assessment

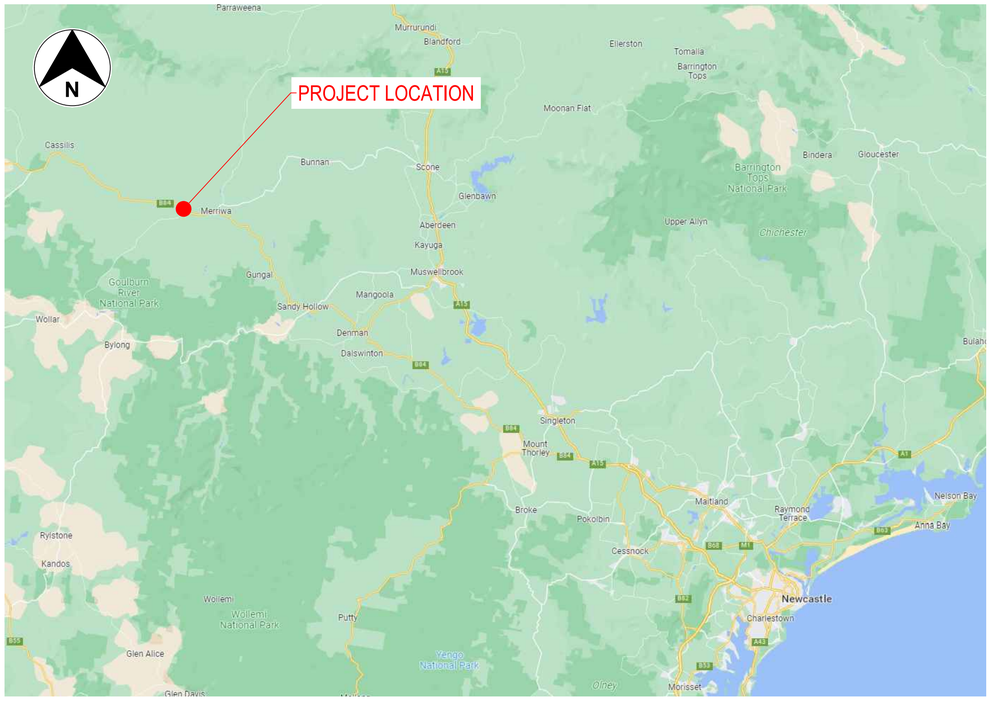
Appendix C Golden Highway / Ringwood Road intersection strategic design

GOULBURN RIVER SOLAR FARM

RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION

ROAD UPGRADE

STRATEGIC DESIGN



LOCALITY PLAN
NOT TO SCALE

DRAWING INDEX

SHEET No.	SHEET TYPE	SHEET DETAILS	No. OF SHEETS	ISSUE
01-GN-0001	ROAD ALIGNMENT	COVER SHEET AND DRAWING INDEX	1 OF 1	A
01-RD-0101	ROAD ALIGNMENT	PLAN	1 OF 3	A
01-RD-0102	ROAD ALIGNMENT	PLAN	2 OF 3	A
01-RD-0103	ROAD ALIGNMENT	PLAN	3 OF 3	A
01-RD-0201	ROAD ALIGNMENT	TYPICAL CROSS SECTION	1 OF 1	A

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED
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EXTERNAL REFERENCE FILES

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
A	27.10.23	STRATEGIC DESIGN	-	RB

SCALES ON A1 SIZE DRAWING

CO-ORDINATE SYSTEM: MGA ZONE 56 (GDA2020)
HEIGHT DATUM: AHD

PLOT DATE / TIME: 27 October 2023 04:47:49 PM
PLOT BY: PakWaHo

TITLE	NAME	DATE
DRAWN	A.REIS	27.10.23
DRG CHECK	B.EVANS	27.10.23
DESIGN	P.PHAM	27.10.23
DESIGN CHECK	D.SHIROKOV	27.10.23
DESIGN MNGR	D.SHIROKOV	27.10.23
PROJECT MNGR	R.BANZON	27.10.23

DRAWINGS / DESIGN PREPARED BY
DESIGNER
turnbull

DRAWINGS / DESIGN PREPARED FOR
CLIENT

DRAWING TITLE
GOULBURN RIVER SOLAR FARM, EIS
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
ROAD ALIGNMENT
COVER SHEET AND DRAWING INDEX

A1
SHEET 1 OF 1

DRAWING NUMBER: 0305-DRG-01-RD-0001

ISSUE STATUS: STRATEGIC DESIGN
SHEET No.: 01-RD-0001
ISSUE: A

X:\0305-06-GE-A1.tmf

LEGEND

GENERAL

- DESIGN
- CADASTRAL
- SURVEY
- SAFETY BARRIER

ROAD GEOMETRY

- CONTROL LINE AND CHAINAGE (50)
- MCXX — CONTROL LINE LABEL
- C1 — LINE MARKING LABEL
- EXISTING SIGN

PAVEMENT AND KERBS

- NEW PAVEMENT

NOTES

1. DESIGN IS UNDERTAKEN IN 2D.
2. SURVEY SHOWN HAS BEEN PROVIDED BY UMWELT (11/09/2023).
3. BOUNDARIES HAVE BEEN SOURCED FROM SIX MAPS "Clip 'n' Snip".
4. PAVEMENT DESIGN AND JOINTING IS EXCLUDED.
5. PROPOSED BARRIER LOCATION IS SHOWN INDICITIVELY ONLY.
6. EXISTING GUIDE POSTS ALONG BARRIER EXTENTS ARE TO BE REMOVED.

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION / NAME
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X:0305-01-RD-JMAP
X:0305-01-RD-PROPOSED-BARRIER
X:0305-01-RD-HATCH
X:0305-01-RD-SURVEY

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
A	27.10.23	STRATEGIC DESIGN	-	RB

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CO-ORDINATE SYSTEM: MGA ZONE 56 (GDA2020)
HEIGHT DATUM: AHD

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PLOT BY: PakWaHo

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DRG CHECK	B.EVANS	27.10.23
DESIGN	P.PHAM	27.10.23
DESIGN CHECK	D.SHIROKOV	27.10.23
DESIGN MNGR	D.SHIROKOV	27.10.23
PROJECT MNGR	R.BANZON	27.10.23

DRAWINGS / DESIGN PREPARED BY
DESIGNER
turnbull

DRAWINGS / DESIGN PREPARED FOR
CLIENT

DRAWING TITLE
GOULBURN RIVER SOLAR FARM, EIS
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
ROAD ALIGNMENT
PLAN

A1
SHEET 1 OF 3

DRAWING NUMBER: 0305-DRG-01-RD-0101

ISSUE STATUS: STRATEGIC DESIGN
SHEET No.: 01-RD-0101
ISSUE: A

LEGEND

GENERAL

- DESIGN
- CADASTRAL
- SURVEY
- SAFETY BARRIER

ROAD GEOMETRY

- CONTROL LINE AND CHAINAGE (50)
- MCXX — CONTROL LINE LABEL
- C1 — LINE MARKING LABEL
- EXISTING SIGN

PAVEMENT AND KERBS

- NEW PAVEMENT

NOTES

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NOT FOR CONSTRUCTION

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REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
A	27.10.23	STRATEGIC DESIGN	-	RB

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CO-ORDINATE SYSTEM: MGA ZONE 56 (GDA2020) HEIGHT DATUM: AHD

PLOT DATE / TIME: 27 October 2023 04:48:45 PM PLOT BY: PakWaHo

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DRG CHECK	B.EVANS	27.10.23
DESIGN	P.PHAM	27.10.23
DESIGN CHECK	D.SHIROKOV	27.10.23
DESIGN MNGR	D.SHIROKOV	27.10.23
PROJECT MNGR	R.BANZON	27.10.23

DRAWINGS / DESIGN PREPARED BY
DESIGNER
turnbull

DRAWINGS / DESIGN PREPARED FOR
CLIENT

DRAWING TITLE
GOULBURN RIVER SOLAR FARM, EIS
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
ROAD ALIGNMENT
PLAN

A1
SHEET 2 OF 3

DRAWING NUMBER 0305-DRG-01-RD-0102

ISSUE STATUS: STRATEGIC DESIGN
SHEET No.: 01-RD-0102
ISSUE: A

LEGEND

GENERAL

- DESIGN
- CADASTRAL
- SURVEY
- SAFETY BARRIER

ROAD GEOMETRY

- CONTROL LINE AND CHAINAGE (50)
- MCXX — CONTROL LINE LABEL
- C1 — LINE MARKING LABEL
- EXISTING SIGN

PAVEMENT AND KERBS

- NEW PAVEMENT

NOTES

1. DESIGN IS UNDERTAKEN IN 2D.
2. SURVEY SHOWN HAS BEEN PROVIDED BY UMWELT (11/09/2023).
3. BOUNDARIES HAVE BEEN SOURCED FROM SIX MAPS "Clip 'n' Snip".
4. PAVEMENT DESIGN AND JOINTING IS EXCLUDED.
5. PROPOSED BARRIER LOCATION IS SHOWN INDICITIVELY ONLY.
6. EXISTING GUIDE POSTS ALONG BARRIER EXTENTS ARE TO BE REMOVED.

NOT FOR CONSTRUCTION

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SCALES ON A1 SIZE DRAWING
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SCALE 1:500m

CO-ORDINATE SYSTEM: MGA ZONE 56 (GDA2020) — HEIGHT DATUM: AHD

PLOT DATE / TIME: 27 October 2023 04:49:10 PM — PLOT BY: PakWaHo

TITLE	NAME	DATE
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DRG CHECK	B.EVANS	27.10.23
DESIGN	P.PHAM	27.10.23
DESIGN CHECK	D.SHIROKOV	27.10.23
DESIGN MNGR	D.SHIROKOV	27.10.23
PROJECT MNGR	R.BANZON	27.10.23

DRAWINGS / DESIGN PREPARED BY
DESIGNER
turnbull

DRAWINGS / DESIGN PREPARED FOR
CLIENT

DRAWING TITLE
GOULBURN RIVER SOLAR FARM, EIS
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
ROAD ALIGNMENT
PLAN

A1

SHEET 3 OF 3

DRAWING NUMBER: 0305-DRG-01-RD-0103

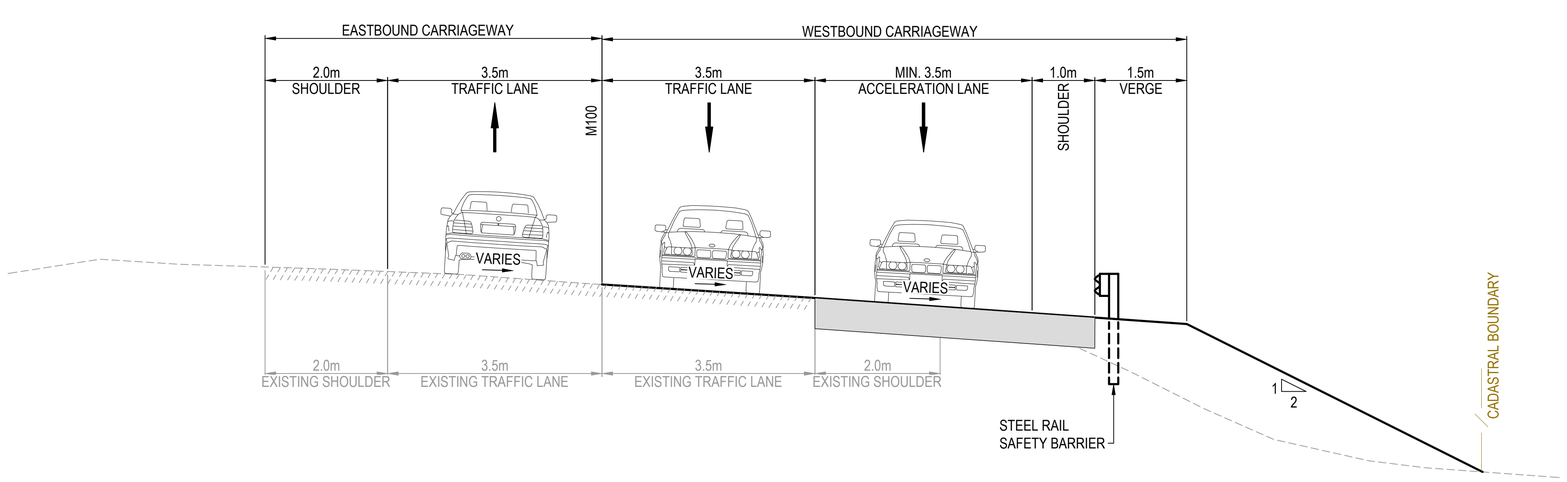
ISSUE STATUS: STRATEGIC DESIGN — SHEET No.: 01-RD-0103 — ISSUE: A

LEGEND

DESIGN SURFACE

EXISTING SURFACE

PROPOSED PAVEMENT



SECTION 1 / RD-0102

SCALE 1:50

GOLDEN HIGHWAY

NOTE

1. PROPOSED PAVEMENT SHOWN IS INDICATIVE ONLY. PAVEMENT DESIGN AND JOINTING IS EXCLUDED FROM SCOPE OF WORKS.
2. CADASTRAL BOUNDARY SOURCED FROM SIX MAPS "Clip 'n' SNIP".
3. GRADES OF PROPOSED ACCELERATION LANE AND SHOULDER TO MATCH EXISTING CONDITIONS.
4. PROPOSED BARRIER LOCATION IS SHOWN INDICATIVELY ONLY

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

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SCALE 1:50m

CO-ORDINATE SYSTEM: MGA ZONE 56 (GDA2020)
HEIGHT DATUM: AHD

PLOT DATE / TIME: 27 October 2023 04:49:13 PM
PLOT BY: PakWaHo

TITLE	NAME	DATE
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DRG CHECK	B.EVANS	27.10.23
DESIGN	P.PHAM	27.10.23
DESIGN CHECK	D.SHIROKOV	27.10.23
DESIGN MNGR	D.SHIROKOV	27.10.23
PROJECT MNGR	R.BANZON	27.10.23

DRAWINGS / DESIGN PREPARED BY
DESIGNER
turnbull

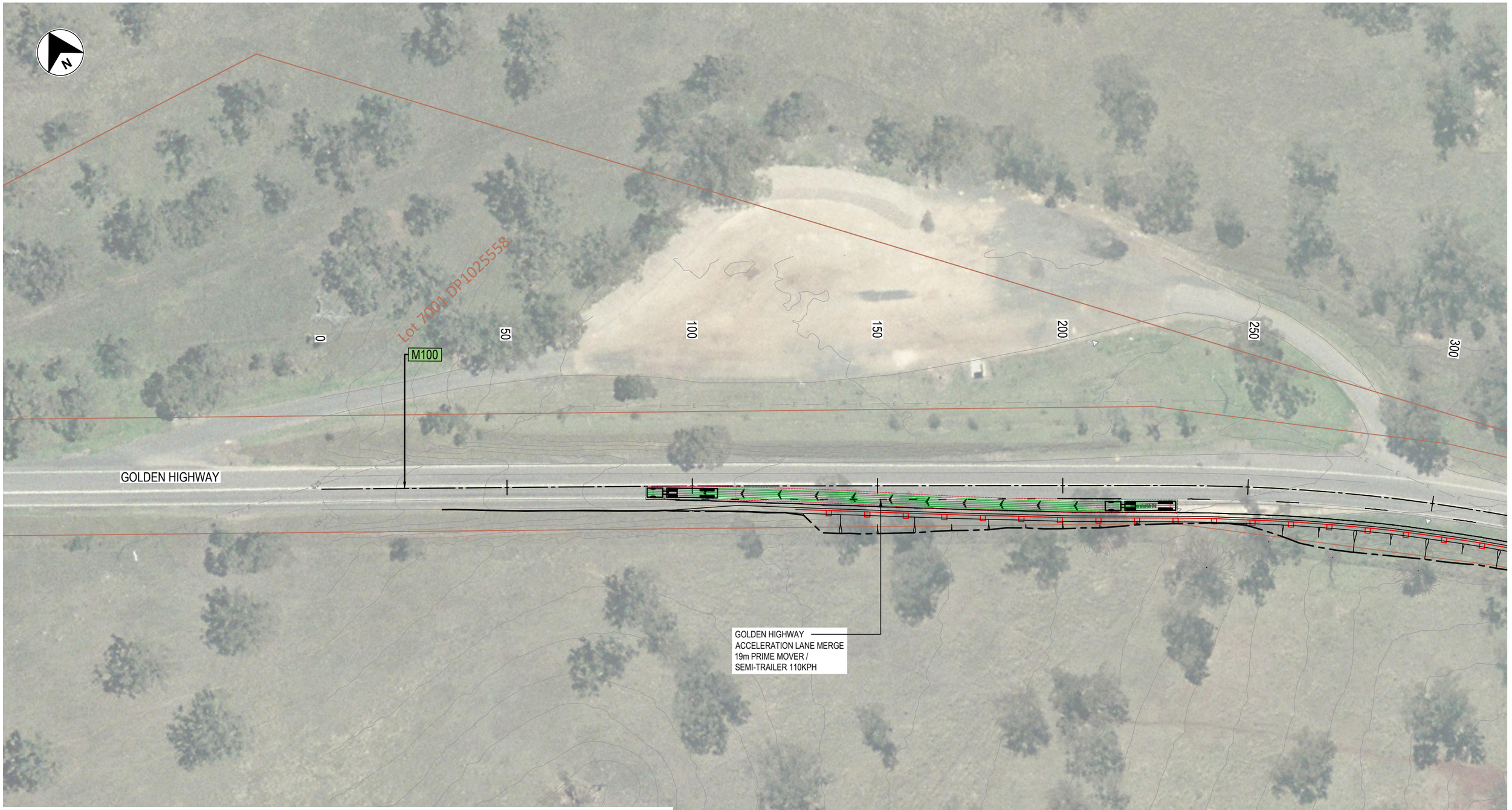
DRAWINGS / DESIGN PREPARED FOR
CLIENT

DRAWING TITLE
GOULBURN RIVER SOLAR FARM, EIS
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
ROAD ALIGNMENT
TYPICAL CROSS SECTION

A1
SHEET 1 OF 1

DRAWING NUMBER: 0305-DRG-01-RD-0201

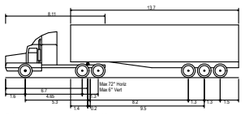
ISSUE STATUS: STRATEGIC DESIGN
SHEET No.: 01-RD-0201
ISSUE: A



NOTES

1. NO ASSESSMENT HAS BEEN UNDERTAKEN FOR EXISTING PAVEMENT.
2. TURN PATHS PRESENTED IS THE INTENDED OPERATIONS OF TRAFFIC ASSOCIATED WITH GOULBURN SOLAR FARM. ONLY THE DISPLAYED MOVEMENTS WILL BE PERMITTED.
3. SURVEY SHOWN HAS BEEN PROVIDED BY UMWELT (11/09/2023).
4. BOUNDARIES HAVE BEEN SOURCED FROM SIX MAPS "Clip 'n' Snip".
5. NO ASSESSMENT HAS BEEN UNDERTAKEN FOR THE EXISTING GOLDEN HIGHWAY AND RINGWOOD ROAD INTERSECTION RIGHT TURN IN AND RIGHT TURN OUT MOVEMENTS. EXISTING VEHICLE MOVEMENTS AND INTERSECTION LAYOUT TO BE RESPECTED.

VEHICLE TURN PATH PROFILE



Prime mover and semi-trailer (19 m)

Overall Length	19.000m
Overall Width	2.500m
Overall Body Height	4.300m
Min Body Ground Clearance	0.540m
Track Width	2.500m
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	12.500m

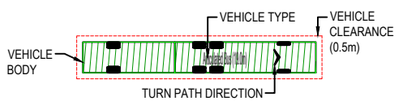
GENERAL

- DESIGN
- CADASTRAL
- SURVEY
- SAFETY BARRIER

ROAD GEOMETRY

- CONTROL LINE AND CHAINAGE (20)
- MCXX — CONTROL LINE LABEL

VEHICLE TURN PATH LEGEND



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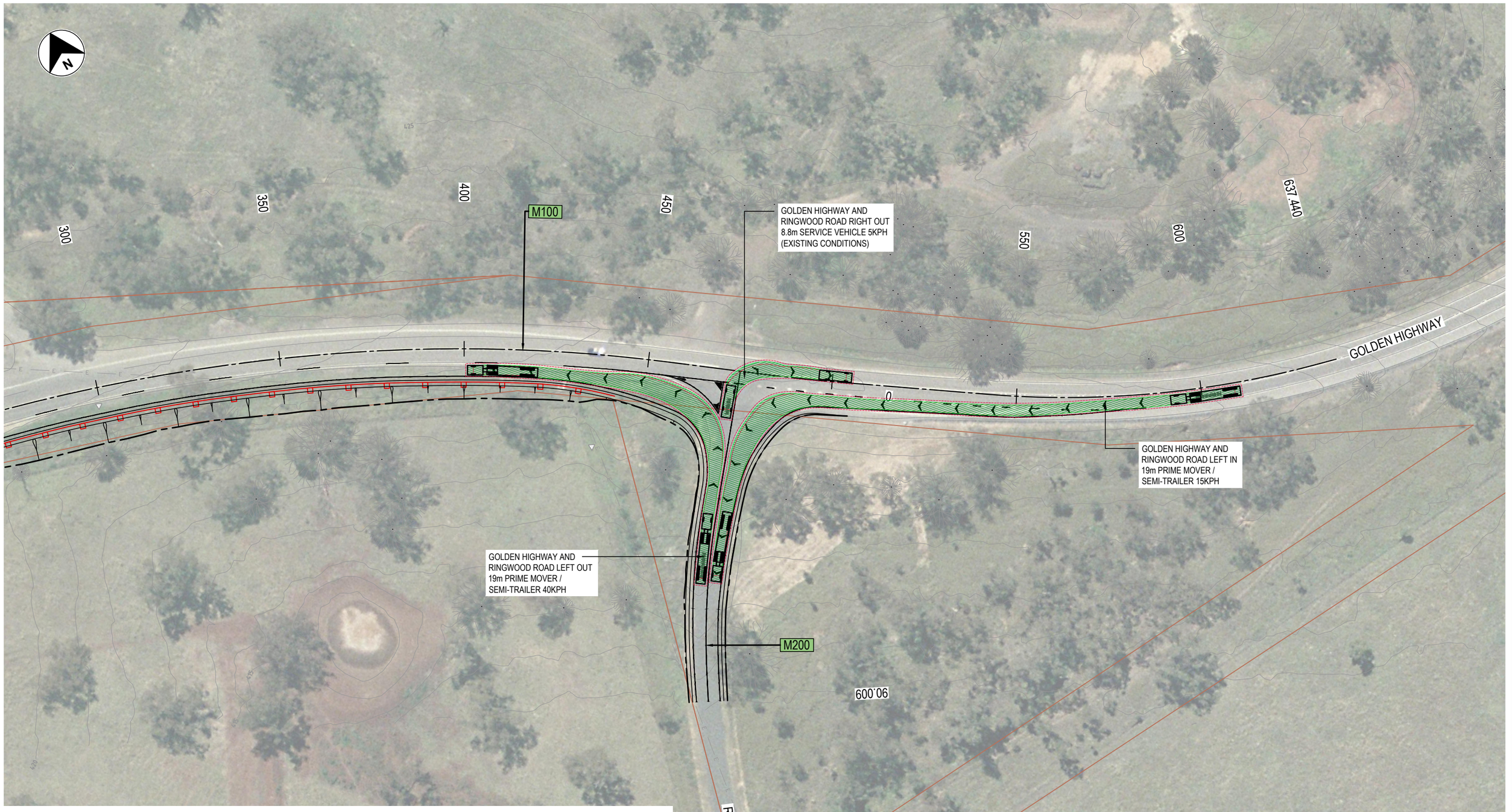
FOR INFORMATION ONLY

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SWEPT PATHS
SHEET 1 OF 4
27/10/2023

turnbull

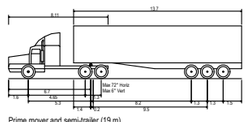
0305-INF-RD-SWEPT-PATH-RINGWOOD-01



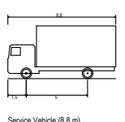
NOTES

1. NO ASSESSMENT HAS BEEN UNDERTAKEN FOR EXISTING PAVEMENT.
2. TURN PATHS PRESENTED IS THE INTENDED OPERATIONS OF TRAFFIC ASSOCIATED WITH GOULBURN SOLAR FARM. ONLY THE DISPLAYED MOVEMENTS WILL BE PERMITTED.
3. SURVEY SHOWN HAS BEEN PROVIDED BY UMWELT (11/09/2023).
4. BOUNDARIES HAVE BEEN SOURCED FROM SIX MAPS "Clip 'n' Snip".
5. NO ASSESSMENT HAS BEEN UNDERTAKEN FOR THE EXISTING GOLDEN HIGHWAY AND RINGWOOD ROAD INTERSECTION RIGHT TURN IN AND RIGHT TURN OUT MOVEMENTS. EXISTING VEHICLE MOVEMENTS AND INTERSECTION LAYOUT TO BE RESPECTED.

VEHICLE TURN PATH PROFILE



Prime mover and semi-trailer (19 m)	
Overall Length	19.000m
Overall Width	2.500m
Overall Body Height	4.300m
Min Body Ground Clearance	0.540m
Track Width	2.500m
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	12.500m



Service Vehicle (8.8 m)	
Overall Length	8.800m
Overall Width	2.500m
Overall Body Height	4.300m
Min Body Ground Clearance	0.427m
Track Width	2.500m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	12.500m

FOR INFORMATION ONLY

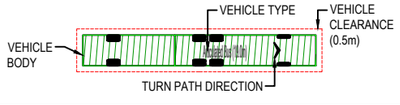
GENERAL

- DESIGN
- CADASTRAL
- SURVEY
- SAFETY BARRIER

ROAD GEOMETRY

- CONTROL LINE AND CHAINAGE (20)
- CONTROL LINE LABEL (MCXX)

VEHICLE TURN PATH LEGEND



0 10 20 30 40
SCALE 1:1000m

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SWEPT PATHS
SHEET 2 OF 4
27/10/2023

turnbull

0305-INF-RD-SWEPT-PATH-RINGWOOD-02

NOTES

1. NO ASSESSMENT HAS BEEN UNDERTAKEN FOR EXISTING PAVEMENT.
2. TURN PATHS PRESENTED IS THE INTENDED OPERATIONS OF TRAFFIC ASSOCIATED WITH GOULBURN SOLAR FARM. ONLY THE DISPLAYED MOVEMENTS WILL BE PERMITTED.
3. SURVEY SHOWN HAS BEEN PROVIDED BY UMWELT (11/09/2023).
4. BOUNDARIES HAVE BEEN SOURCED FROM SIX MAPS "Clip 'n' Snip".
5. NO ASSESSMENT HAS BEEN UNDERTAKEN FOR THE EXISTING GOLDEN HIGHWAY AND RINGWOOD ROAD INTERSECTION RIGHT TURN IN AND RIGHT TURN OUT MOVEMENTS. EXISTING VEHICLE MOVEMENTS AND INTERSECTION LAYOUT TO BE RESPECTED.

VEHICLE TURN PATH PROFILE

Service Vehicle (8.8 m)	
Overall Length	8.800m
Overall Width	2.500m
Overall Body Height	4.300m
Min Body Ground Clearance	0.427m
Track Width	2.500m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	12.500m

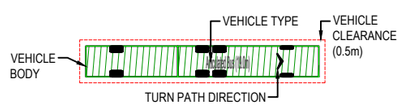
GENERAL

- DESIGN
- CADASTRAL
- SURVEY
- SAFETY BARRIER

ROAD GEOMETRY

- CONTROL LINE AND CHAINAGE (20)
- CONTROL LINE LABEL (MCXX)

VEHICLE TURN PATH LEGEND



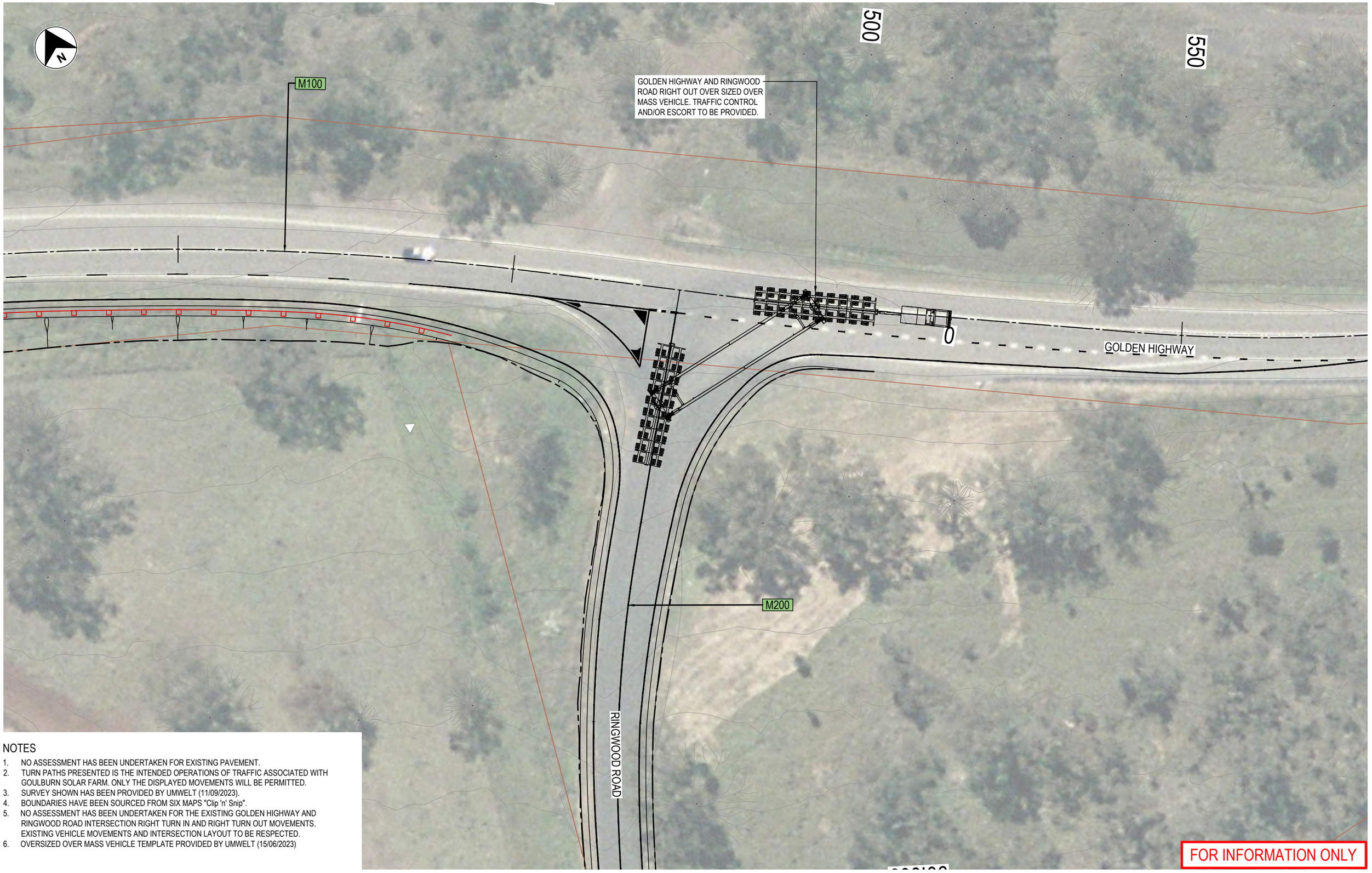
0 10 20 30 40
SCALE 1:1000m

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SWEPT PATHS
SHEET 3 OF 4
27/10/2023

turnbull

0305-INF-RD-SWEPT-PATH-RINGWOOD-03

FOR INFORMATION ONLY



NOTES

1. NO ASSESSMENT HAS BEEN UNDERTAKEN FOR EXISTING PAVEMENT.
2. TURN PATHS PRESENTED IS THE INTENDED OPERATIONS OF TRAFFIC ASSOCIATED WITH GOULBURN SOLAR FARM. ONLY THE DISPLAYED MOVEMENTS WILL BE PERMITTED.
3. SURVEY SHOWN HAS BEEN PROVIDED BY UMWELT (11/09/2023).
4. BOUNDARIES HAVE BEEN SOURCED FROM SIX MAPS "Clip 'n' Snip".
5. NO ASSESSMENT HAS BEEN UNDERTAKEN FOR THE EXISTING GOLDEN HIGHWAY AND RINGWOOD ROAD INTERSECTION RIGHT TURN IN AND RIGHT TURN OUT MOVEMENTS. EXISTING VEHICLE MOVEMENTS AND INTERSECTION LAYOUT TO BE RESPECTED.
6. OVERSIZED OVER MASS VEHICLE TEMPLATE PROVIDED BY UMWELT (15/06/2023)

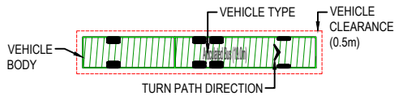
GENERAL

- DESIGN
- CADASTRAL
- SURVEY
- SAFETY BARRIER

ROAD GEOMETRY

- CONTROL LINE AND CHAINAGE (20)
- MCXX — CONTROL LINE LABEL

VEHICLE TURN PATH LEGEND



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GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SWEPT PATHS
SHEET 4 OF 4
27/10/2023

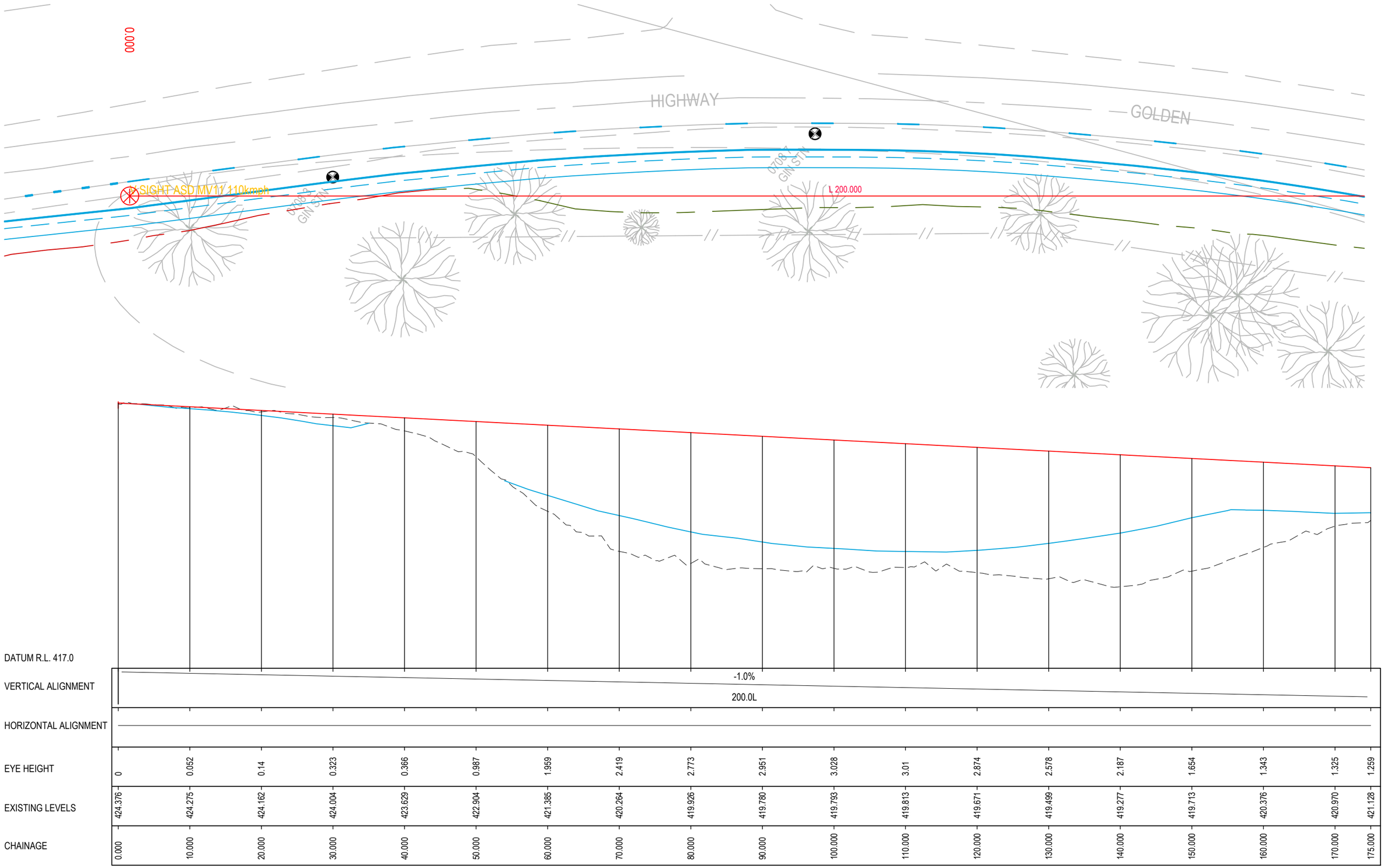
turnbull

0305-INF-RD-SWEPT-PATH-RINGWOOD-04

Ringwood Road and Golden Highway Intersection and Acceleration Lane

Verification Summary - ASD

Location	Design Speed (km/hr)	Eye Height (m)	Object Height (m)	Reaction time (s)	Grade % (average)	ASD Required (m)	ASD Achieved (m)	ASD Control	Result (Pass/Fail)	Comments
Golden Highway WB Acceleration Lane End Merge Taper	110	1.1	0	N/A	N/A	375	200	MV11	FAIL	Merge Sight Distance value from AGRD Part 3 Table 9.3. Matching existing conditions, start of merge taper is at the crest of Golden Highway. Due to curvature of the existing road sight distance is obstructed by the existing terrain outside the road corridor.
Golden Highway WB Acceleration Lane Start	110	1.1	0	2	2	185.82	185.82	MV12	PASS	
Golden Highway WB Deceleration Lane Start	110	1.1	0	2	2	185.82	60.5	MV15	FAIL	54km/h ASD Achieved. Matching existing conditions, Start of deceleration lane taper is along a curved section of the Golden Highway and is uphill. Sight distance obstructed by existing road geometry.



CHAINAGE	EYE HEIGHT	EXISTING LEVELS
0.000	0	424.376
10.000	0.052	424.275
20.000	0.14	424.162
30.000	0.323	424.004
40.000	0.366	423.629
50.000	0.987	422.904
60.000	1.959	421.385
70.000	2.419	420.264
80.000	2.773	419.926
90.000	2.951	419.780
100.000	3.028	419.793
110.000	3.01	419.813
120.000	2.874	419.671
130.000	2.578	419.499
140.000	2.187	419.277
150.000	1.654	419.713
160.000	1.343	420.376
170.000	1.325	420.970
175.000	1.259	421.128

LONGITUDINAL SECTION ALONG - V SIGHT ASD MV11 110kmph

HORIZONTAL 1:500
VERTICAL 1:100

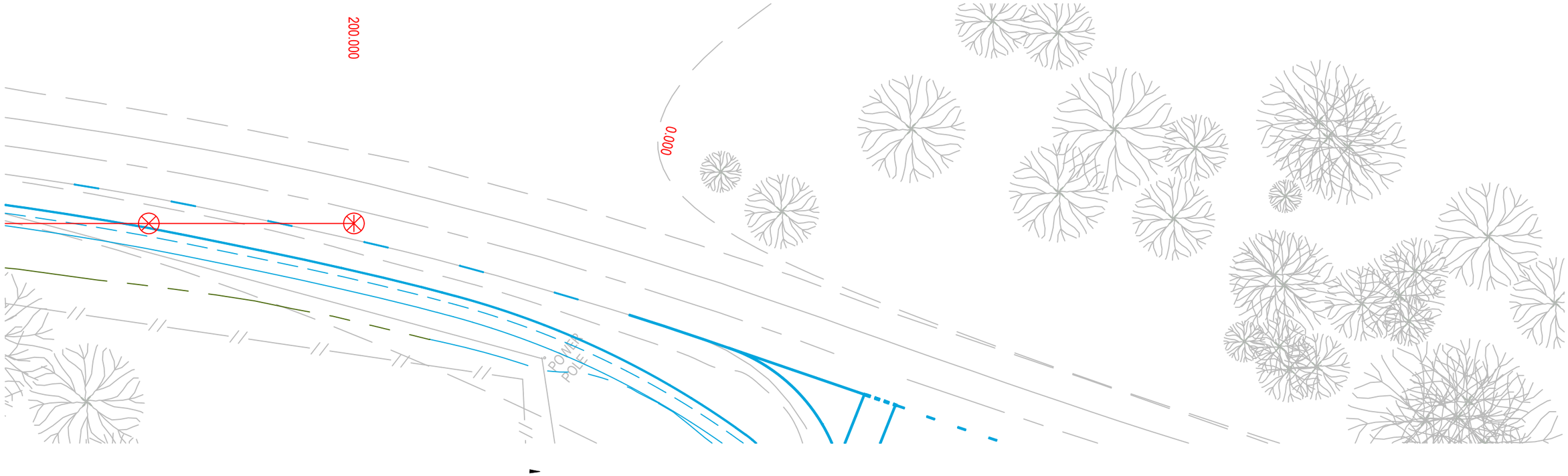
FOR INFORMATION ONLY

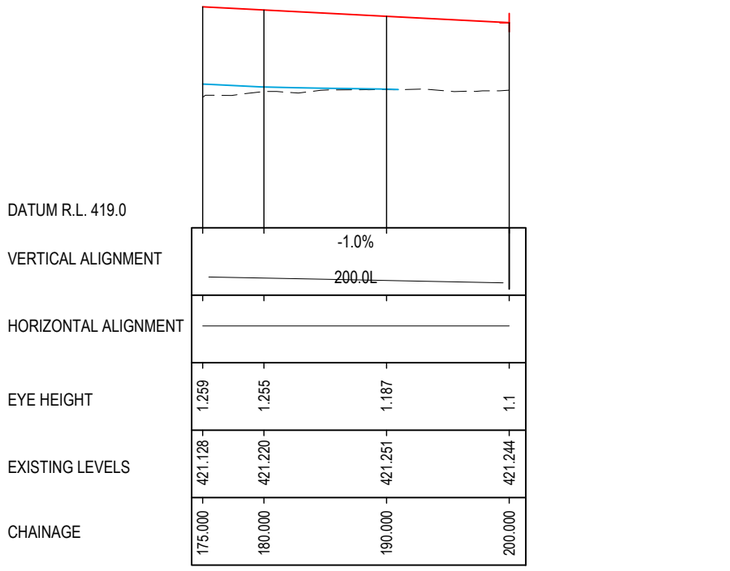
HORIZ. 1:500m
0 5 10 15 20
0 1 2 3 4
VERT. 1:100m

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SIGHT DISTANCE CHECKS
APPROACH SIGHT DISTANCE
1 OF 5

turnbull

0305-INF-LS-SIGHT_ASD-01





LONGITUDINAL SECTION ALONG - V SIGHT ASD MV11 110kmph

HORIZONTAL 1:500
VERTICAL 1:100

FOR INFORMATION ONLY

HORIZ. 1:500m
0 5 10 15 20
0 1 2 3 4
VERT. 1:100m

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SIGHT DISTANCE CHECKS
APPROACH SIGHT DISTANCE
2 OF 5

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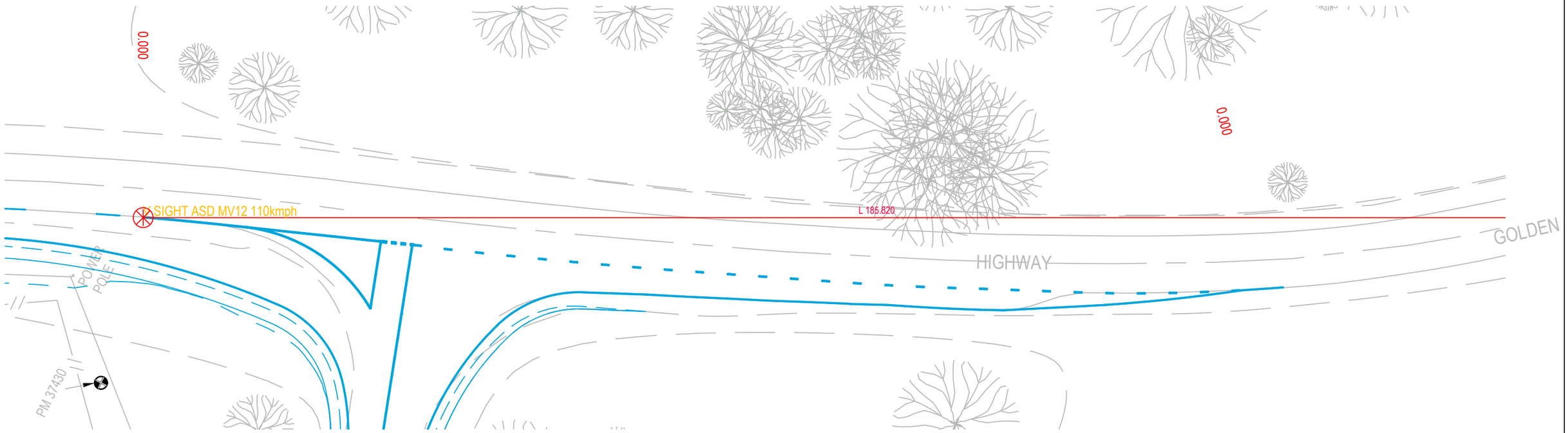
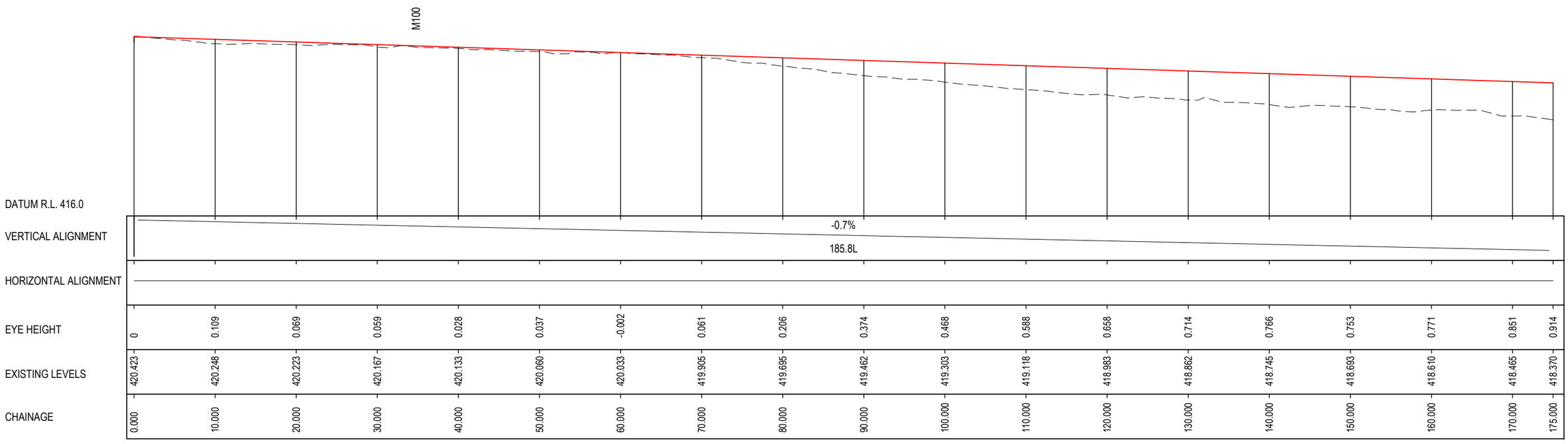
0305-INF-LS-SIGHT_ASD-02





LONGITUDINAL SECTION ALONG - V SIGHT ASD MV12 110kmph

HORIZONTAL 1:500
VERTICAL 1:100

FOR INFORMATION ONLY

HORIZ. 1:500m
0 5 10 15 20
0 1 2 3 4
VERT. 1:100m

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SIGHT DISTANCE CHECKS
APPROACH SIGHT DISTANCE
3 OF 5

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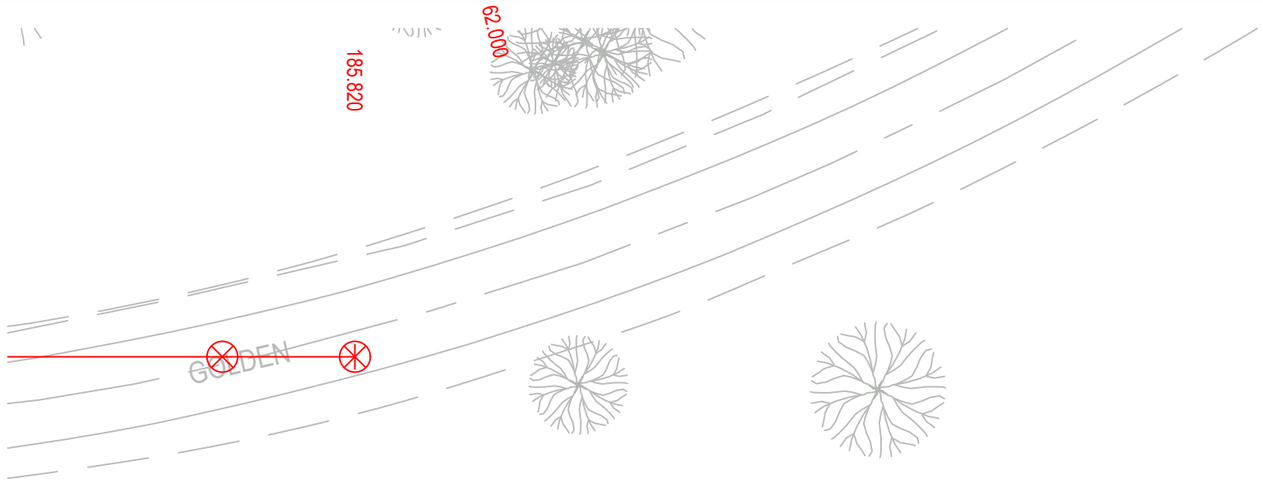
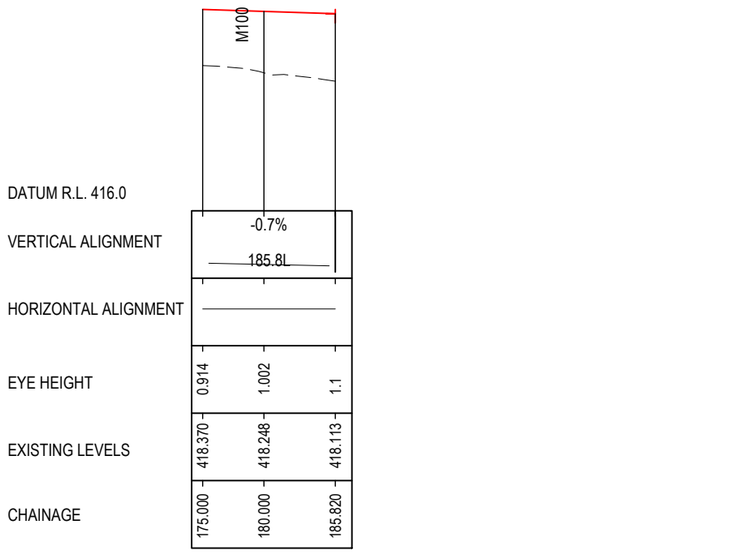
0305-INF-LS-SIGHT_ASD-03





LONGITUDINAL SECTION ALONG - V SIGHT ASD MV12 110kmph

HORIZONTAL 1:500
VERTICAL 1:100

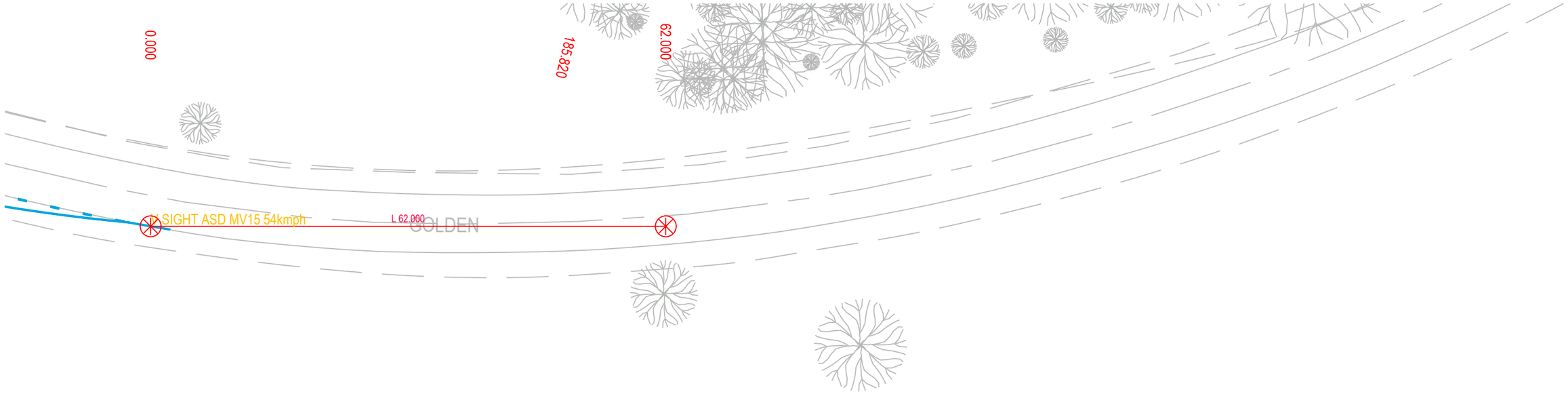
FOR INFORMATION ONLY

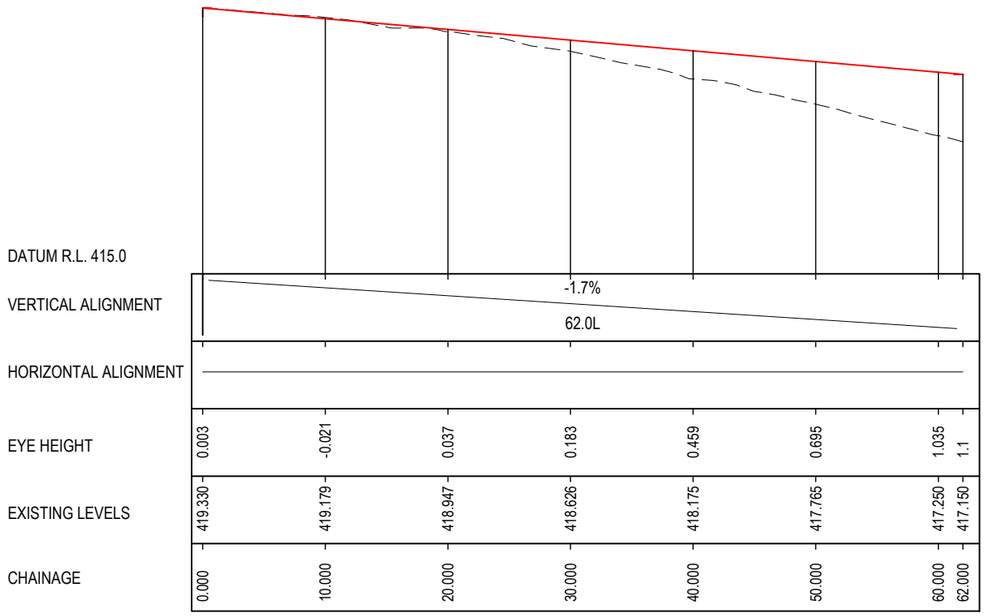
HORIZ. 1:500m
0 5 10 15 20
0 1 2 3 4
VERT. 1:100m

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SIGHT DISTANCE CHECKS
APPROACH SIGHT DISTANCE
4 OF 5

turnbull

0305-INF-LS-SIGHT_ASD-04





LONGITUDINAL SECTION ALONG - V SIGHT ASD MV15 54kmph

HORIZONTAL 1:500
VERTICAL 1:100

FOR INFORMATION ONLY

HORIZ. 1:500m
0 5 10 15 20
0 1 2 3 4
VERT. 1:100m

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SIGHT DISTANCE CHECKS
APPROACH SIGHT DISTANCE
5 OF 5

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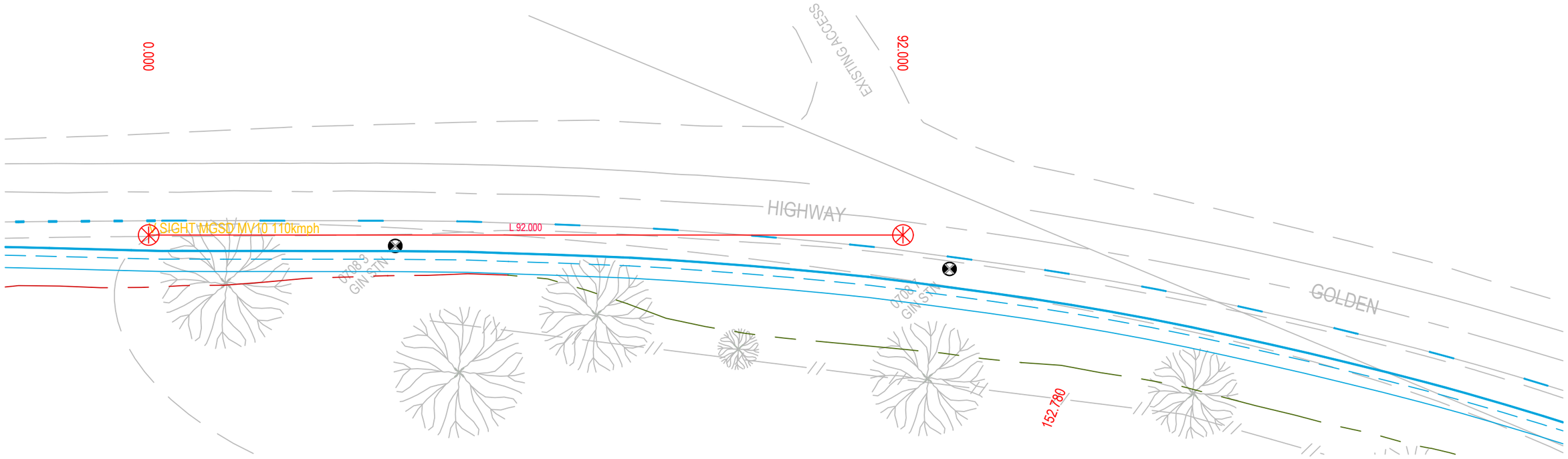
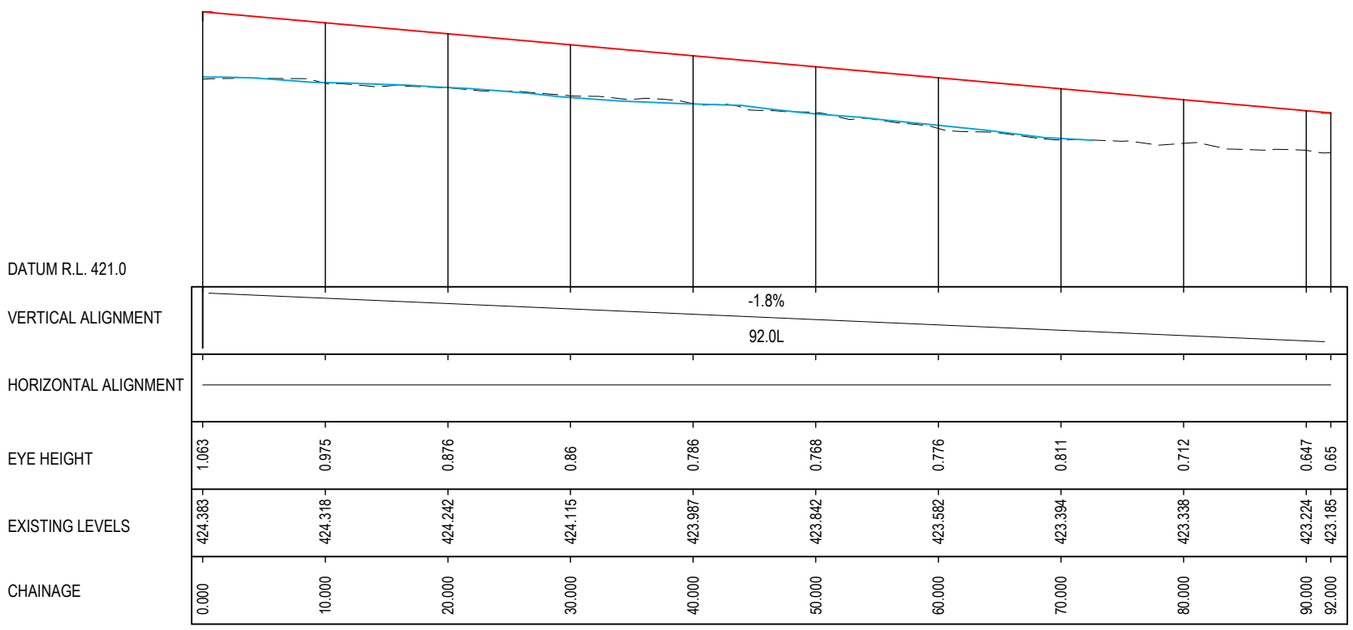
0305-INF-LS-SIGHT_ASD-05

Ringwood Road and Golden Highway Intersection Upgrade and Acceleration Lane

Verification Summary - MGSD

Location	Eye Height (m)	Object Height (m)	Critial Acceptance Gap (s)	MGSD Required (m)	MGSD Achieved (m)	MGSD Control	Result (Pass/Fail)	Comments
Golden Highway WB Acceleration Lane End	1.1	0.65	3	91.67	91.67	MV10	PASS	
Golden Highway EB and Ringwood Road SB Intersection - Right-In Turn	1.1	0.65	4	122.22	122.22	MV17	PASS	
Ringwood Road NB and Golden Highway EB and Intersection - Right-Out Turn	1.1	0.65	5	152.78	152.78	MV20	PASS	





LONGITUDINAL SECTION ALONG - V SIGHT MGSD MV10 110kmph

HORIZONTAL 1:500
VERTICAL 1:100

FOR INFORMATION ONLY

HORIZ. 1:500m
0 5 10 15 20
VERT. 1:100m
0 1 2 3 4

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SIGHT DISTANCE CHECKS
MINIMUM GAP SIGHT DISTANCE
1 OF 3

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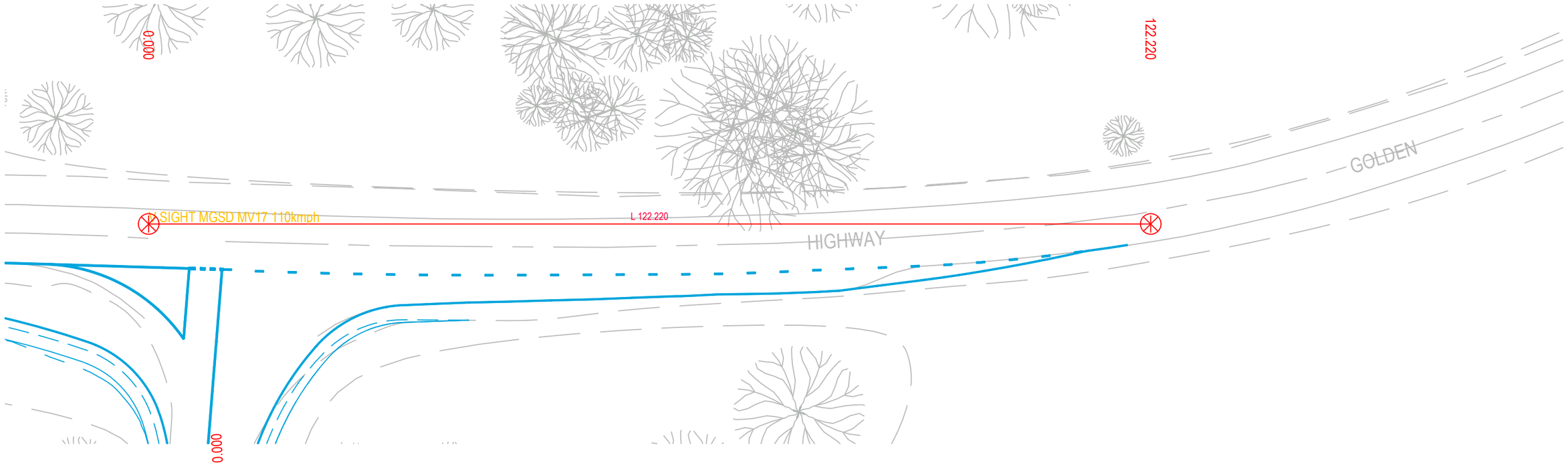
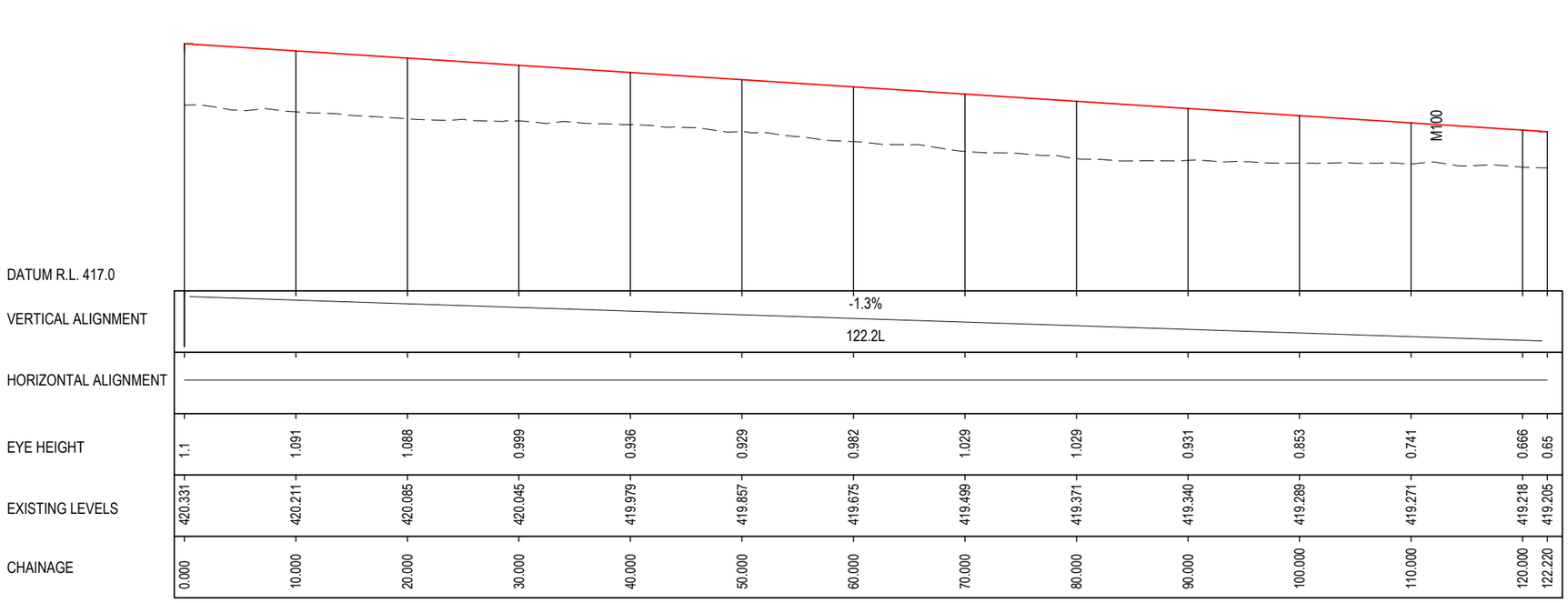
0305-INF-LS-SIGHT_MGSD-01





LONGITUDINAL SECTION ALONG - V SIGHT MGSD MV17 110kmph

HORIZONTAL 1:500
VERTICAL 1:100

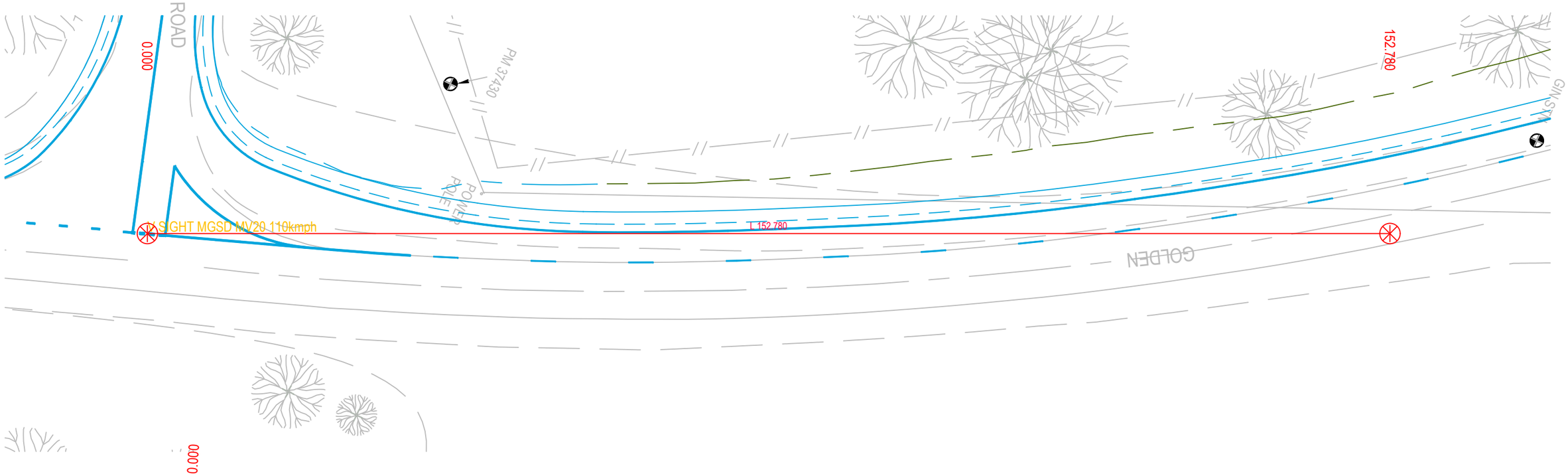
FOR INFORMATION ONLY

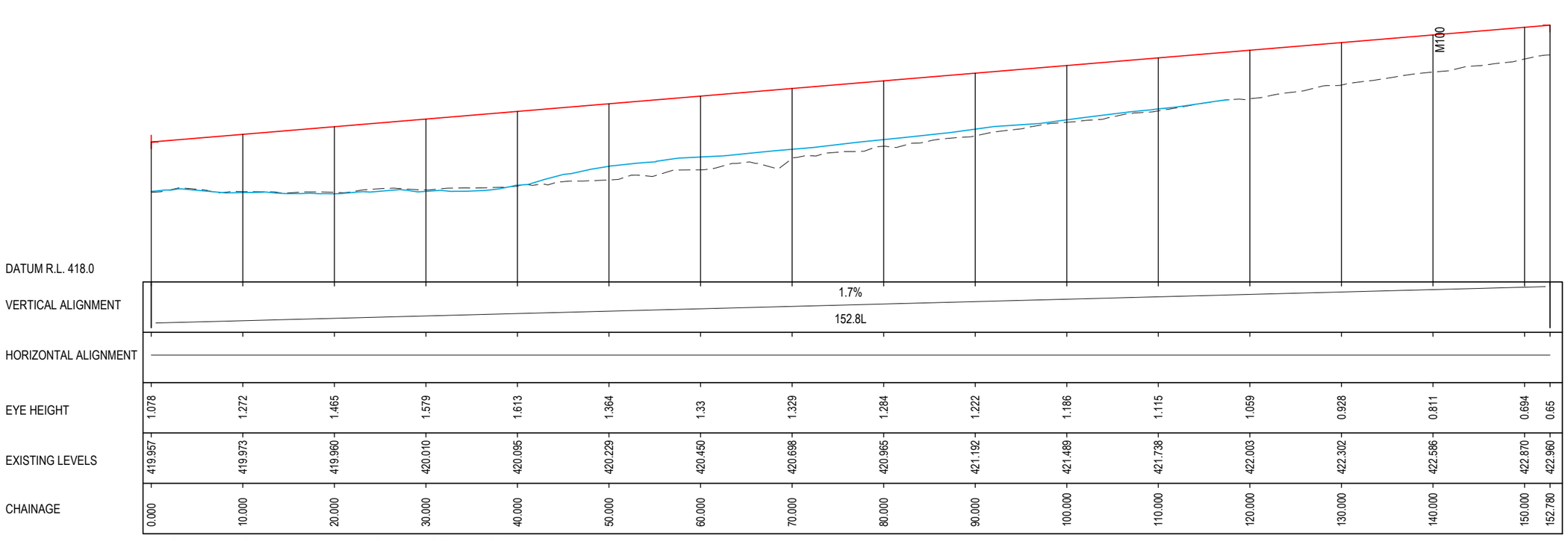
HORIZ. 1:500m
0 5 10 15 20
0 1 2 3 4
VERT. 1:100m

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SIGHT DISTANCE CHECKS
MINIMUM GAP SIGHT DISTANCE
2 OF 3

turnbull

0305-INF-LS-SIGHT_MGSD-02





LONGITUDINAL SECTION ALONG - V SIGHT MGSD MV20 110kmph

HORIZONTAL 1:500
VERTICAL 1:100

FOR INFORMATION ONLY

HORIZ. 1:500m
0 5 10 15 20
0 1 2 3 4
VERT. 1:100m

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SIGHT DISTANCE CHECKS
MINIMUM GAP SIGHT DISTANCE
3 OF 3

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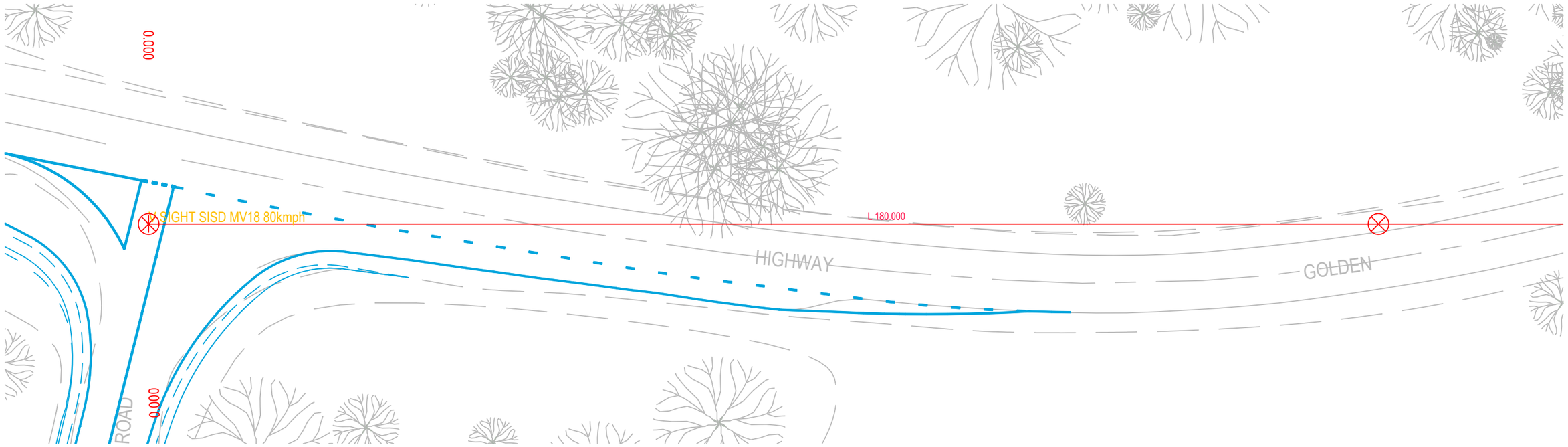
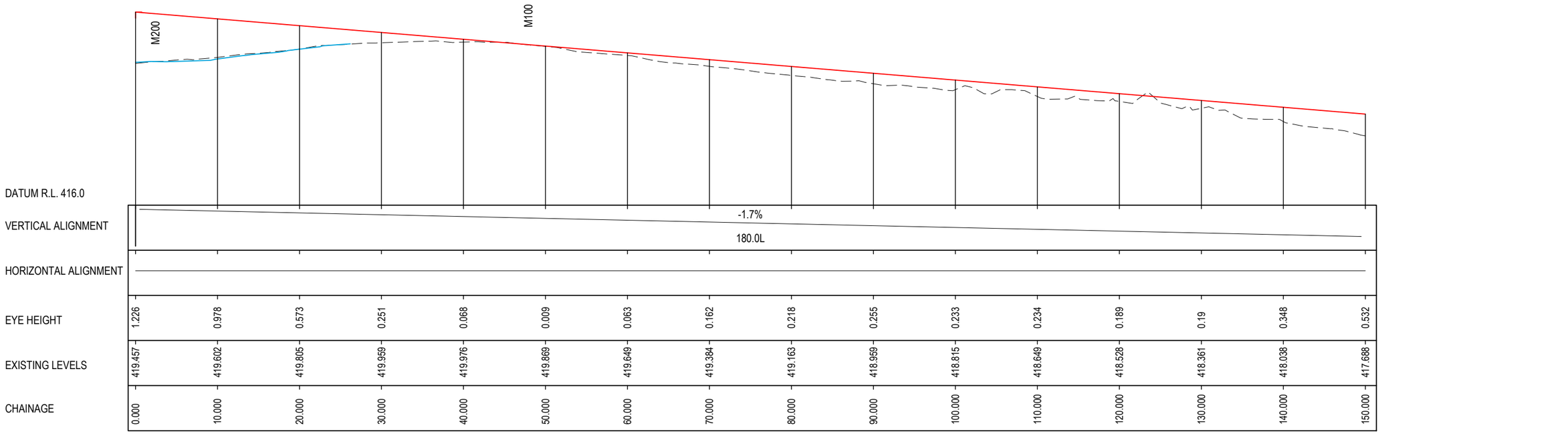
0305-INF-LS-SIGHT_MGSD-03

Ringwood Road and Golden Highway Intersection and Acceleration Lane

Verification Summary - SISD

Location	Design Speed (km/hr)	Eye Height (m)	Object Height (m)	Reaction time (s)	Observation Time (s)	Grade % (average)	SISD Required (m)	SISD Achieved (m)	SISD Control	Result (Pass/Fail)	Comments
Golden Highway WB and Ringwood Road NB Intersection	110	1.25	1.1	2	3	2	277.48	180	MV18	FAIL	80km/h SISD achieved. Matching existing conditions, existing intersection is following a curved section of the Golden Highway and is uphill. Sight distance obstructed by existing road geometry.
Golden Highway EB and Ringwood Road NB Intersection	110	1.25	1.1	2	3	-2	292.07	292.07	MV19	PASS	May be obstructed by existing trees.





LONGITUDINAL SECTION ALONG - V SIGHT SISD MV18 80kmph

HORIZONTAL 1:500
VERTICAL 1:100

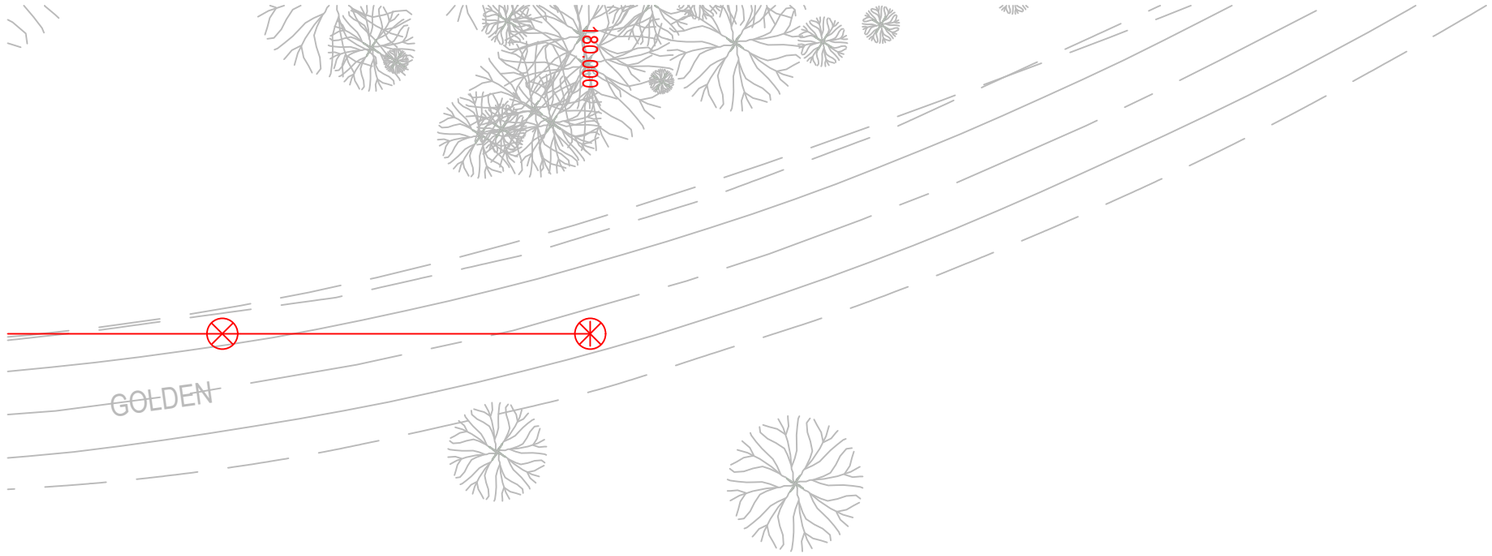
FOR INFORMATION ONLY

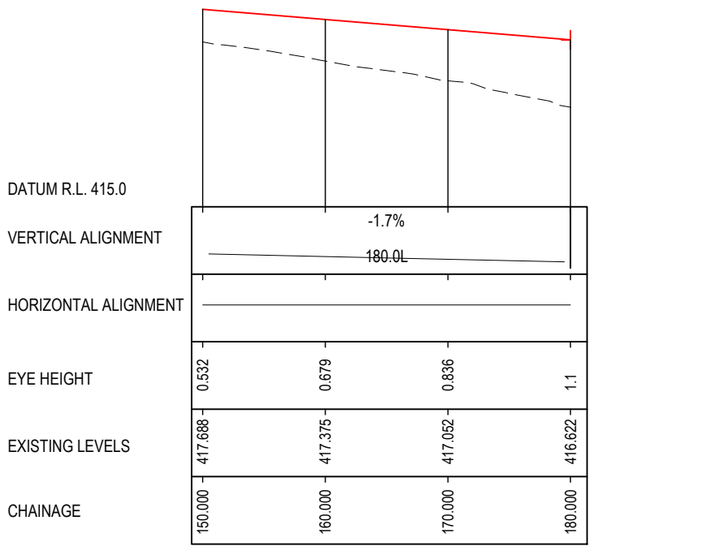
HORIZ. 1:500m
0 5 10 15 20
0 1 2 3 4
VERT. 1:100m

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SIGHT DISTANCE CHECKS
SAFE INTERSECTION SIGHT DISTANCE
1 OF 4

turnbull

0305-INF-LS-SIGHT_SISD-01





LONGITUDINAL SECTION ALONG - V SIGHT SISD MV18 80kmph

HORIZONTAL 1:500
VERTICAL 1:100

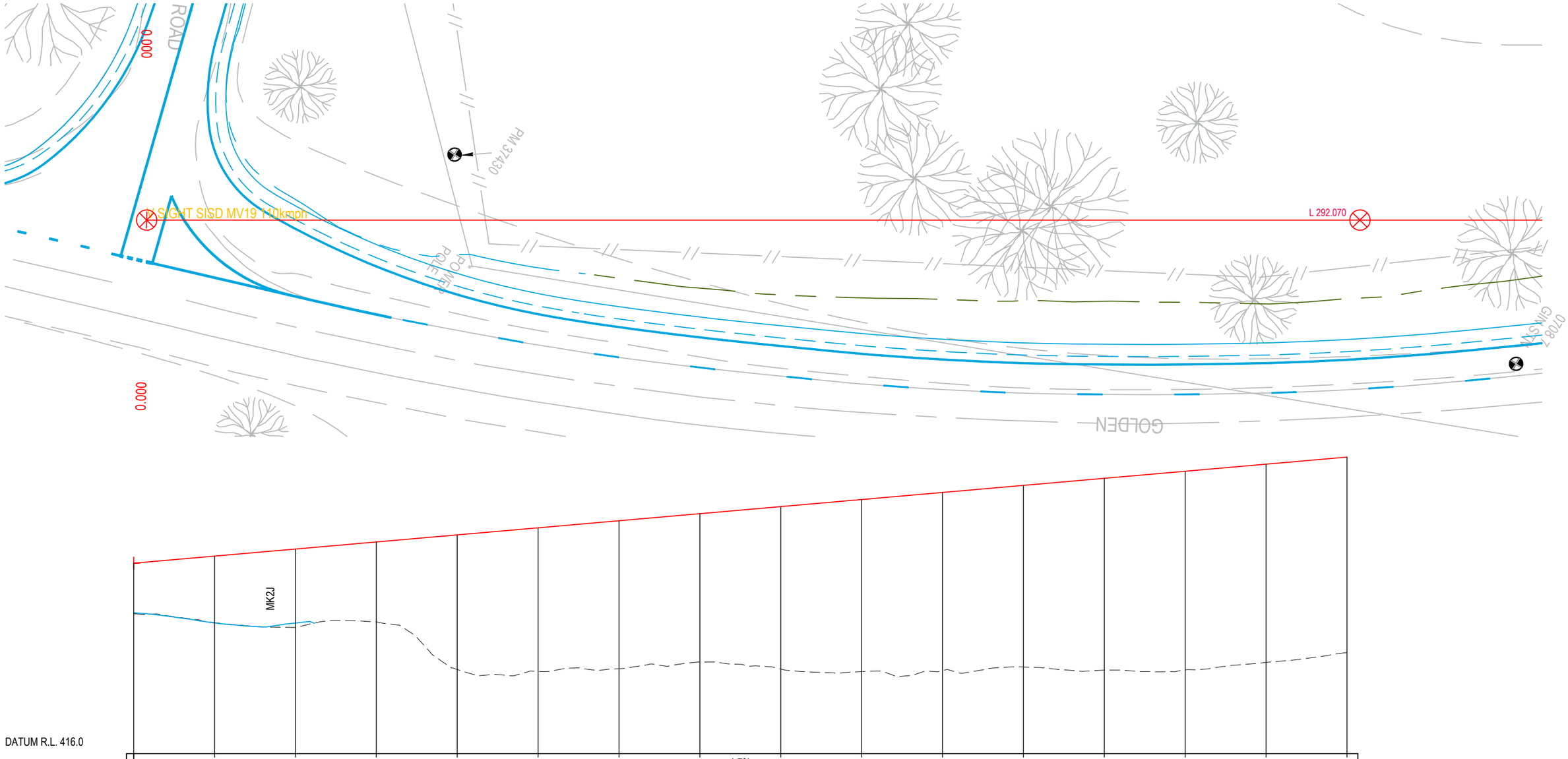
FOR INFORMATION ONLY

HORIZ. 1:500m
0 5 10 15 20
0 1 2 3 4
VERT. 1:100m

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SIGHT DISTANCE CHECKS
SAFE INTERSECTION SIGHT DISTANCE
2 OF 4

turnbull

0305-INF-LS-SIGHT_SISD-02



LONGITUDINAL SECTION ALONG - V SIGHT SISD MV19 110kmph

HORIZONTAL 1:500
VERTICAL 1:100

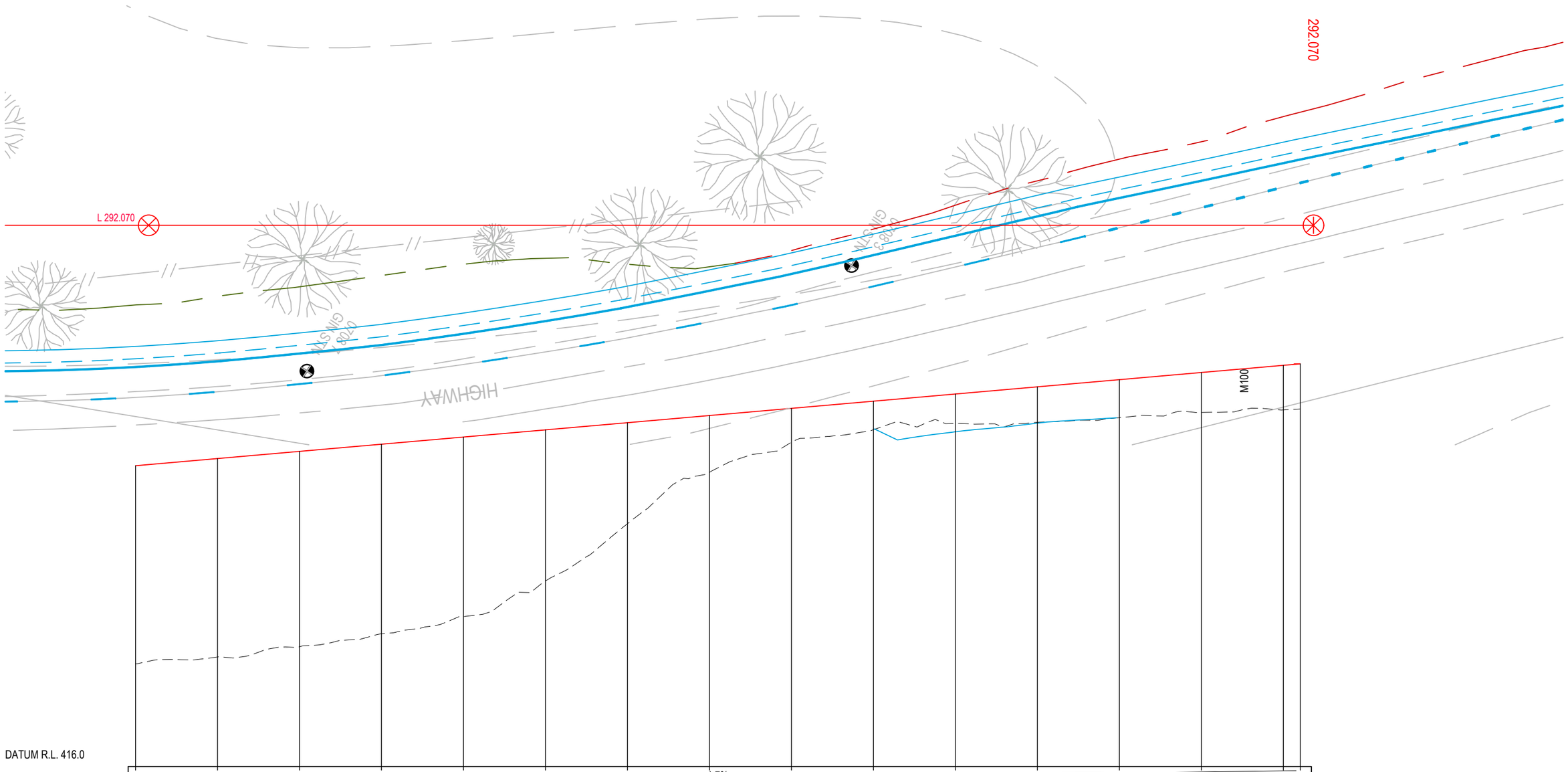
FOR INFORMATION ONLY

HORIZ. 1:500m
0 5 10 15 20
0 1 2 3 4
VERT. 1:100m

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SIGHT DISTANCE CHECKS
SAFE INTERSECTION SIGHT DISTANCE
3 OF 4

turnbull

0305-INF-LS-SIGHT_SISD-03



DATUM R.L. 416.0																	
VERTICAL ALIGNMENT	1.7%																
	292.1L																
HORIZONTAL ALIGNMENT																	
EYE HEIGHT	4.83	4.835	4.758	4.621	4.374	3.683	2.461	1.385	0.824	0.696	0.92	0.886	0.924	0.972	1.087	1.1	
EXISTING LEVELS	418.499	418.669	418.921	419.233	419.654	420.521	421.917	423.168	423.903	424.207	424.364	424.389	424.503	424.630	424.690	424.713	
CHAINAGE	150.000	160.000	170.000	180.000	190.000	200.000	210.000	220.000	230.000	240.000	250.000	260.000	270.000	280.000	290.000	292.070	

LONGITUDINAL SECTION ALONG - V SIGHT SISD MV19 110kmph

HORIZONTAL 1:500
VERTICAL 1:100

FOR INFORMATION ONLY

HORIZ. 1:500m
0 5 10 15 20
0 1 2 3 4
VERT. 1:100m

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SIGHT DISTANCE CHECKS
SAFE INTERSECTION SIGHT DISTANCE
4 OF 4

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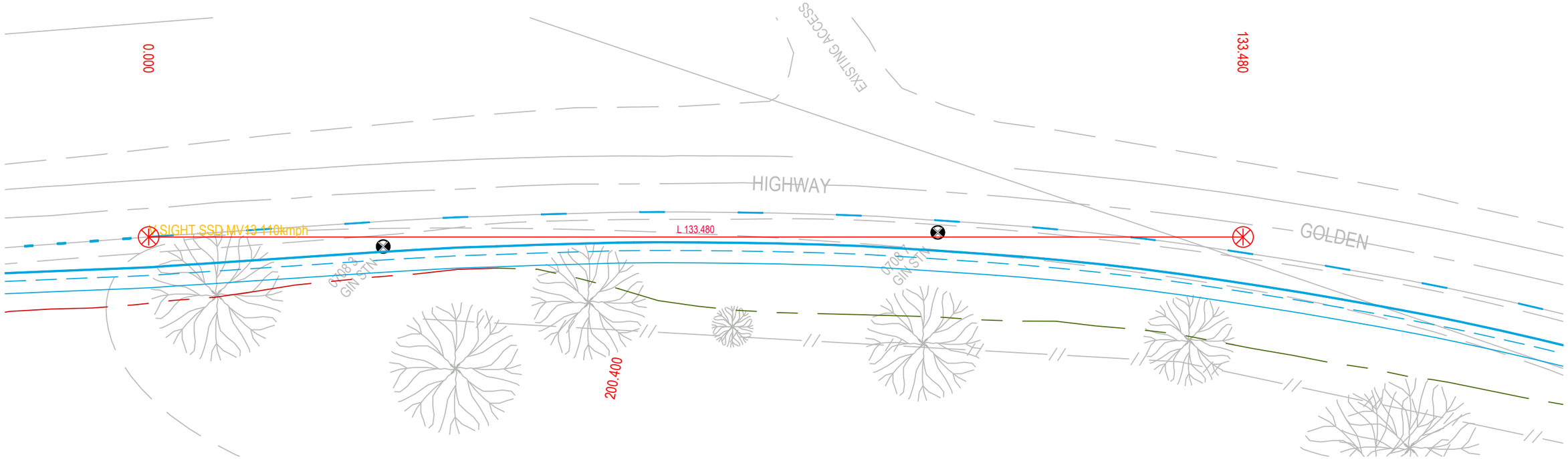
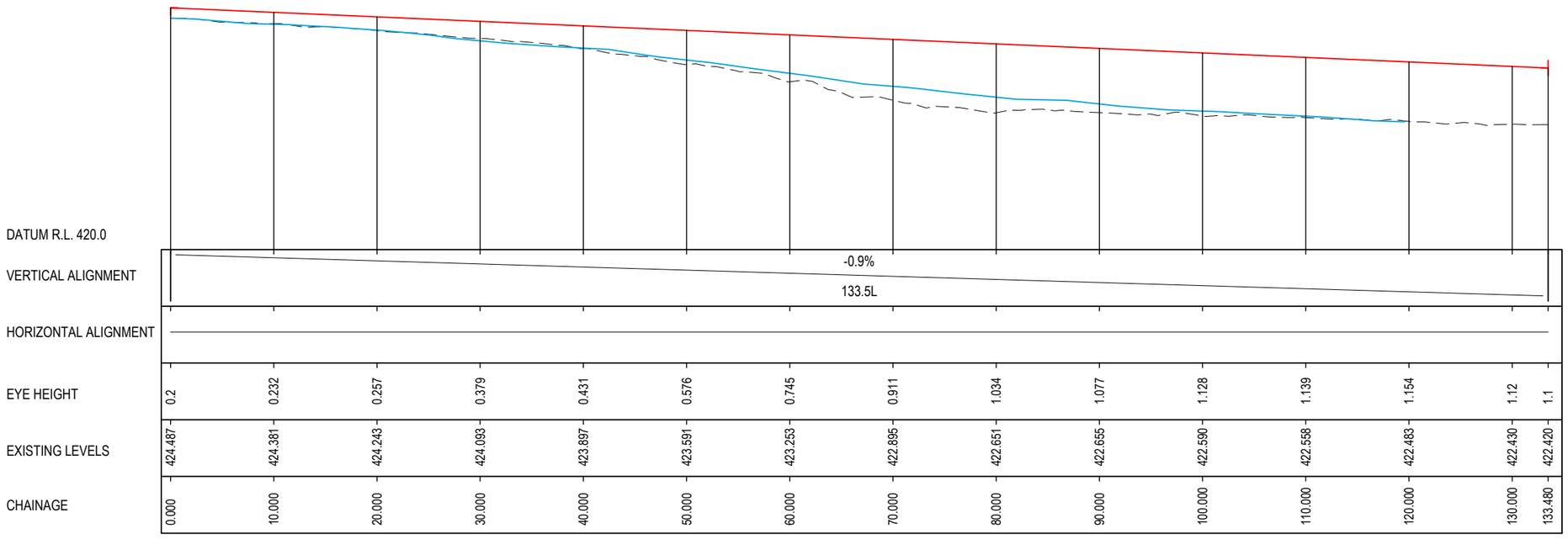
0305-INF-LS-SIGHT_SISD-04

Ringwood Road and Golden Highway Intersection Upgrade and Acceleration Lane

Verification Summary - SSD

Location	Eye Height (m)	Object Height (m)	Design Speed (km/hr)	Reaction time (s)	Grade % (average)	SSD Required (m)	SSD Achieved (m)	SSD Control	Result (Pass/Fail)	Comments
Golden Highway WB Acceleration Lane Merge Taper / End	1.1	0.2	90	2	2	133.48	133.48	MV13	PASS	May be obstructed by existing trees
Golden Highway WB and Ringwood Road Intersection	1.1	0.2	110	2	1	189.17	135	MV16	FAIL	89km/h SSD achieved. Matching existing conditions, existing intersection is following a curved section of the Golden Highway and is uphill. Sight distance obstructed by existing road geometry.
Golden Highway EB and Ringwood Road Intersection	1.1	0.2	110	2	-2	200.4	200.4	MV14	PASS	May be obstructed by existing trees





LONGITUDINAL SECTION ALONG - V SIGHT SSD MV13 110kmph

HORIZONTAL 1:500
VERTICAL 1:100

FOR INFORMATION ONLY

HORIZ. 1:500m
0 5 10 15 20
0 1 2 3 4
VERT. 1:100m

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SIGHT DISTANCE CHECKS
STOPPING SIGHT DISTANCE
1 OF 4

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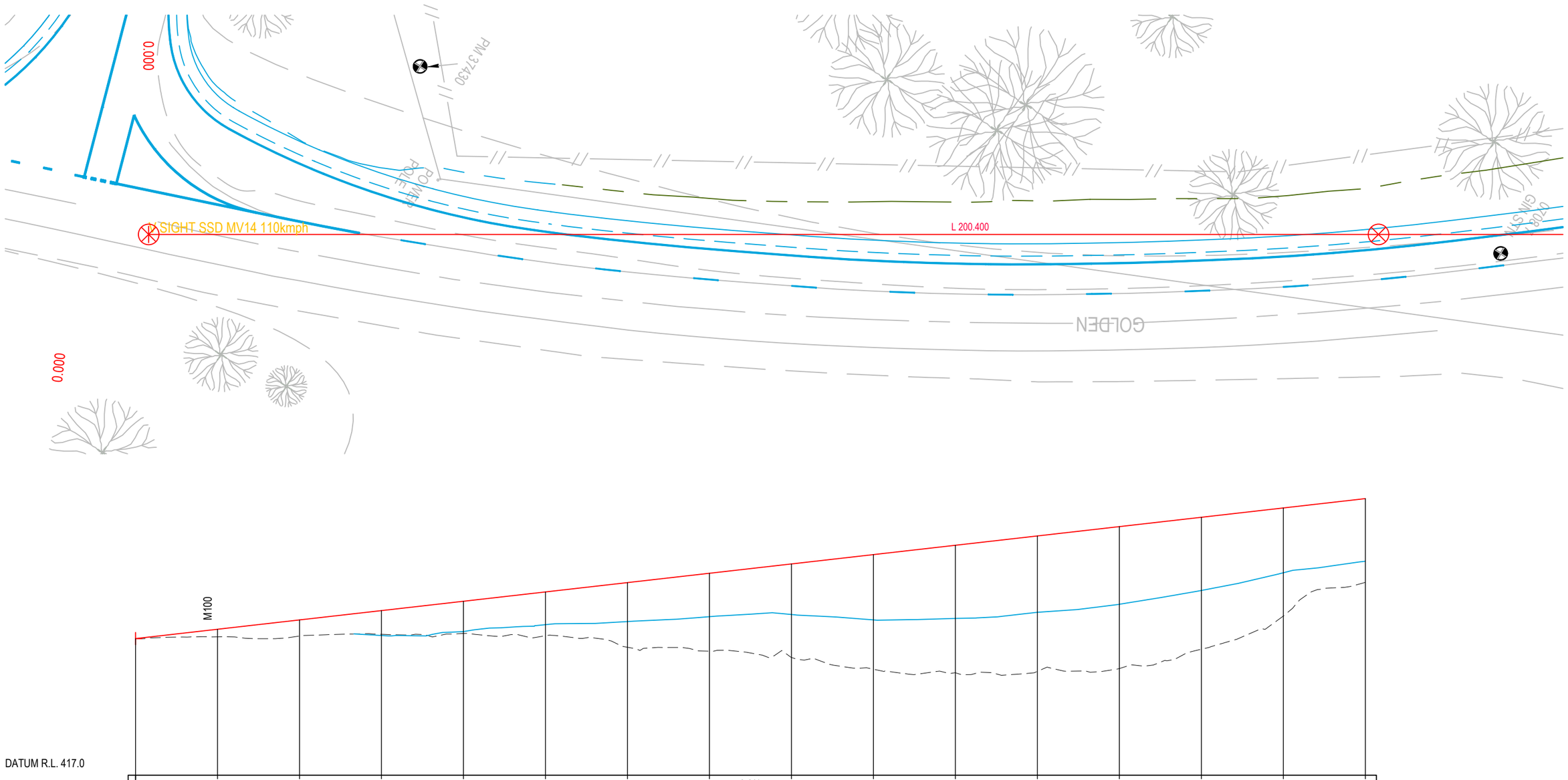
0305-INF-LS-SIGHT_SSD-01



LONGITUDINAL SECTION ALONG - V SIGHT SSD MV14 110kmph

HORIZONTAL 1:500
VERTICAL 1:100

FOR INFORMATION ONLY

HORIZ. 1:500m
0 5 10 15 20
0 1 2 3 4
VERT. 1:100m

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SIGHT DISTANCE CHECKS
STOPPING SIGHT DISTANCE
2 OF 4

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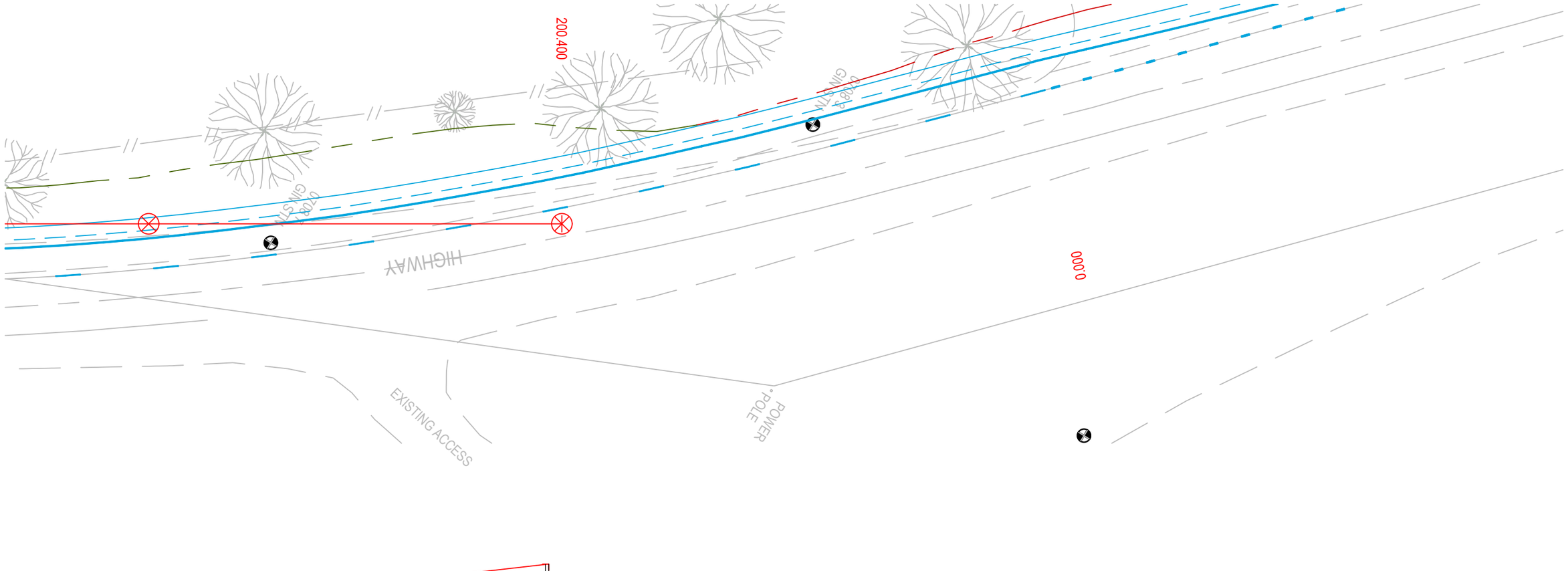
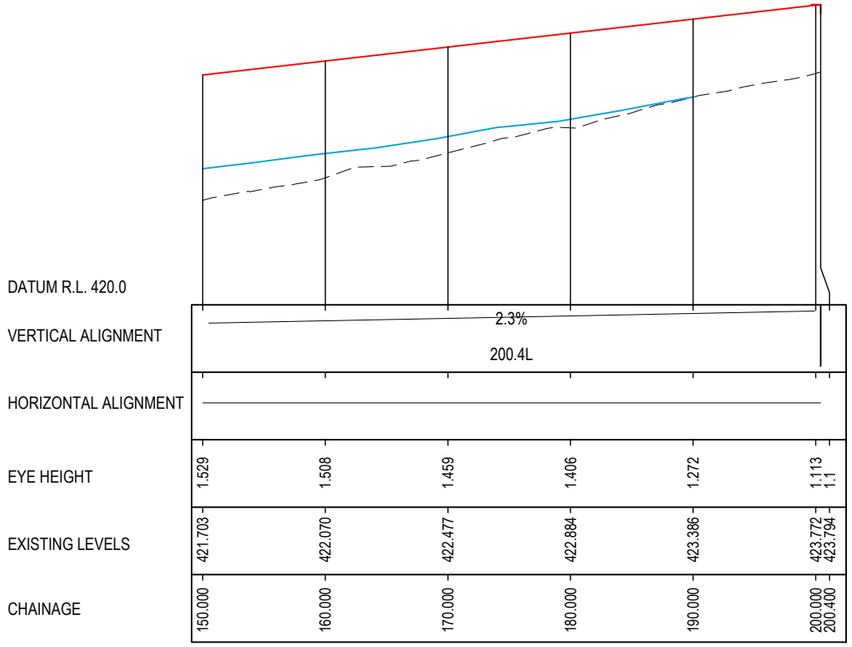
0305-INF-LS-SIGHT_SSD-02





LONGITUDINAL SECTION ALONG - V SIGHT SSD MV14 110kmph

HORIZONTAL 1:500
VERTICAL 1:100

FOR INFORMATION ONLY

HORIZ. 1:500m
0 5 10 15 20
0 1 2 3 4
VERT. 1:100m

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SIGHT DISTANCE CHECKS
STOPPING SIGHT DISTANCE
3 OF 4

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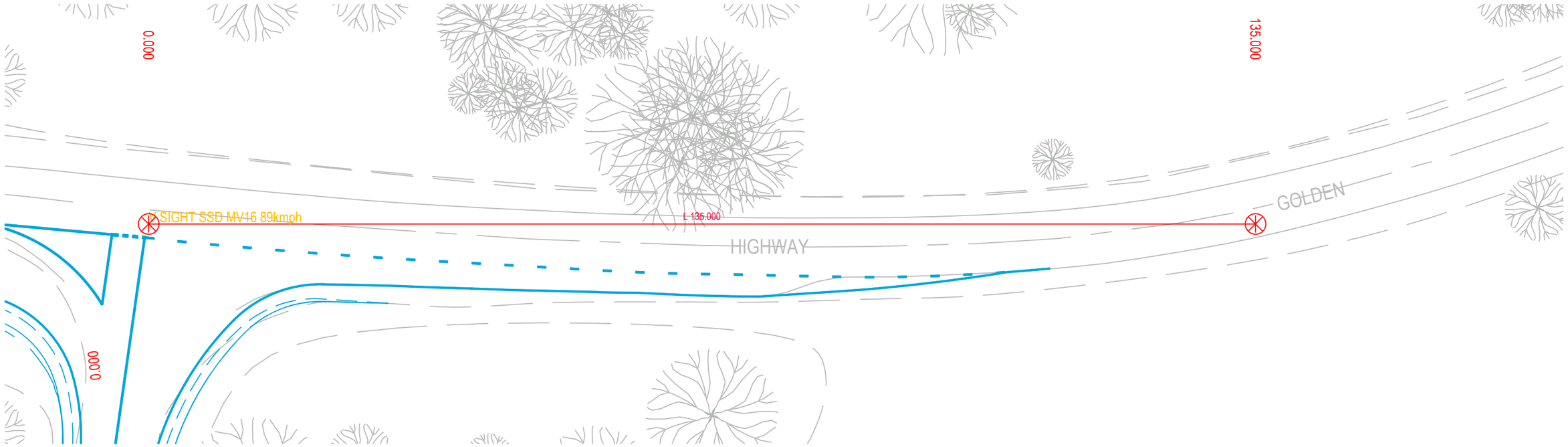
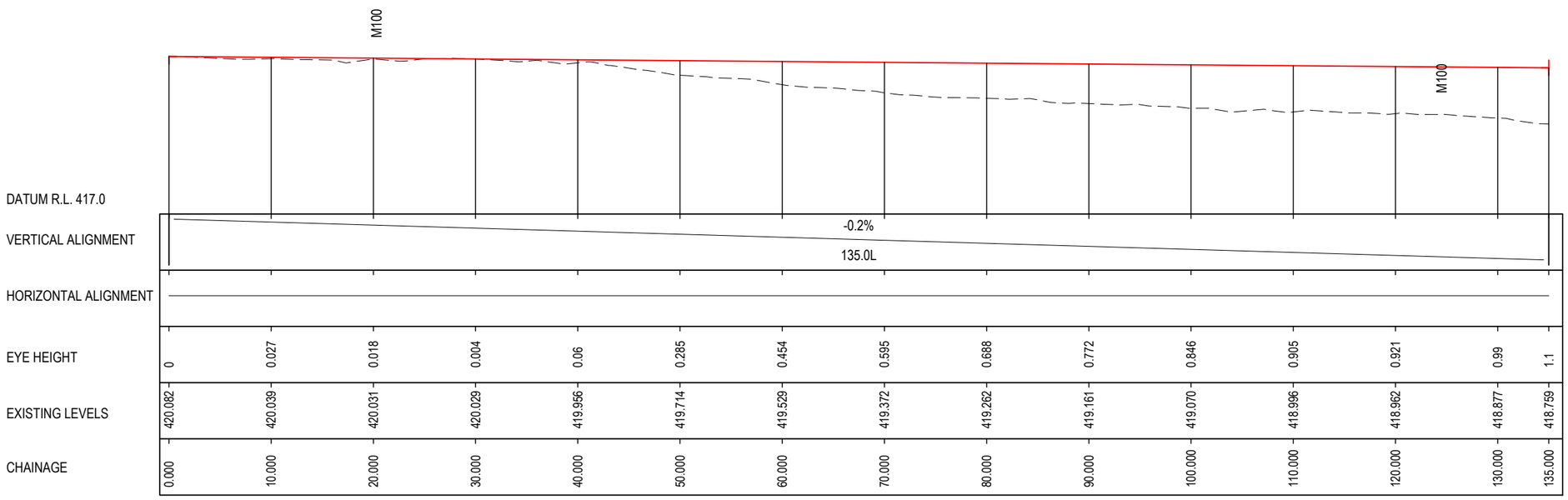
0305-INF-LS-SIGHT_SSD-03





LONGITUDINAL SECTION ALONG - V SIGHT SSD MV16 89kmph

HORIZONTAL 1:500
VERTICAL 1:100

FOR INFORMATION ONLY

HORIZ. 1:500m
0 5 10 15 20
0 1 2 3 4
VERT. 1:100m

GOULBURN RIVER SOLAR FARM
RINGWOOD ROAD AND GOLDEN HIGHWAY INTERSECTION
SIGHT DISTANCE CHECKS
STOPPING SIGHT DISTANCE
4 OF 4

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0305-INF-LS-SIGHT_SSD-04

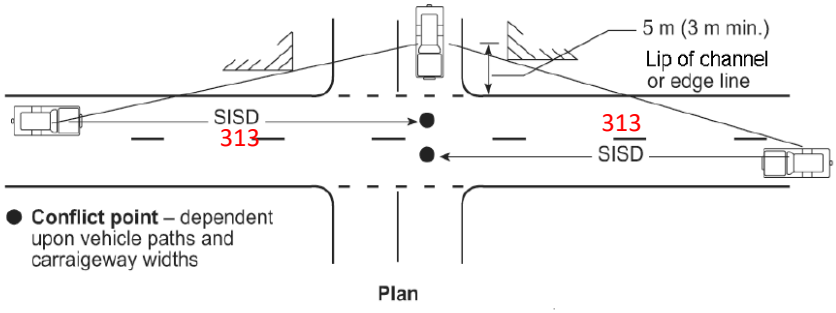
Appendix D Wollar Road / Ringwood Road intersection SISD checks

Safe Intersection Sight Distance (SISD) for Cars

Source: Austroads Guide to Road Design
Part: Part 4A: Unsignalised and Signalsied Intersections
Edition: February 2021
Section: 3.2.2 - Equation 2

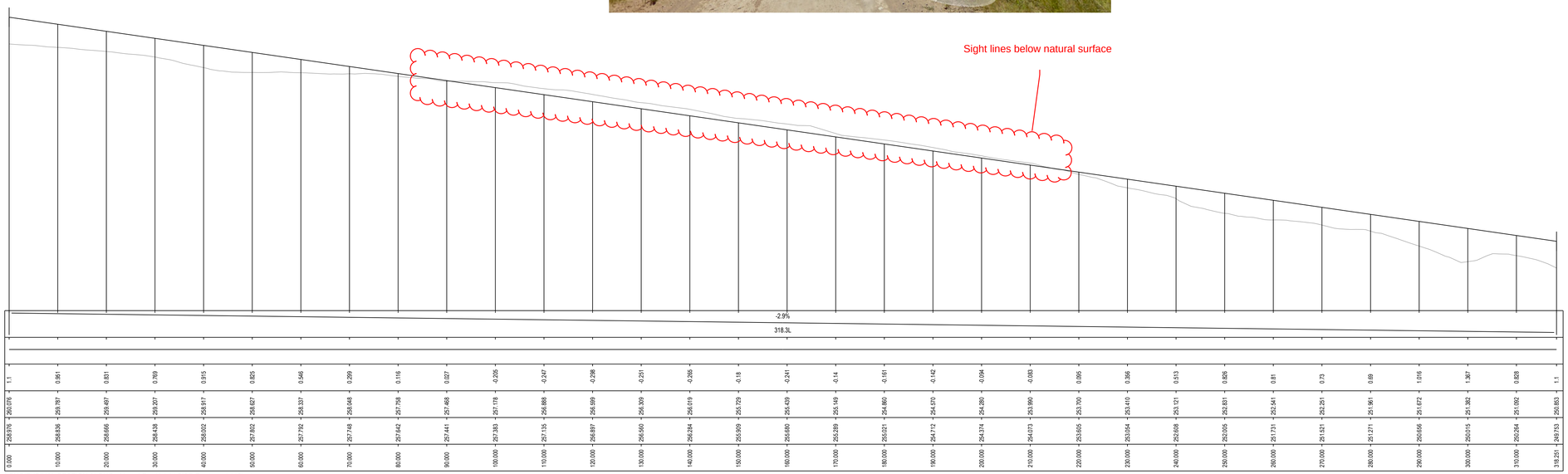
Summary of Outputs

Figure 3.2: Safe intersection sight distance (SISD)



Parameter Inputs				
Coefficient	*Value*	*Unit*	*Reference / Note*	
Driver Eye	1.1	m	Part 3: Section 3.2.2	
Target Eye	1.1	m	Part 3: Section 3.2.2	!Top of car
Rt	2.5	s	Part 3: Table 5.2	
V	110	km/h	Design speed of road	
d	0.36		Part 3: Table 5.3	
a	-3	%	Longitidunal grade	

Calculations				
Coefficient	*Value*	*Unit*	*Reference / Note*	
Dt	5.5	s	Part 4A: Equation 2	!Plus 3 seconds to Rt
SISD	313	m	Part 4A: Equation 2	!Rounded up to integer



LONGITUDINAL SECTION ALONG - Mutual Eye Height SISD Eastbound 110kmh

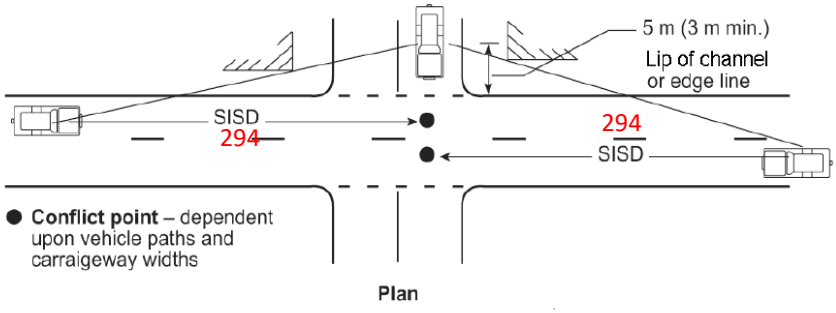
HORIZONTAL 1:500
VERTICAL 1:100

Safe Intersection Sight Distance (SISD) for Cars

Source: Austroads Guide to Road Design
Part: Part 4A: Unsignalised and Signalsied Intersections
Edition: February 2021
Section: 3.2.2 - Equation 2

Summary of Outputs

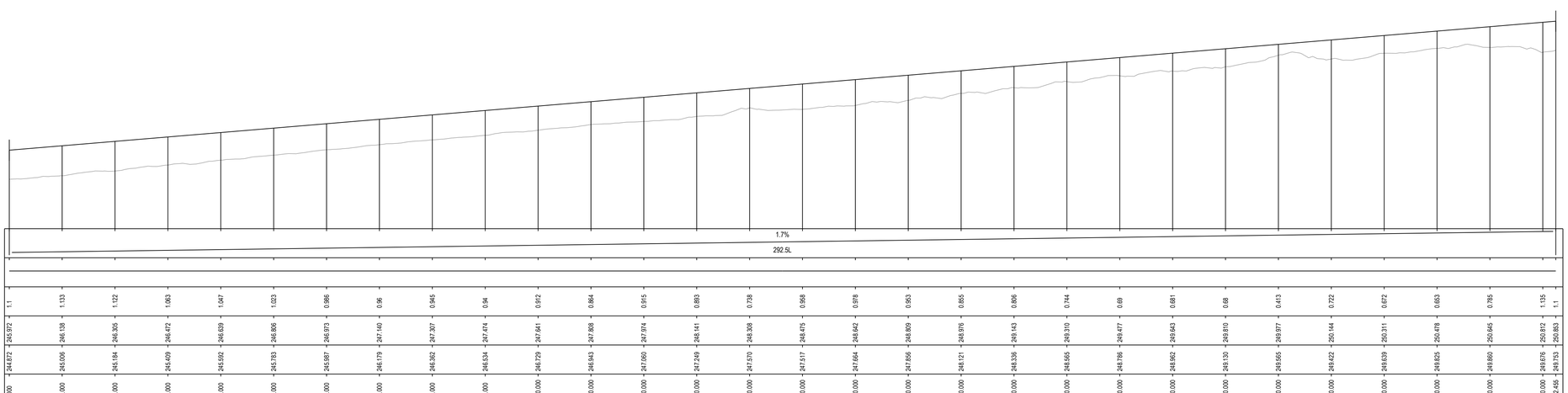
Figure 3.2: Safe intersection sight distance (SISD)



Plan

Parameter Inputs				
Coefficient	*Value*	*Unit*	*Reference / Note*	
Driver Eye	1.1	m	Part 3: Section 3.2.2	
Target Eye	1.1	m	Part 3: Section 3.2.2	!Top of car
Rt	2.5	s	Part 3: Table 5.2	
V	110	km/h	Design speed of road	
d	0.36		Part 3: Table 5.3	
a	2	%	Longitidunal grade	

Calculations				
Coefficient	*Value*	*Unit*	*Reference / Note*	
Dt	5.5	s	Part 4A: Equation 2	!Plus 3 seconds to Rt
SISD	294	m	Part 4A: Equation 2	!Rounded up to integer


1.7%
292.5L

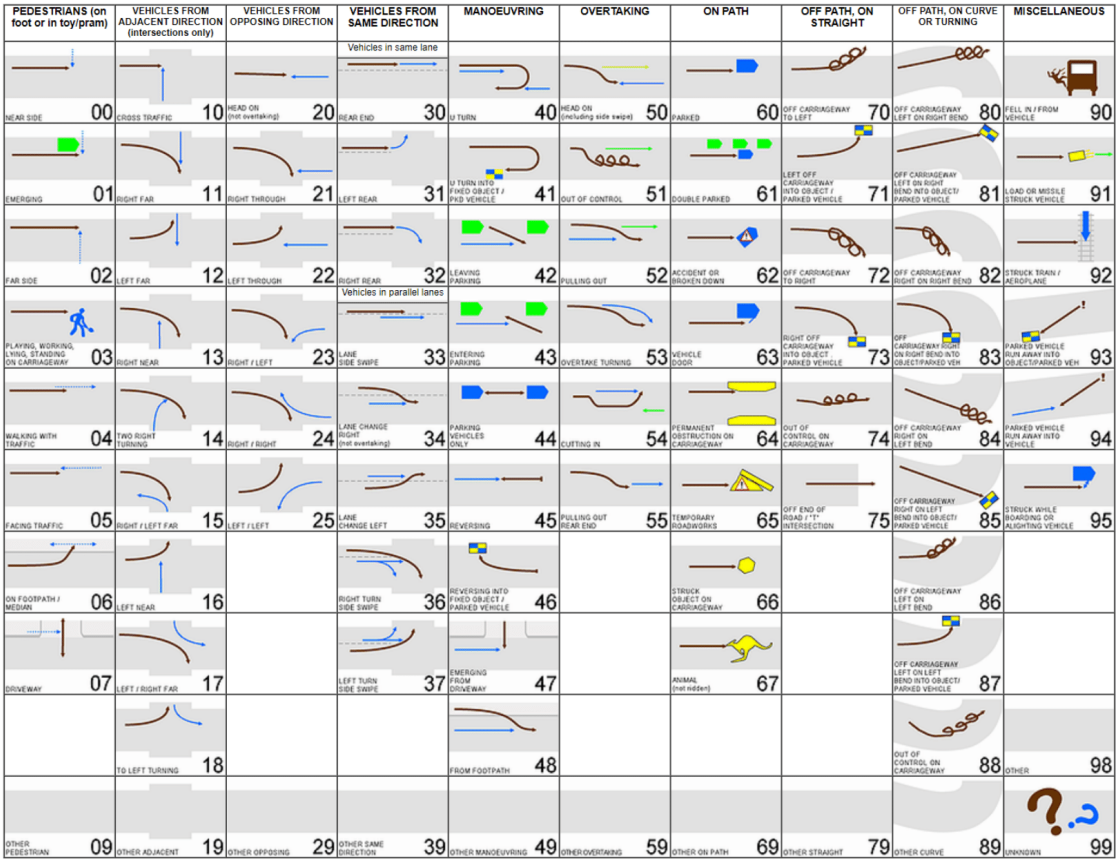
| | | |

Appendix E Crash history

Severity of crash	Year	Location	Town	RUM code
Fatal	2018	Cullingral Road 2.2km south of Golden Highway	Merriwa	87
	2021	Macartney Street at Old Scone Road	Merriwa	85
	2021	Golden Highway 200m west of Wyoming Road	Cassilis	20
	2022	Flaggs Road 100m north of house number 1246	Merriwa	85
Serious Injury	2018	Wollar Road 100m west of Ringwood Road	Wollar	88
	2018	Flaggs Road 3km south of Merriwa	Merriwa	80
	2018	Gooch Street 300m south of Glebe Street	Merriwa	75
	2018	Golden Highway 2km north of Flaggs Road	Gungal	20
	2019	Bylong Valley Way 8km east of Wollar Road	Murrumbo	85
	2019	Bylong Valley Way 8m north of Upper Bylong Road	Murrumbo	80
	2019	Bylong Valley Way 10.5km east of Wollar Road	Murrumbo	84
	2019	Bylong Valley Way 3.8km east of Wollar Road	Bylong	20
	2019	Golden Highway 160m west of Bow Street	Merriwa	81
	2020	Golden Highway 5km east of Westwood Road	Gungal	30
	2020	Golden Highway 1km east of Redwell Road	Merriwa	73
	2021	Golden Highway at Quigley Street	Merriwa	81
	2021	Golden Highway 5km west of Westwood Road	Merriwa	20
	2021	Cullingral Road 1km south of Golden Highway	Merriwa	71
	2022	Golden Highway at house number 5993	Merriwa	80
	2022	Golden Highway 10km west of Ringwood Road	Merriwa	71
	2022	Golden Highway at Brisbane Street	Merriwa	71
	2022	Golden Highway 1km west of Ringwood Road	Merriwa	87
	2022	Golden Highway 2km south of Westwood Road	Gungal	85
	2022	Golden Highway 1km east of Wyoming Road	Cassilis	70
Moderate Injury	2018	Bylong Valley Way 3km east of Wollar Road	Bylong	80
	2018	Golden Highway 10km east of Merriwa	Merriwa	81
	2018	Golden Highway 10km east of Merriwa	Merriwa	84
	2018	Hall Road 500m west of Flaggs Road	Merriwa	90
	2018	Golden Highway at house number 7675	Merriwa	71
	2018	Golden Highway 5km west of Glenroy Road	Merriwa	71
	2019	Golden Highway 2km west of Dunblane Road	Merriwa	81
	2019	Wollara Road 22.7km south of Golden Highway	Merriwa	80
	2019	Cullingral Road 3km north of Tunbridge Road	Merriwa	88
	2019	Golden Highway at Ulan Road	Cassilis	13
	2020	Flight Springs Road at house number 494	Merriwa	71
	2020	Golden Highway 200m east of Comialla Road	Cassilis	72
	2020	Golden Highway at Ulan Road	Cassilis	13
	2020	Golden Highway 1.3km west of Cornialla Road	Cassilis	88
	2021	Golden Highway 5km east of Merriwa	Merriwa	73
	2021	Golden Highway 5.5km east of Prices Lane	Merriwa	42
	2021	Golden Highway 1.3km east of Pembroke Road	Cassilis	30
	2022	Ringwood Road 1km west of Flight Springs Road	Merriwa	70
	2022	Bunnan Road 20km east of Coulsen Creek Road	Bunnan	67
	2022	Golden Highway 400m west of Forest Reserve Road	Merriwa	40
	2022	Golden Highway 200m east of Idaville Road	Merriwa	74

Minor / Other Injury	2020	Bylong Valley Way 10km east of Wollar Road	Murrumbo	67
	2020	Golden Highway 30km west of Merriwa	Cassilis	67
	2020	Vennacher Street at Hayes Street	Merriwa	71
Non-casualty (towaway)	2018	Bylong Valley Way 400m east of Wollar Road	Bylong	71
	2018	Bylong Valley Way 4.9km east of Wollar Road	Bylong	84
	2018	Scone Road 2km east of Coulsons Creek Road	Merriwa	67
	2018	Golden Highway 1km west of Pembroke Road	Cassilis	71
	2018	Golden Highway 280m east of Ulan Road	Cassilis	87
	2019	Bylong Valley Way 20km north of Lee Creek Road	Bylong	84
	2019	Bunnan Road 18km north of Coulsen Creek Road	Bunnan	67
	2019	Golden Highway 260m east of Ulan Road	Cassilis	85
	2020	Golden Highway 300m north of Flaggs Road	Gungal	73
	2020	Golden Highway 300m east of Lowlers Lane	Merriwa	71
	2020	Golden Highway 1km west of Cullingral Road	Merriwa	74
	2021	Ulan Road 700m south of Golden Highway	Cassilis	85
	2021	Golden Highway 4km west of Cassilis Road	Cassilis	81
	2021	Golden Highway at house number 8661	Cassilis	88
	2021	Golden Highway 2km north of Westwood Road	Gungal	67
	2021	Golden Highway 4.3km north of Flaggs Road	Gungal	85
	2021	Golden Highway 2.8km west of Redwell Road	Merriwa	86
	2022	Ringwood Road 5km west of Golden Highway	Merriwa	81
	2022	Golden Highway 2km west of Ringwood Road	Merriwa	87
	2022	Golden Highway 10km west of Bow Street	Merriwa	74
	2022	Golden Highway 1.7km west of Westwood Road	Gungal	20
	2022	Golden Highway 20km west of Merriwa	Merriwa	52

RUM code table



Appendix F OSOM vehicle checks

HARRYAN
ENGINEERING COUNSULTING

CLIENT:
lightsource bp

DATE:	REVISION:	DESCRIPTION:
09.02.2023	0	CLIENT REVIEW

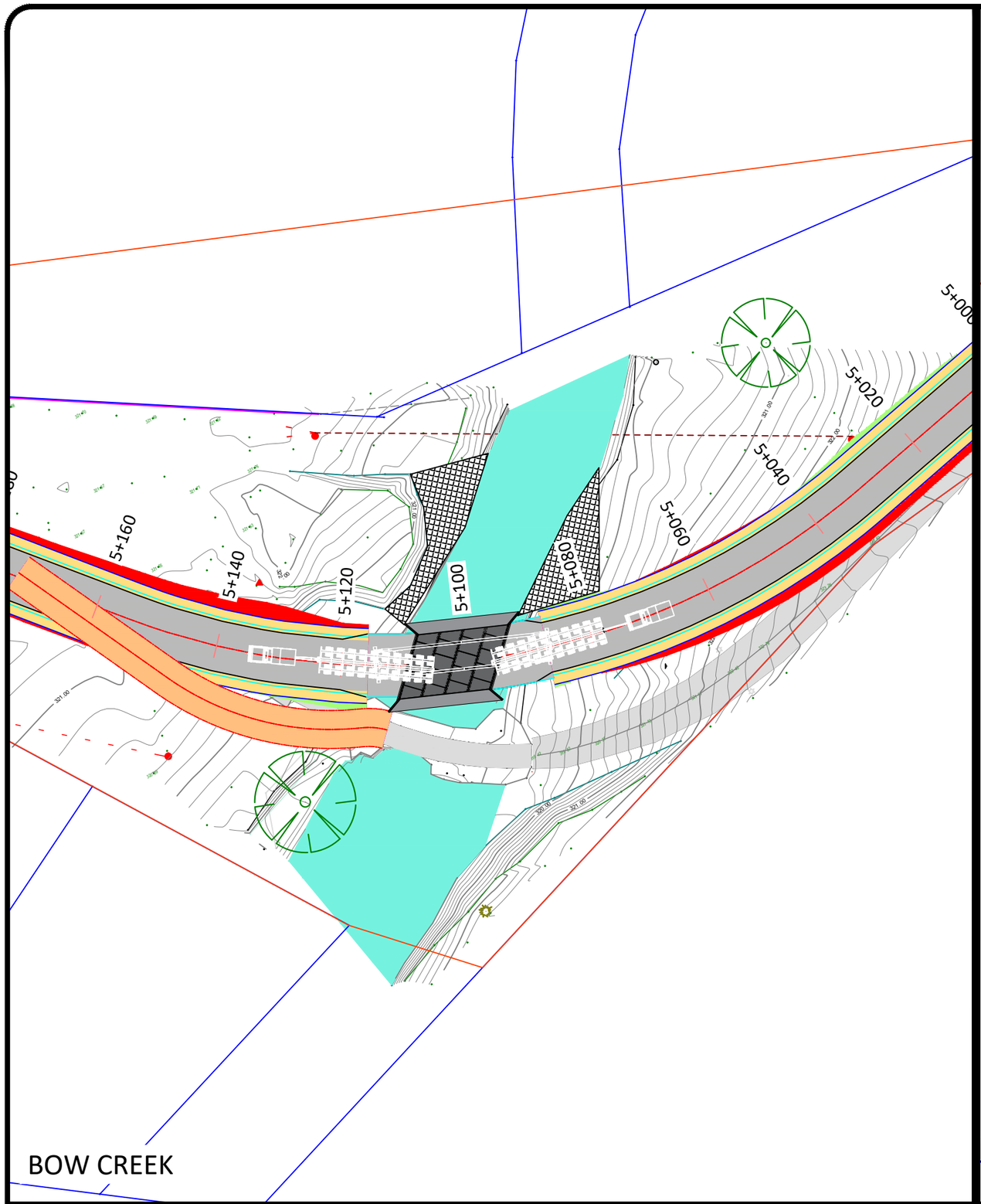
PROJECT:
RINGWOOD ROAD UPGRADE

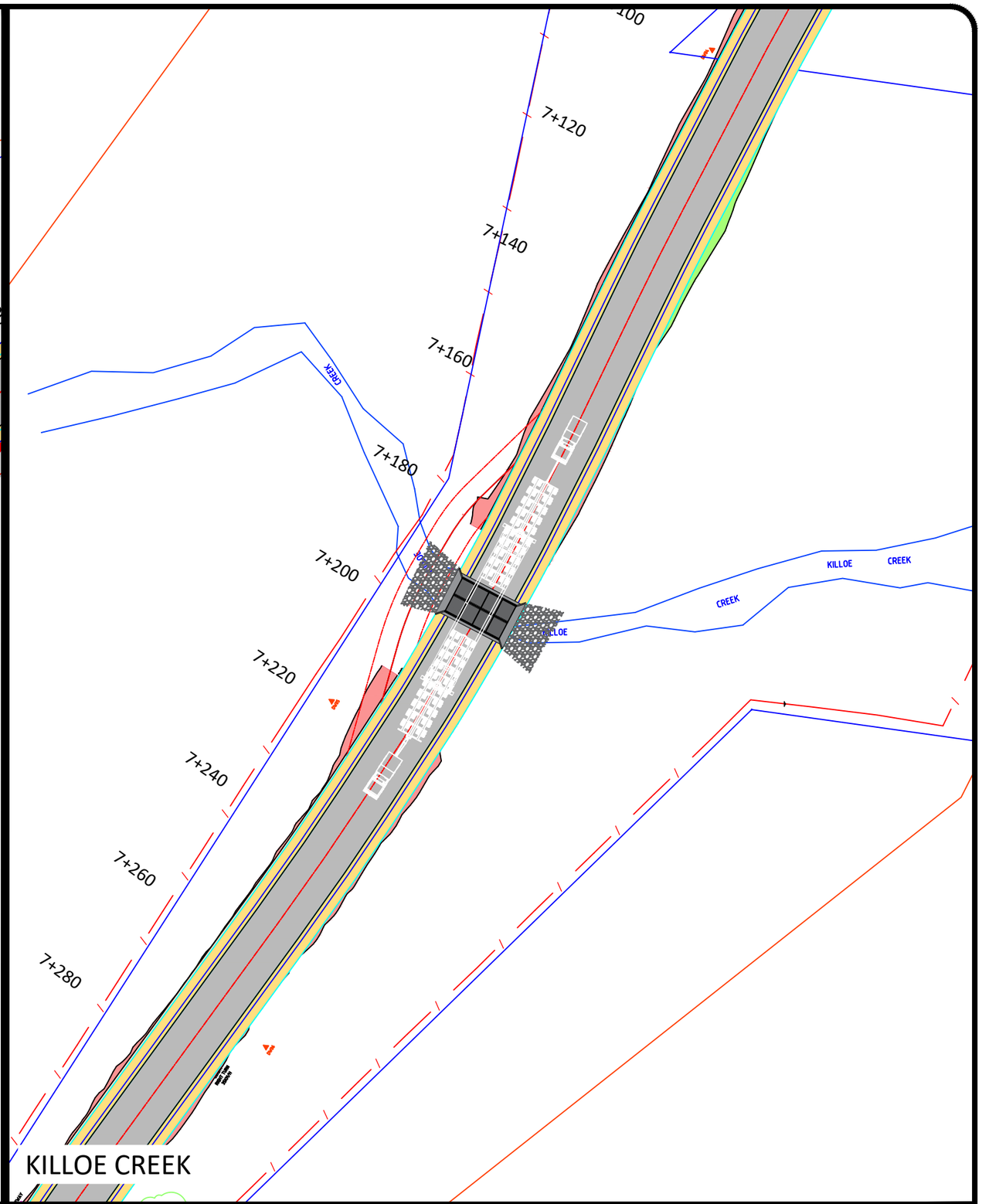
DRAWING TITLE:
SWEPTH PATHS

ISSUE STATUS:
CLIENT REVIEW

SCALE: 1:750 @ A3
DWG No: HEC22_
JOB No: 22Q3J3
COORDINATE SYSTEM: MGA ZONE 56 GDA 2020
DATUM: AHD

SURVEYED: OTHERS
DESIGNED: RS
DRAWN: RJ
SHEET: 1
REV: 0





HARRYAN
ENGINEERING COUNSULTING

CLIENT:
lightsource bp

DATE:	REVISION:	DESCRIPTION:
09.02.2023	0	CLIENT REVIEW

PROJECT:
RINGWOOD ROAD UPGRADE

DRAWING TITLE:
SWEPTH PATHS

ISSUE STATUS:
CLIENT REVIEW

SCALE: 1:750 @ A3
SURVEYED: OTHERS
DWG No: HEC22_
JOB No: 22Q3J3
DESIGNED: RS
DRAWN: RJ
COORDINATE SYSTEM: MGA ZONE 56 GDA 2020
DATUM: AHD
SHEET: 2
REV: 0

Appendix G OSOM Transport Management Plan for Avonlea Solar Farm

REX J ANDREWS
ENGINEERED TRANSPORTATION

TRANSPORT MANAGEMENT PLAN

CLIENT: DEUGRO

PROJECT: AVONLEA SOLAR FARM

PORT OF IMPORT: MAYFIELD #4 BERTH NEWCASTLE

DELIVERY POINT: MUNTZ ROAD SANDIGO

22/03/2022 REV 02

Rev.	Date	Change	Responsible	Checked
00	24/01/22	Route Assessed	C Ewin	✓
00	14/02/22	Report compiled	W Andrews	✓
00	21/02/22	Report completed	W Andrews	✓
01	22/02/22	Edits.	W Andrews	✓
02	22/03/22	Updated route at Parkes	W Andrews	✓

Index:

INDEX: 2

INDEX: 2

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2.0 EVALUATION 4
3.0 PROJECT DATA. 5
5.0 TRANSPORT ROUTE 8
6.0 TRANSPORT CONDITIONS 9
7.0 FATIGUE SCHEDULING: 10
8.0 TRANSPORT APPROVALS REQUIRED 12
9.0 TRAVEL DATES 13
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1.0 Introduction

This document describes observations and previous experience on route and explains the Transport of a Transformer from Mayfield, NSW to Sandigo NSW.

This Route study took place on 24.01.22

2.0 Evaluation

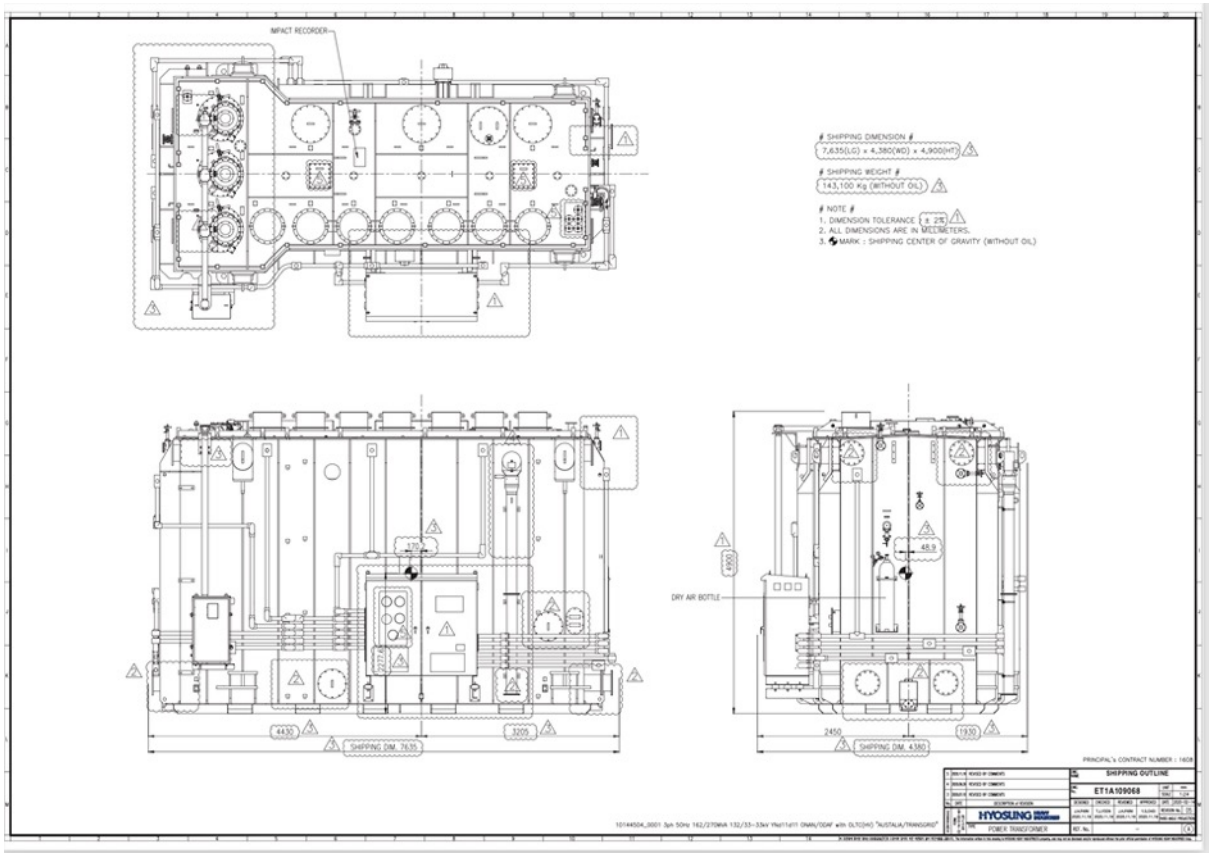
1	No Cost
2	Some Work
3	Urgent Modification
4	Extreme Amount of Work

(Mark below boxes with an X)

		1	2	3	4
A	Harbour	**N/A**			
B	Road Modification	**X**			
C	Road Furnishings	**X**			
D	Trees		**X**		
E	Site Entrance	**X**			
F	Bridge Calculations		**X**		
G	Traffic Control		**X**		

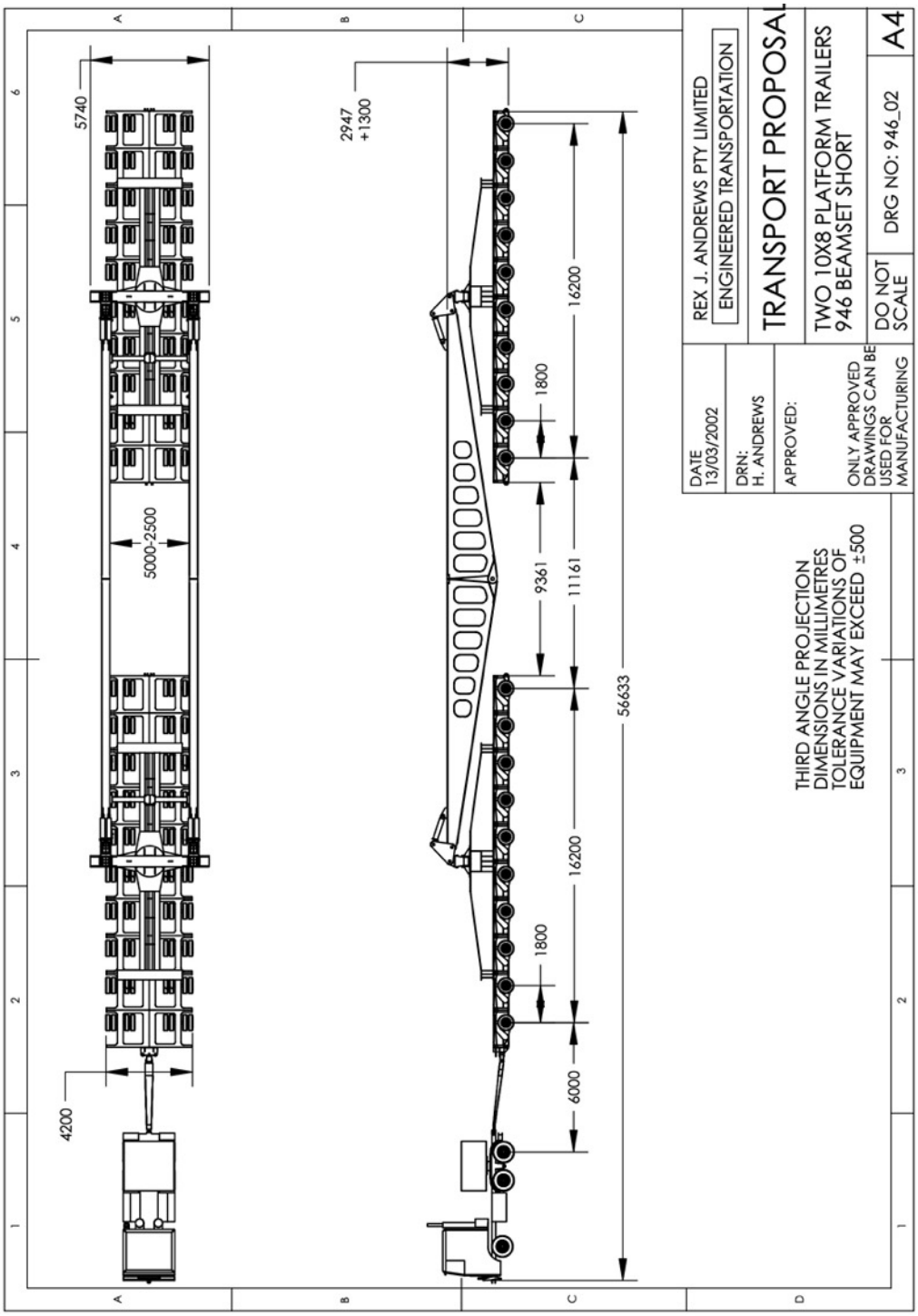
3.0 Project data.

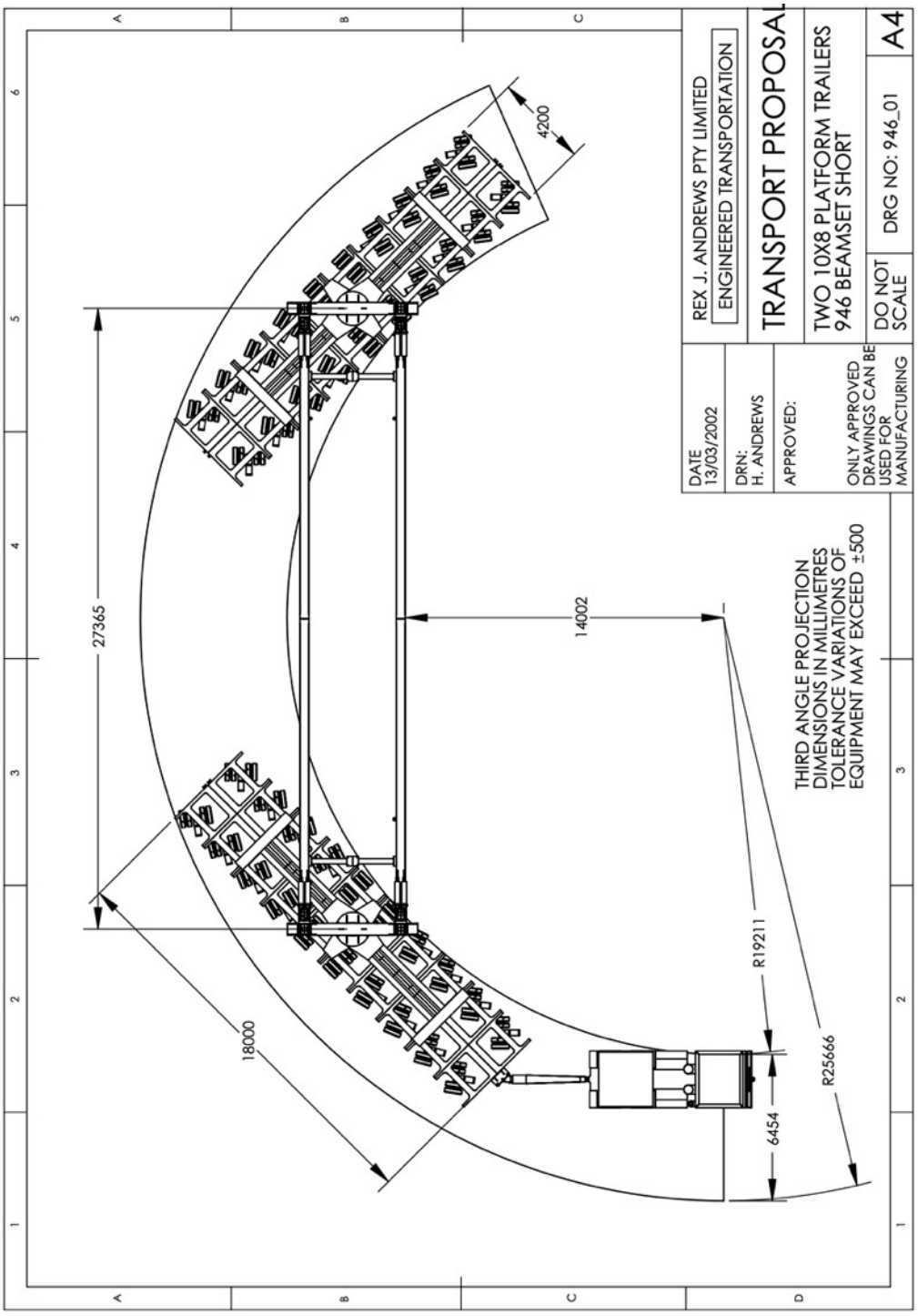
Date of latest Route Study. 24/01/22
Survey undertaken by. (Rex J Andrews P/L)
Project name. Avonleigh Solar Farm
Route. Mayfield NSW to Sandigo NSW Australia
Transformer dimensions: 7.8l x 4.4w x 4.9h x 143.0T



Transport combination type: 4 x block trucks with 10x8-10x8 Beamset
Transport combination tare weight: 216.5T
Transport combination overall dimensions:
110 long x 6.5 wide x 5.6 high x 359.0 Ton

4.0 Transport Drawing.




REX J. ANDREWS PTY LIMITED
ENGINEERED TRANSPORTATION
TRANSPORT PROPOSAL
TWO 10X8 PLATFORM TRAILERS
946 BEAMSET SHORT
DO NOT SCALE
DRG NO: 946_01
A4
DATE 13/03/2002
DRN: H. ANDREWS
APPROVED:
ONLY APPROVED DRAWINGS CAN BE USED FOR MANUFACTURING
THIRD ANGLE PROJECTION
DIMENSIONS IN MILLIMETRES
TOLERANCE VARIATIONS OF EQUIPMENT MAY EXCEED ±500
4200
27365
14002
18000
R19211
R25666
6454

5.0 Transport Route.

ROUTE: Newcastle Port (Mayfield #4 berth) to Sandigo, 823.0 kilometres:

This route took us via Selwyn street, George Street, Industrial Drive, Maitland Road, New England Highway, John Renshaw Drive, Hunter Expressway, New England Highway, Golden Highway, Boothenba Road,Troy Bridge Road, Bunglegumbie Road, Mitchell Highway, Manildra Street, Derribong Avenue, Algalah Street, Tomingley Road, Newell Highway, Thomas Street, Moulden Street,Back Trundle Road, Ross Road, Henry Parkes Way, Westlime Road, Hartigan Avenue, Newell Highway, Compton Road, Showground Road, Newell Highway, Sturt Highway, Sandigo Road, Muntz Road.

GPS LINK: https://goo.gl/maps/Vwd1QXaorcU3KMkX6

6.0 Transport conditions

The following are the conditions and pinch points for this route:

- No unnecessary noise to be made before 7.00am.
- A prestart meeting to be held between the truck drivers, Pilots & Police before load departs.
- If for any reason communications fail between any of the pilot, escort of load vehicle occurs, the load is to cease until such time as it can be re-established.
- Load is to travel in the Newcastle and Sydney Metro between 10.00pm and 5.00am weekdays, and 10.00pm and 8.00am weekends. public holiday period.
- Load is to travel in rural areas in daylight hours only.
- Load will require a minimum 2 x police escort & 4 x Company Pilots.
- Client to give adequate access for load to access Avonleigh Solar farm.
- Roadwork's to be checked with RMS 7 days prior to leaving and relayed to client with any potential problems.
- Load to travel at an average speed of 20 km p/hr. However, the load will slow down for bridge crossings, corners and inclines/declines.
- Portable VMS board to travel with the load.
- Load to traverse bridge structures as per TfNSW bridge investigation report.
- Permits/Approval letters from state government authorities to access their networks on this route are to be carried with load.
- Permits/Approval letter from Local councils to access their networks on this route are to be carried with load.
- Permits/Approval letter from Electrical/Communication authorities to pass under their networks on this route are to be carried with load.

7.0 Fatigue scheduling:

REX J ANDREWS PTY LTD
ENGINEERED TRANSPORTATION

Sydney
PO Box 271, Penrith NSW 2751
Ph: 02 4721 7633 Fx: 02 47217644
Em: sydney@rja.com.au

Adelaide
PO Box 6072, Burton SA 5110
Ph: 08 8280 5541 Fx: 08 8280 8365
Em: adelaide@rja.com.au

Newcastle
16 Yilen Close, Beresfield NSW 2322
Ph: 02 4966 1788 Fx: 02 4966 1744
Em: newcastle@rja.com.au

Trip Schedule

Schedule Details Avonleigh Solar Project
Transportation of a power transformer in a beamset

Sch No SCH02274
Date 21/02/2022 1:28:12 pm
Written By Warrick Andrews
Consulted Carl Andrews

Schedule Notes:
-This Schedule has been written based on values known at the time for good driving conditions and no known fatigue related issues prior to starting the trip.
- Do not drive to the schedule if you fell tired. Stop revive survive
- No attempt should be made to make up for lost time on a schedule.
- Please modify all times according to your real start time.
- You must still fill in your Logbook, exactly as the hours you have worked.

Please work with the Scheduler who wrote this to make the schedule better for all.

Start	End	Hr	Day	Km	avg	Type	Location	Notes
0:15am	0:30am	0.25	1	0	0	Working	Mayfield	Toolbox and prestart
0:30am	5:30am	5.00	1	103	21	Driving	Mayfield to Warkworth	Loaded travel
5:30am	6:00am	0.50	1	0	0	Paid Rest	Warkworth	30 Minute rest break
6:00am	11:00am	5.00	1	94	19	Driving	Warkworth to Merriwa	Loaded travel
11:00am	11:59pm	12.98	1	0	0	Rest	Merriwa	Minimum 7 hour rest break
12:00am	5:45am	5.75	2	0	0	Rest	Merriwa	Minimum 7 hour rest break
5:45am	6:00am	0.25	2	0	0	Working	Merriwa	Toolbox and prestart
6:00am	11:00am	5.00	2	109	22	Driving	Merriwa to Dunedoo	Loaded travel
11:00am	11:30am	0.50	2	0	0	Paid Rest	Dunedoo	30 Minute rest break
11:30am	4:30pm	5.00	2	117	23	Driving	Dunedoo to Narromine	Loaded travel
4:30pm	11:59pm	7.48	2	0	0	Rest	Narromine	Minimum 7 hour rest break
12:00am	5:45am	5.75	3	0	0	Rest	Narromine	Minimum 7 hour rest break
5:45am	6:00am	0.25	3	0	0	Working	Narromine	Toolbox and prestart
6:00am	11:00am	5.00	3	112	22	Driving	Narromine to Parkes	Loaded travel
11:00am	11:30am	0.50	3	0	0	Paid Rest	Parkes	30 Minute rest break
11:30am	4:30pm	5.00	3	129	26	Driving	Parkes to West Wyalong	Loaded travel
4:30pm	11:59pm	7.48	3	0	0	Rest	West Wyalong	Minimum 7 hour rest break

Form A013 Schedule Report / Rex J Andrews Pty Ltd , Page 1
UNCONTROLLED COPY Downloaded from Asset Database by Warrick on 21/2/2022

Sydney
PO Box 271, Penrith NSW 2751
Ph: 02 4721 7633 Fx: 02 47217644
Em: sydney@rja.com.au

Adelaide
PO Box 6072, Burton SA 5110
Ph: 08 8280 5541 Fx: 08 8280 8365
Em: adelaide@rja.com.au

Newcastle
16 Yilen Close, Beresfield NSW 2322
Ph: 02 4966 1788 Fx: 02 4966 1744
Em: newcastle@rja.com.au

Trip Schedule

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Transportation of a power transformer in a beamset

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- Do not drive to the schedule if you fell tired. Stop revive survive
- No attempt should be made to make up for lost time on a schedule.
- Please modify all times according to your real start time.
- You must still fill in your Logbook, exactly as the hours you have worked.

Please work with the Scheduler who wrote this to make the schedule better for all.

Start	End	Hr	Day	Km	avg	Type	Location	Notes
12:00am	5:45am	5.75	4	0	0	Rest	West Wyalong	Minimum 7 hour rest break
5:45am	6:00am	0.25	4	0	0	Working	West Wyalong	Toolbox and prestart
6:00am	11:00am	5.00	4	125	25	Driving	West Wyalong to Grong Grong	Loaded travel
11:00am	11:30am	0.50	4	0	0	Paid Rest	Grong Grong	30 Minute rest break
11:30am	4:30pm	5.00	4	39	8	Driving	Grong Grong To Sandigo	Loaded travel
4:30pm	11:59pm	7.48	4	0	0	Rest		

8.0 Transport approvals required

Approvals will need to be sought from the following departments.

- NHVR
- TfNSW
- TMC
- NSW Police
- ARTC
- Local councils
- Power service providers
- Telstra

\

9.0 Travel dates

TBC, Likely Q3 2022

10.0 Managing queued traffic behind the load.

During the journey the interaction with other road users will require management of queued traffic.

The protocol to provide queued traffic an opportunity to pass the load will be reliant on the rear pilot constantly monitoring the queue of traffic and relaying this information back to the convoy, the lead pilot / Police in conjunction with the driver will identify suitable areas that allow a safe passing point for the passing vehicles.

The lead escort / Police escort will also determine safe areas to halt the load to allow backed up vehicles to pass. Safe pull over areas can include turn off into Private Roads and/or other roads, pull over on the shoulder during over taking lanes, designated pull over/ rest stop areas or service stations, these areas will be a hardstand area, or an area wide enough for the escort to direct vehicles around the combination.

The load MUST pull over or slow to allow the backed-up vehicles to pass. Rear pilot will inform all other pilots and driver when there has been a lag from last pull over and if other cars have been following for a short distance, in this instance apply the passing protocol again, this will continue throughout the journey as required to ensure queued traffic do not experience excessive delays. The driver and pilots will also allow vehicles to pass at any opportunity that allows a safe area for this vehicle and its load to pull over safely and will.

11.0 Interacting with roadwork:

Roadworks to be checked prior to load departing. TfNSW/TMC will provide RJA with a list of conflicts. RJA will contact each of these conflicts and seek approval to pass through their workzone.

The lead pilot will make contact with the road crews to advise of the nature of the load, size, dimensions, to establish if the load is ok to enter the work zone.

In this instance the convoy will work with all reasonable instructions from the road crew to coordinate the safe passage of the load through the affected areas.

Pilots, Police and local traffic controllers will work together to facilitate the necessary actions required to travel through the work zone.

12.0 Emergency Contacts & plans.

1st Point of contact: RJA Operations 0247217633
2nd Point of contact: Rex J Andrews's supervisor 24 hrs. (Carl Andrews 0419219890)

STANDARD EMERGENCY NUMBERS IF REQUIRED

- Main Emergency number (000)
- NSW Traffic Operations (02 88821219)
- TMC Operations room (1800 679782) or (1300725886)
- Essential Energy (132080)
- Ausgrid (131388)
- GRS Towing 1300 550 600

- In the event of an emergency situation, such as breakdown, the load will be moved to the left-hand lane/shoulder to ensure minimal traffic impacts; police and pilots (Under the direction of the police) will manage traffic flow. In such instances the TMC should be promptly advised so that all necessary warnings can be made.
- Where a tow is required, the trailer will be unhooked from the prime mover and a standby truck be called. In such instances the TMC should be promptly advised so that all necessary warnings can be made.
- If police decide that the movement should be suspended as a result of time or potential traffic impacts the trailer with the load will be moved to a safe parking location and the TMC will be notified.
- In the event of bad weather, the driver is to notify the first point of contact before departing.
- If the road is blocked between the pickup location and drop off location, then the load is not to depart.
- Roadwork's to be checked with TfNSW 2 days prior to leaving and relayed to client with any potential problems.
- Route to be checked with Live Traffic and TMC 2 days before travel and on the night of travel before departure

13.0 Emergency stopping / pulling up for rest areas:

In the event of an emergency or scheduled rest break, establish positive communications with all pilots and driver and identify the next suitable area to halt the load, rear pilot should remain 200 metres behind the load to warn approaching traffic.

Ensure the load is as far to the left as possible so as to not impede any traffic from passing.

If the breakdown is major and requires a mechanic to attend contact the TMC and advise them of the disruption to traffic. Minor repairs that can be rectified in a short time do not require the TMC to be advised.

In the event that road works are encountered on route lead pilot is to call in on the nominated UHF channel and advise the local traffic control of the inbound load and await approval to enter the work zone.

Follow normal traffic management procedures as out lined in: SOP_030 Traffic Management Procedures.

The suggested rest areas are an indication only and dependant on the local traffic movements and occupancy of these rest areas it may not be possible to get off the road.

In this instance the lead pilot should travel ahead to identify the next suitable area.

This methodology can also be adopted to allow built up traffic to pass by slowing the load down and easing into break down areas to allow traffic to pass before continuing on.

Listed in the index are Emergency parking areas on route.

14.0 Transport plan & pinch points: Newcastle Port to Sandigo

This route took us via: Selwyn street, George Street, Industrial Drive, Maitland Road, U-Turn at Old Maitland Road, Maitland Road, Newcastle Inner City Bypass, Newcastle Road, Thomas Street, Newcastle Link Road, Hunter Expressway, New England Highway, Golden Highway, Boothenba Road,Troy Bridge Road, Bunglegumbie Road, Mitchell Highway, Manildra Street, Derribong Avenue, Algalah Street, Tomingley Road, Newell Highway, Thomas Street, Moulden Street, Back Trundle Road, Ross Road, Henry Parkes Way, Westlime Road, Hartigan Avenue, Newell Highway, Compton Road, Showground Road, Newell Highway, Sturt Highway, Sandigo Road, Muntz Road.

Distance: 828 Kilometres

GPS Link: https://goo.gl/maps/Vwd1QXaorcU3KMkX6

KEY	
CRITICAL	
CAUTION	
EMERGENCY PARKING	

KM index	Location	Section of road	Current clearance	Procedure	Notes
0.0	Mayfield	Mayfield #4 berth onto Selwyn Street GPS link: https://goo.gl/maps/afLwPYKuNdm	Length: 70.0 metres Width: 8.5 metres Height: N/A	Right hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
0.4	Mayfield	Selwyn Street rail crossing GPS link: https://goo.gl/maps/AmohE54hKSz	Width: 9.0 metres	Travel directly ahead	Loads to travel over the crossing in the center of the road. Approval required crossing this line, likely cross with caution.
1.3	Mayfield	Selwyn Street onto Industrial Drive via George Street GPS link: https://goo.gl/maps/gXeHvBtCp4D2	Length: 70.0 metres Width: 9.0 metres Height: N/A	Right hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
5.5	Mayfield West	Industrial Drive onto Maitland Road GPS link: https://goo.gl/maps/Kn49dhWG2qG2	Length: 50.0 metres Width: 9.0 metres Height: 5.8	Right hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
8.0	Sandgate	Maitland Road U-turn procedure at Inner City Bypass intersection GPS link: https://goo.gl/maps/meQGKpGdRuvCTPgr7	Length: 80.0 metres Width: 10.0 metres Height: N/A	Travel to the incorrect side of the road.	Load is to cross to incorrect side (Southbound lanes) of Maitland Road at the intersection of the Inner-City Bypass. Then travel on the incorrect side (Southbound Lanes) of Maitland road through to Old Maitland Road. Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
8.4	Sandgate	Maitland Road onto Old Maitland Road GPS link: https://goo.gl/maps/RGSB79x8xbvj4wqe6	Length: 50.0 metres Width: 7.0 metres Height: N/A	Left hand turn	Load is to turn from the southbound lanes on Maitland Road into Old Maitland Road. Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.

KM index	Location	Section of road	Current clearance	Procedure	Notes
8.5	Sandgate	Old Maitland Road onto Maitland Road GPS link: https://goo.gl/maps/MHtTKSrgbtgGC4T37	Length: 50.0 metres Width: 7.0 metres Height: N/A	Reverse back onto Maitland Road	The load is to reverse back onto the Southbound lanes of Maitland Road, before travelling south on the correct side of Maitland Road towards the Inner-City bypass. Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
9.0	Sandgate	Maitland Road onto Newcastle Inner City bypass GPS link: https://goo.gl/maps/WR97pBUPiG7ULd757	Length: 80.0 metres Width: 10.0 metres Height: N/A	Right hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
9.0 to 14.0	Sandgate to Jesmond	Newcastle Inner City bypass GPS link: https://goo.gl/maps/ieyMJatCTV5NHUHK7	HEIGHT: 5.45 metres	Travel directly ahead	The Newcastle inner city bypass has 4 structures that the load will travel under. The lowest of these is Janet street which has a clearance of 5.45 metres in the left lane, and 5.7 metres in the right lane.
14.0	Jesmond	Newcastle Inner City bypass onto Newcastle Road GPS link: https://goo.gl/maps/1MUmyjNyydDakRZx6	Length: 80.0 metres Width: 10.0 metres Height: N/A	Right hand turn at the roundabout before taking the second exit onto Newcastle Road	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
15.5	Wallsend	Newcastle Road onto the Thomas Street GPS link: https://goo.gl/maps/1DCZxPpZT41RFd8w7	Length: 60.0 metres Width: 7.0 metres Height: N/A	Left hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
16.5	Wallsend	Thomas Street onto Newcastle Link Road GPS link: https://goo.gl/maps/J6kSa2e99L5gMxbD8	Length: 100.0 metres Width: 12.0 metres Height: N/A	Travel directly ahead	No problems with this section of road.
19.0	Wallsend	Newcastle Link Road at Transfield Avenue GPS link: https://goo.gl/maps/noHnEkQTa641xHT49	Length: 60.0 metres Width: 9.0 metres Height: N/A	Travel directly ahead through the roundabout	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
21.0	Cameron Park	Newcastle Link Road at Minmi Road GPS link: https://goo.gl/maps/bPWYt3pzVRyWd7QeA	Length: 60.0 metres Width: 9.0 metres Height: N/A	Travel directly ahead through the roundabout	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.

KM index	Location	Section of road	Current clearance	Procedure	Notes
23.0	Cameron Park	Newcastle Link Road onto the Hunter Expressway GPS link: https://goo.gl/maps/WNCELytZxc2hV7YR7	Length: 80.0 metres Width: 7.0 metres Height: N/A	Travel directly ahead	No problems with this section of road.
64.0	Branxton	The Hunter Expressway onto The New England Highway https://goo.gl/maps/7rauNuxzqjq	Length: 100.0 Mtrs Width: 12.0 Mtrs	Travel directly ahead	No problems with this section of road.
72.0	Whittingham	The New England Highway onto the Golden Highway https://goo.gl/maps/nAnfkYfeUn42	Length: 70.0 Mtrs Width: 8.0 Mtrs	Left Hand turn	The NSW Government is currently upgrading this intersection. At this stage the data that is available for the upgrades shows that the section of road that we would need to access does not change considerably. However, it is recommended that you monitor the progress of the upgrades, and that any changes are thoroughly looked at.
72.1	Whittingham	Golden Highway https://goo.gl/maps/R86RFuPnmFU2	115.0 x 9.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
73.0	Whittingham	Golden Highway over rail bridge https://goo.gl/maps/5NwDQofandvvMKfY9	Length: 90 metres Width: 9.0 Metres	Travel directly ahead in the centre of the road.	Approval from Rail company required to cross this structure. Travel over this structure may have specific conditions.
82.3	Mount Thorley	Golden Highway over rail bridge https://goo.gl/maps/qTxSbkxPu87L5hx4A	Length: 90 metres Width: 9.0 Metres	Travel directly ahead in the centre of the road.	Approval from Rail company required to cross this structure. Travel over this structure may have specific conditions.
82.4	Whittingham	Golden Highway intersection with the Putty Road https://goo.gl/maps/7hQdEmK1EgE2	Length: 65 metres Width: 6.0 Metres	Left hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
82.5	Mount Thorley	Golden Highway https://goo.gl/maps/zGvdupDuixx	100.0 x 10.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
85.6	Mount Thorley	Golden Highway over rail bridge https://goo.gl/maps/ipGU4USXmWZ8GkJs6	Length: 90 metres Width: 9.0 Metres Height: 5.2 metres	Travel directly ahead in the centre of the road.	Approval from Rail company required to cross this structure. Travel over this structure may have specific conditions.
85.8	Mount Thorley	Golden Highway intersection with the Putty Road https://goo.gl/maps/QS9quvSyHYWaFHoX9	Length: 45 metres Width: 6.0 Metres	Right hand turn	Loads to turn onto the incorrect side of the Golden Highway, and travel on the incorrect side for 300 metres. Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.

KM index	Location	Section of road	Current clearance	Procedure	Notes
103.0	Warkworth	Golden Highway https://goo.gl/maps/Y6V6EXaCwxq	100.0 x 8.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
112.0	Jerrys Plains	Golden Highway through Jerrys Plains village https://goo.gl/maps/WgSCRsJ9ZGt	Length: 60 metres Width: 6.0 Metres	Left hand than right hand turn	No problems with this section of road.
131.0	Ogilvy	Golden Highway https://goo.gl/maps/58Tj9ojs7CC2	6% gradient	Travel directly ahead	This section of road has a steep mountain range that will require additional pull trucks to assists loads that exceed 80T gross weight. Additionally, the NSW Government is currently upgrading this section of road. It is recommended that you monitor the progress of the upgrades, and that any changes are thoroughly looked at.
137.0	Denman	Golden Highway at Denman Road https://goo.gl/maps/sf4PNnycxB32	Length: 55 metres Width: 6.0 Metres	Left hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
138.0	Denman	Golden Highway over Denman Bridge GPS link: https://goo.gl/maps/UToXyFe3QKu	5.7 Metres height clearance 6.9 Metres width clearance	Travel directly ahead in the centre of the lane	A width of 6.5 metres and a height of 5.5 metres should not be exceeded of this structure. Load to be lowered to 5.5 metres before travelling over this structure.
158.0	Sandy Hollow	Golden highway https://goo.gl/maps/2THBuV165xx	50.0 x 4.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
159.0	Sandy Hollow	Golden Highway under safety Cam https://goo.gl/maps/b7t9zH2ankJcvWpT6	Height: Left: 6.3 metres	Travel directly ahead on the correct side	No problems with this section of road.
170.0	Gungal	Golden highway https://goo.gl/maps/WDoL2LfeCoP2	70.0 x 6.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
187.0	Merriwa	Golden Highway under safety Cam https://goo.gl/maps/D92rzQ8vnUcYsqj56	Height: Right: 6.4 metres	Travel directly ahead on the correct side	No problems with this section of road.
197.0	Merriwa	Golden highway https://goo.gl/maps/NqrWzTsRmnt	100.0 x 5.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
247.0	Cassilis	Golden highway https://goo.gl/maps/vs6YMT6TxCA2	200.0 x 8.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
273.0	Leadville	Golden highway https://goo.gl/maps/ujxMGukhopeFWRhb8	200.0 x 8.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
306.0	Dunedoo	Golden Highway over rail crossing https://goo.gl/maps/wsyNKfcoAij3SosY9	Length: 90 metres Width: 7.0 Metres	Travel directly ahead	Loads to travel over the crossing in the center of the road. Approval required crossing this line, likely cross with caution.

KM index	Location	Section of road	Current clearance	Procedure	Notes
306.1	Dunedoo	Golden Highway intersection with Wargundy Street https://goo.gl/maps/WzACUHey3jYadj1K7	Length: 60 metres Width: 6.0 Metres	Right hand bend	No problems with this section of road.
357.0	Ballimore	Golden Highway https://goo.gl/maps/RuKKrfHarw1Mjy5E9	150.0 x 8.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
365.0	Ballimore	Golden Highway over rail crossing https://goo.gl/maps/yb15Kz6R2r3E69fj6	Length: 90 metres Width: 7.0 Metres	Travel directly ahead	Loads to travel over the crossing in the center of the road. Approval required crossing this line, likely cross with caution.
372.0	Dubbo	Golden Highway onto Boothenba Road https://goo.gl/maps/TJLi5W4ir11ejgtb6	Length: 50 metres Width: 6.5 Metres	Right hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
384.0	Dubbo	Boothenba Road over rail crossing https://goo.gl/maps/72ageimPLqPWYY7M9	Length: 90 metres Width: 6.5 Metres	Travel directly ahead	Loads to travel over the crossing in the center of the road. Approval required crossing this line, likely cross with caution.
384.1	Dubbo	Boothenba Road onto Troy Bridge Road https://goo.gl/maps/2u5uRf2BvKxseoFm9	Length: 90 metres Width: 6.5 Metres	Travel directly ahead	No problems with this section of road.
387.0	Dubbo	Troy Bridge Road onto Bunglegumbie road https://goo.gl/maps/6Uke9jwPypNYVPux5	Length: 90 metres Width: 6.5 Metres	Travel directly ahead	No problems with this section of road.
403.0	Dubbo	Bunglegumbie road onto the Mitchell Highway https://goo.gl/maps/jCWqmaQsd3fChp837	Length: 50 metres Width: 6.5 Metres	Right hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
423.0	Narromine	Mitchell Highway onto Manildra Street https://goo.gl/maps/hFG648tcSMUHxJ8h6	Length: 40 metres Width: 6.5 Metres	Left hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
423.1	Narromine	Manildra Street over rail crossing https://goo.gl/maps/4s2HYJJfJQ5pGbKg7	Length: 60 metres Width: 7.0 Metres	Travel directly ahead	Loads to travel over the crossing in the center of the road. Approval required crossing this line, likely cross with caution.
423.2	Narromine	Manildra Street onto Derribong Avenue https://goo.gl/maps/776aPaxgsFTWi6qL6	Length: 40 metres Width: 6.5 Metres	Left hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
423.5	Narromine	Derribong Avenue onto Algalah Street https://goo.gl/maps/9s8cb8G4T2c75t1V8	Length: 40 metres Width: 6.5 Metres	Left hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
425.0	Narromine	Algalah Street onto Tomingley Road https://goo.gl/maps/EWfZYo3Xos6T3J8A8	Length: 60 metres Width: 7.0 Metres	Travel directly ahead	No problems with this section of road.
460.0	Tomingley	Tomingley Road onto the Newell Highway https://goo.gl/maps/NJtXmHCFHxaiMaq39	Length: 60 metres Width: 7.0 Metres	Travel directly ahead	No problems with this section of road.

KM index	Location	Section of road	Current clearance	Procedure	Notes
461.0	Tomingley	Newell Highway https://goo.gl/maps/ADMke5At2A1Uy1z4A	200.0 x 15.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
462.0	Tomingley	Newell Highway under safety Cam https://goo.gl/maps/9Vqu9xXxRwhHt4Uk6	Height: Right: 6.8 metres	Travel directly ahead on the correct side	No problems with this section of road.
463.0	South Tomingley	Newell Highway https://goo.gl/maps/1q8f6HJ2zsZSxup66	150.0 x 7.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
475.0	Peak Hill	Newell Highway https://goo.gl/maps/orKTBB8wobK6exsc6	90.0 x 7.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
476.0	Peak Hill	Newell Highway under safety Cam https://goo.gl/maps/sAbh8zwZzZVMriD2A	Height: Right: 6.3 metres	Travel directly ahead on the correct side	No problems with this section of road.
499.0	Alectown	Newell Highway https://goo.gl/maps/GMGbEJHAEkeWuRyz5	90.0 x 7.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
525.0	Parkes	Newell Highway onto Thomas Street https://goo.gl/maps/fSnFVWPr78RePSTz9	Length: 55 metres Width: 6.5 Metres	Right hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
527.0	Parkes	Thomas Street onto Moulden Street https://goo.gl/maps/HpYrcwcx8BHrUmfc8	Length: 55 metres Width: 6.5 Metres	Left hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
527.4	Parkes	Moulden Street onto Back Trundle Road https://goo.gl/maps/1JA2hh5EMZ3G3QfS9	Length: 55 metres Width: 6.5 Metres	Right hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
527.5	Parkes	Back Trundle Road onto Ross Road https://goo.gl/maps/wTLkjNyCVjLWBSuGA	Length: 55 metres Width: 6.5 Metres	Left hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
527.8	Parkes	Ross Road onto Henry Parkes Way https://goo.gl/maps/UKvs2QekwwFuP6oS8	Length: 55 metres Width: 6.5 Metres	Left hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
528.0	Parkes	Henry Parkes Way onto Westlime Road https://goo.gl/maps/Uk2nuLS7xvfnv5dt6	Length: 55 metres Width: 6.5 Metres	Right hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
529.0	Parkes	Westlime Road onto Hartigan Ave https://goo.gl/maps/XtKgPrWcZHY3im65A	Length: 55 metres Width: 6.5 Metres	Travel directly ahead	No problems with this section of road.
530.0	Parkes	Hartigan Avenue under traffic signal https://goo.gl/maps/sQxVxzZivbDX7E3j6	Height: Left: 5.5 metres	Travel around the traffic signal on the incorrect side of the road.	Traffic signal is too low. Pass on right hand side.

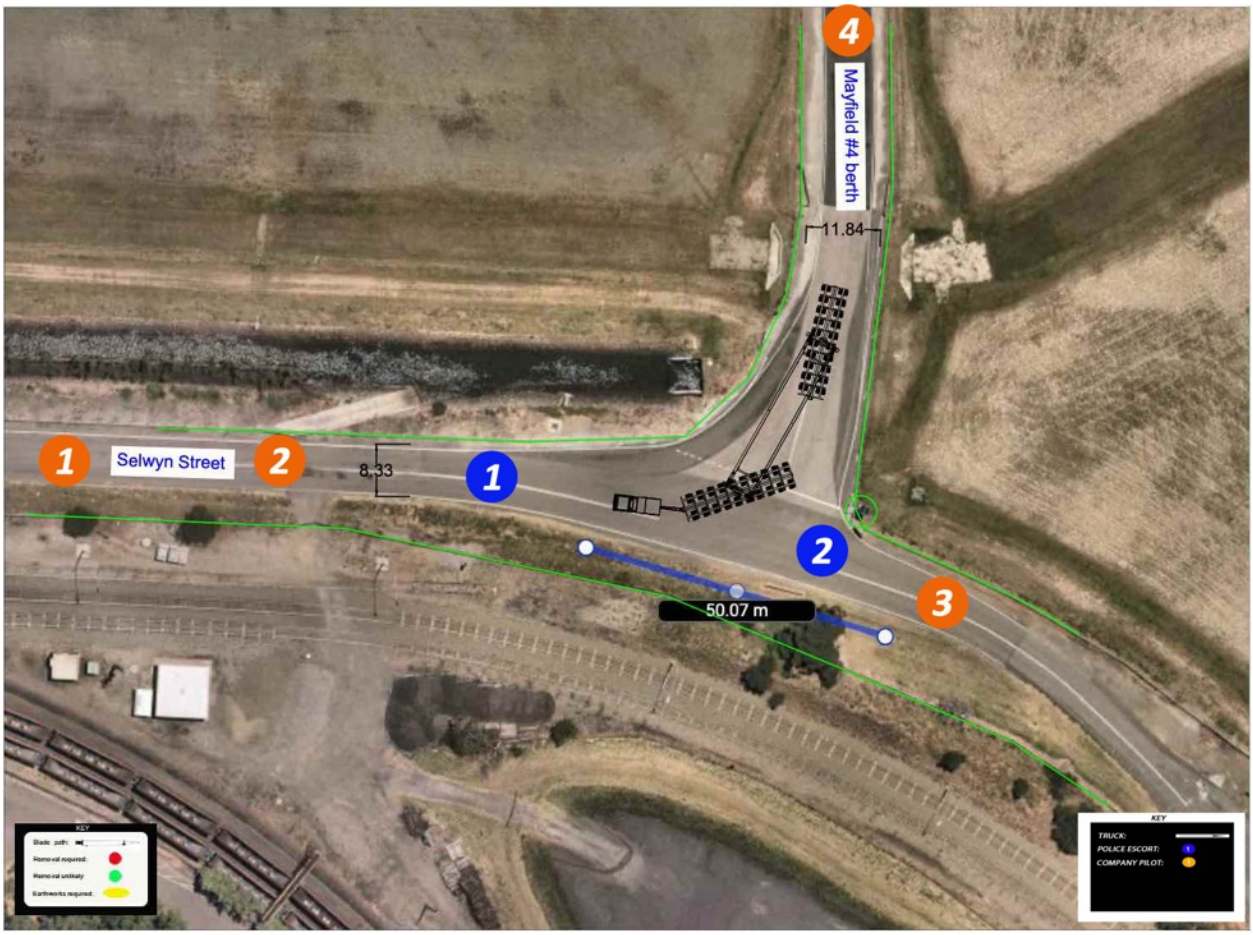
KM index	Location	Section of road	Current clearance	Procedure	Notes
532.0	Parkes	Hartigan Ave onto the Newell Highway https://goo.gl/maps/y3rabftt4HGreX9e6	Length: 55 metres Width: 6.5 Metres	Travel directly ahead	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
533.0	Parkes	Newell Highway over rail crossing https://goo.gl/maps/7tSoLfFManXyKV3T9	Length: 60 metres Width: 7.0 Metres	Travel directly ahead	Loads to travel over the crossing in the center of the road. Approval required crossing this line, likely cross with caution.
535.0	Parkes	Newell Highway over rail crossing https://goo.gl/maps/Kxa3shUCMiuKe2sX7	Length: 60 metres Width: 7.0 Metres	Travel directly ahead	Loads to travel over the crossing in the center of the road. Approval required crossing this line, likely cross with caution.
542.0	Tichborne	Newell Highway over rail crossing https://goo.gl/maps/gxYUZLLe3jsCEJgD7	Length: 60 metres Width: 7.0 Metres	Travel directly ahead	Loads to travel over the crossing in the center of the road. Approval required crossing this line, likely cross with caution.
549.0	Daroobalgie rest area	Newell Highway https://goo.gl/maps/swec16PWh1N8ZbUR7	200.0 x 7.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
563.0	Forbes	Newell Highway intersection with Dowling Street https://goo.gl/maps/DqkvxH4qtWnXvLJ26	Length: 45 metres Width: 6.0 Metres	Left hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
563.2	Forbes	Newell Highway https://goo.gl/maps/Hsmjs9pqvZ5UYFAH7	100.0 x 6.5 metres	Parking Bay	Suitable parking for Fatigue breaks.
568.0	Forbes	Newell Highway under safety Cam https://goo.gl/maps/hUdv6YJunC9yfoxF7	Height: Right: 6.4 metres	Travel directly ahead on the correct side	No problems with this section of road.
631.0	Marsden	Newell Highway under safety Cam https://goo.gl/maps/fRpjbRoXfup29Swx6	Height: Right: 6.9 metres	Travel directly ahead on the correct side	No problems with this section of road.
632.0	Marsden rest area	Newell Highway https://goo.gl/maps/AfAfr2wuNTjQMdKT8	200.0 x 7.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
662.0	Wyalong	Newell Highway under safety Cam https://goo.gl/maps/sudP4qYXPWbDB6sL6	Height: Centre: 6.2 metres	Travel directly ahead on the correct side	No problems with this section of road.
664.0	West Wyalong	Newell Highway onto Compton Road https://goo.gl/maps/PeM4uWq5hLiyZiPd8	Length: 55 metres Width: 6.5 Metres	Left hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
666.5	West Wyalong	Compton Road onto Showground Road https://goo.gl/maps/hts5qARMMWZcvW7R7	Length: 50 metres Width: 6.5 Metres	left hand turn	No problems with this section of road.
667.0	West Wyalong	Compton Road over rail crossing https://goo.gl/maps/KQwsqDkEDASMpB9r8	Length: 50 metres Width: 6.0 Metres	Travel directly ahead	Loads to travel over the crossing in the center of the road. Approval required crossing this line, likely cross with caution.

KM index	Location	Section of road	Current clearance	Procedure	Notes
668.5	West Wyalong	Showground Road https://goo.gl/maps/C8GevkquVtpkHjkFA	150.0 x 7.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
669.0	West Wyalong	Showground Road onto the Newell Highway https://goo.gl/maps/yAyBdrZcocEeTBnz6	Length: 50 metres Width: 6.5 Metres	Left hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
687.0	Allena	Newell Highway over rail crossing https://goo.gl/maps/GMHsd5ynEFwzjmnXA	Length: 50 metres Width: 7.0 Metres	Travel directly ahead	Loads to travel over the crossing in the center of the road. Approval required crossing this line, likely cross with caution.
715.0	Mirrool	Newell Highway over rail crossing https://goo.gl/maps/kFkwMBL9nfKgL954A	Length: 50 metres Width: 6.5 Metres	Travel directly ahead	Loads to travel over the crossing in the center of the road. Approval required crossing this line, likely cross with caution.
750.0	Ardlethan rest area	Newell Highway https://goo.gl/maps/Na3rzBt25sMnsBya6	200.0 x 7.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
789.0	Grong Grong rest area	Newell Highway https://goo.gl/maps/vBTyD3zJVMcbn6wy9	200.0 x 7.0 metres	Parking Bay	Suitable parking for Fatigue breaks.
802.0	Narrandera	Newell Highway over rail bridge https://goo.gl/maps/YBWuYYyVoZfSUTJ37	Length: 50 metres Width: 7.0 Metres	Travel directly ahead	Loads to travel over the bridge in the center of the road.
803.0	Narrandera	Newell Highway at Whitton Street https://goo.gl/maps/EXcuuBeMsXdhVDtm8	Length: 50 metres Width: 7.5 Metres	Left hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
803.0 to 804.0	Narrandera	Newell Highway (Cadell St) https://goo.gl/maps/Z3ptasM9sGGtaB5A8	Length: 50 metres Width: 7.5 Metres	Travel directly ahead	Trees to be trimmed
805.0	Narrandera	Newell Highway onto Sturt Highway https://goo.gl/maps/uFiCyhp9uF147Wie8	Length: 80 metres Width: 7.5 Metres	Left hand turn	No problems with this section of road.
825.0	Sandigo	Sturt Highway onto Sandigo Road https://goo.gl/maps/c3ZDZEj78aMwmqEh8	Length: 60 metres Width: 7.0 Metres	Right hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.
825.0 to 826.0	Sandigo	Sandigo Road https://goo.gl/maps/DMGEho8QouQxWxiH7	Width: 6.5 Metres	Travel directly ahead	Sandigo Road has been recently sealed and is in good condition.
826.0	Sandigo	Sandigo Road into Muntz Road https://goo.gl/maps/WErjz7kPjHWLPRsP6	Length: 40 metres Width: 6.0 Metres	Right hand turn	Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.

KM index	Location	Section of road	Current clearance	Procedure	Notes
826.0 to 8238.0	Sandigo	Muntz Road https://goo.gl/maps/tTfFuMmCxNXziRb56	Width: 6.5 Metres	Travel directly ahead	This road is gravel and in average condition. Load to travel at no more than 10 km's per hour for this section of road.
828.0	Sandigo	Muntz Road into Avonleigh Solar farm https://goo.gl/maps/R3T3az3oQiSRg6GV7	Length: 40 metres Width: 6.0 Metres	Right hand turn	Site to make a suitable entrance for the swept path of this load. Spotter to assist at this pinchpoint. Escorts to control traffic as per plan below for this section of road.

0.0 Km's: Mayfield #4 berth onto Selwyn Street at Mayfield.

Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/afLwPYKuNdm

COMPANY PILOT 1: Warn all eastbound traffic on Selwyn Street.

COMPANY PILOT 2: Warn all eastbound traffic on Selwyn Street.

COMPANY PILOT 3: Warn all westbound traffic on Selwyn Street.

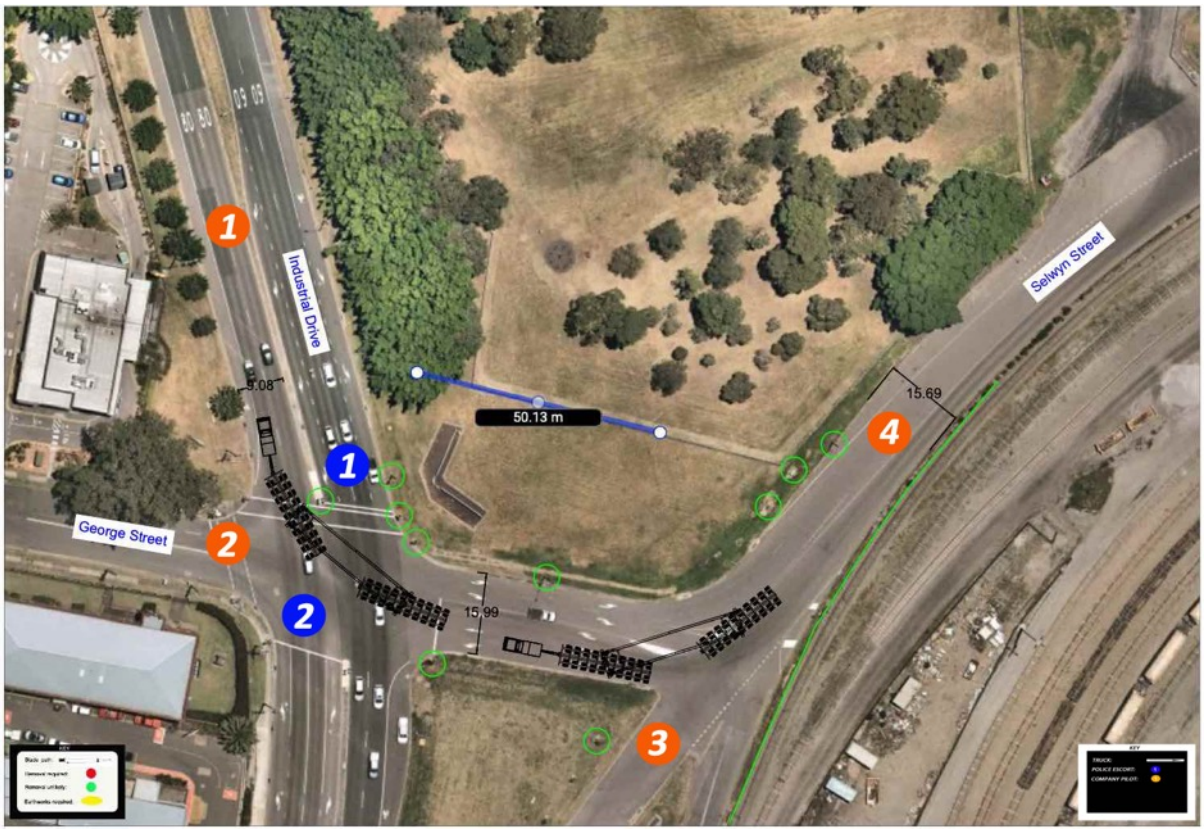
COMPANY PILOT 4: Stay 50 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn right from the port access road onto Selwyn Street.

ROAD MODIFICATIONS: Nil.

1.3 Km's: Selwyn Street onto Industrial Drive at Mayfield.

Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/gXeHvBtCp4D2

COMPANY PILOT 1: Warn all southbound traffic on Industrial Drive.

COMPANY PILOT 2: Warn all eastbound traffic on George Street.

COMPANY PILOT 3: Warn all eastbound traffic on Selwyn Street.

COMPANY PILOT 4: Stay 50 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn right from Selwyn Street onto Industrial Drive via George Street.

ROAD MODIFICATIONS: Nil.

5.5 Km's: Industrial Drive onto Maitland Road at Mayfield West.

Image 1:

GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/Kn49dhWG2qG2

COMPANY PILOT 1: Warn all southbound traffic on Maitland Road.

COMPANY PILOT 2: Warn all southbound traffic on Maitland Road.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn right from Industrial Drive onto Maitland Road.

ROAD MODIFICATIONS: Nil.

8.0 Km's: Maitland Road crossover at the intersection of the Newcastle Inner City bypass at Sandgate.

Image 1:

GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/meQGKpGdRuvCTPgr7

COMPANY PILOT 1: Warn all southbound traffic on Maitland Road.

COMPANY PILOT 2: Warn all southbound traffic on Maitland Road.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

COMPANY PILOT 4: Stay 50 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load is to cross to incorrect side (Southbound lanes) of Maitland Road at the intersection of the Inner-City Bypass. Then travel on the incorrect side (Southbound Lanes) of Maitland Road through to Old Maitland Road.

ROAD MODIFICATIONS: Nil.

8.4 Km's: Maitland Road onto Old Maitland Road at Sandgate.

Image 1:

GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/RGSB79x8xbvj4wqe6

COMPANY PILOT 1: Warn all traffic in Old Maitland Road.

COMPANY PILOT 2: Warn all southbound traffic on Maitland Road.

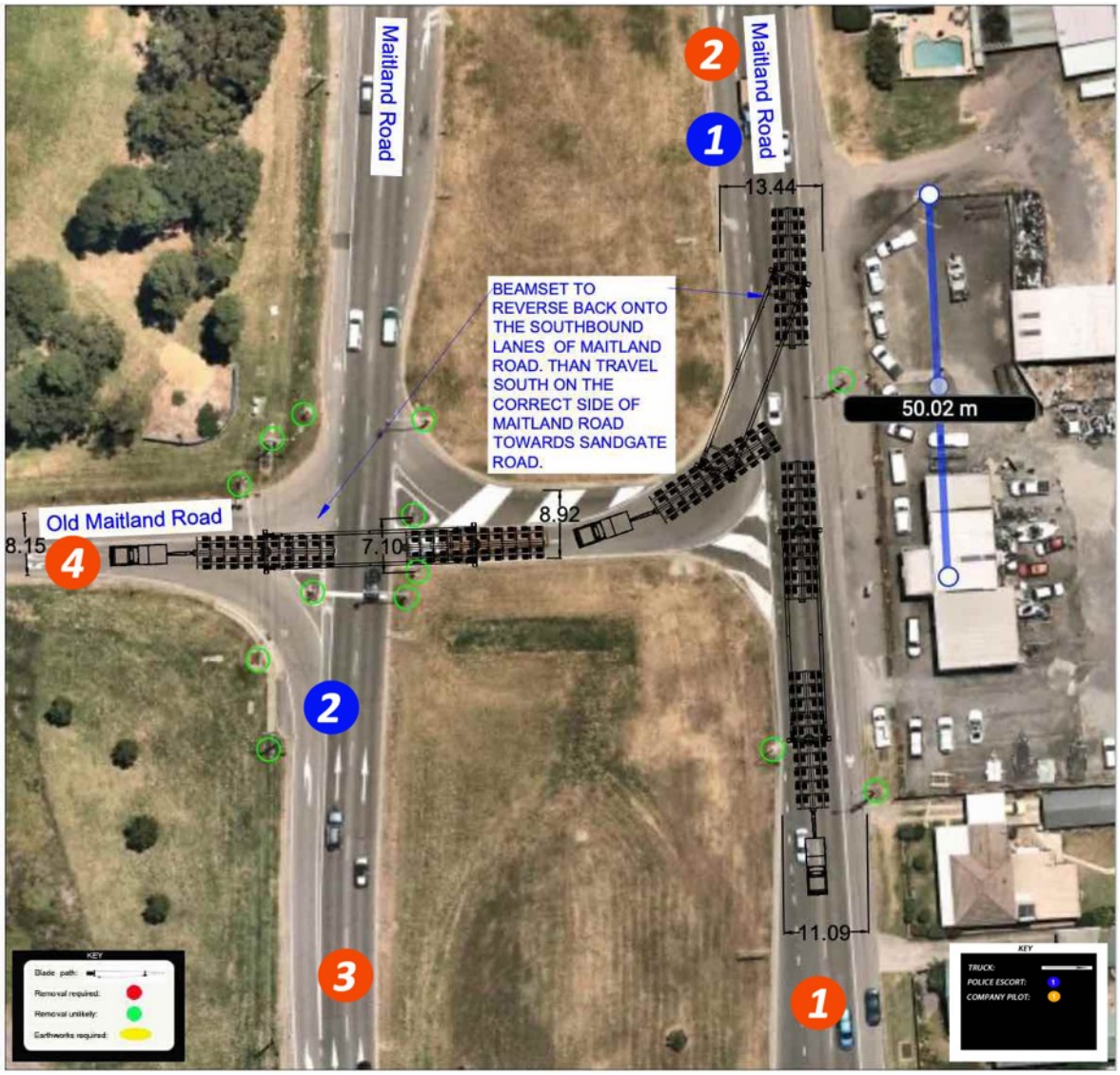
COMPANY PILOT 3: Warn all northbound traffic on Maitland Road.

COMPANY PILOT 4: Stay 50 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load is to turn from the southbound lanes on Maitland Road into Old Maitland Road.

ROAD MODIFICATIONS: Nil.

8.5 Km's: Old Maitland Road onto Maitland Road at Sandgate.
Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/MHtTKSrgbtgGC4T37

COMPANY PILOT 1: Warn all northbound traffic on Maitland Road.

COMPANY PILOT 2: Warn all southbound traffic on Maitland Road.

COMPANY PILOT 3: Warn all northbound traffic on Maitland Road.

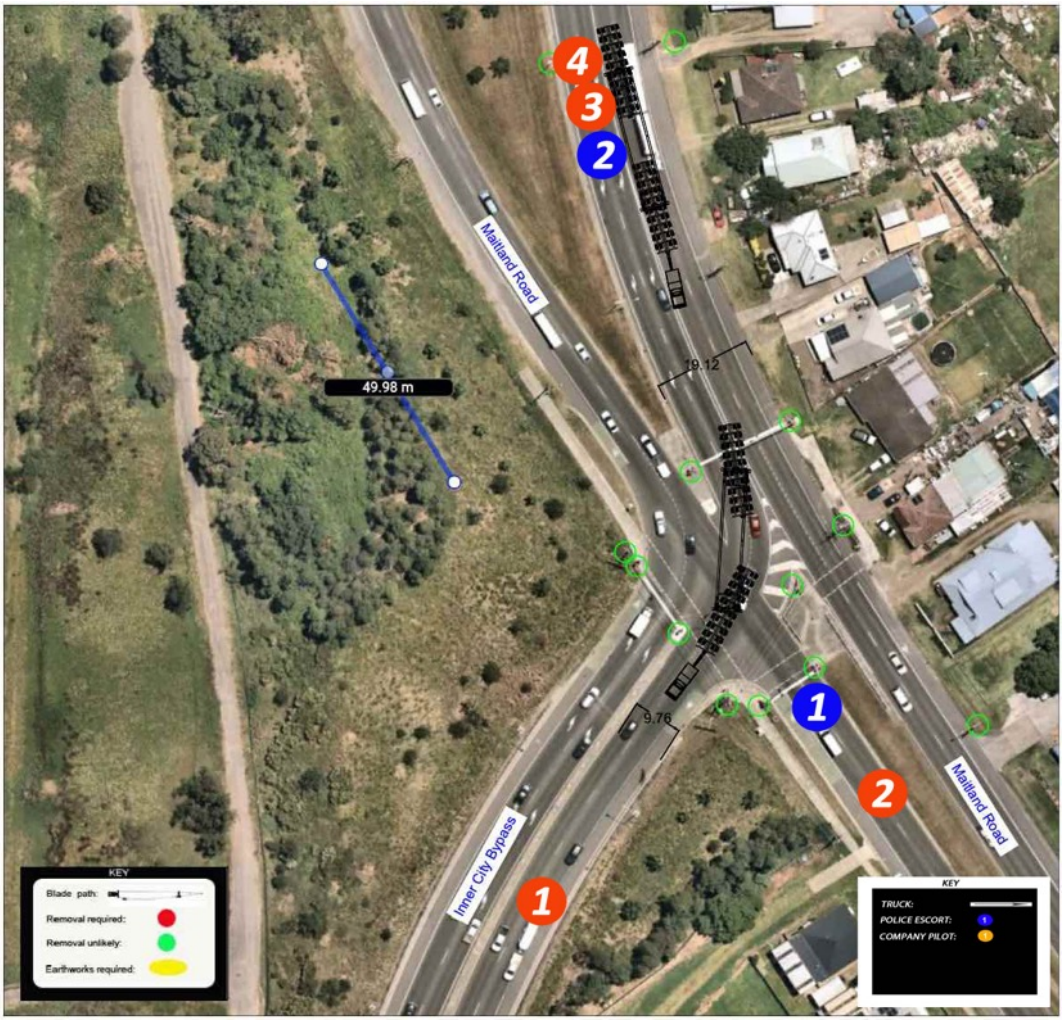
COMPANY PILOT 4: Warn all traffic in Old Maitland Road.

PINCHPOINT PROCEDURE: The load is to reverse back onto the Southbound lanes of Maitland Road, before travelling south on the correct side of Maitland Road towards the Inner-City bypass.

ROAD MODIFICATIONS: Nil.

9.0 Km's: Maitland Road onto Newcastle Inner City Bypass at Sandgate.

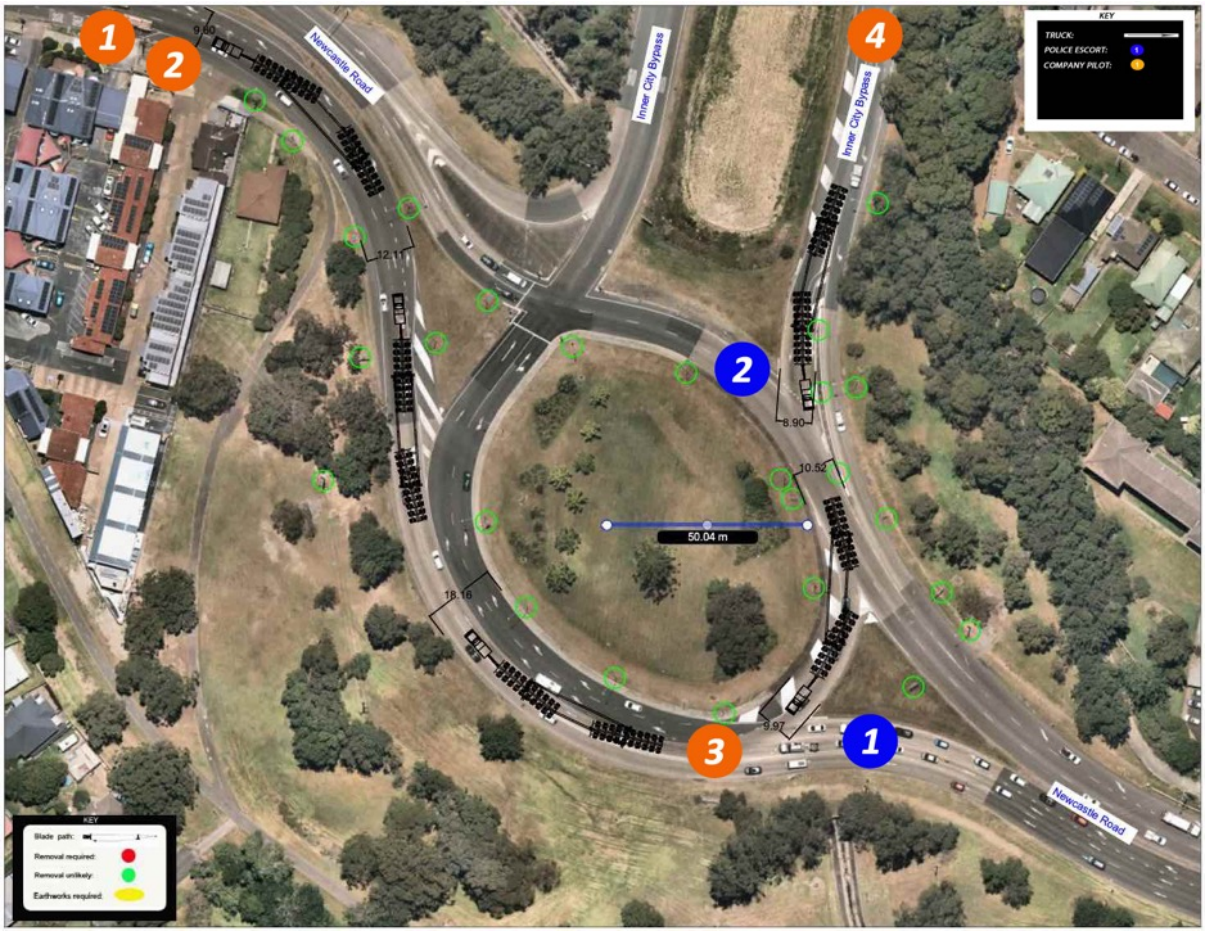
Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/WR97pBUPiG7ULd757
COMPANY PILOT 1: Warn all Northbound traffic on Newcastle Inner City Bypass.
COMPANY PILOT 2: Warn all northbound traffic on Maitland Road.
COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.
COMPANY PILOT 4: Stay 50 metres behind the load and warn all traffic.
PINCHPOINT PROCEDURE: Load to turn right from Maitland Road onto Sandgate Road.
ROAD MODIFICATIONS: Nil.

14.0 Km's: Newcastle Inner City Bypass onto Newcastle Road at Jesmond.

Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/1MUmyjNyydDakRZx6

COMPANY PILOT 1: Warn all eastbound traffic on Newcastle Road.

COMPANY PILOT 2: Warn all eastbound traffic on Newcastle Road.

COMPANY PILOT 3: Warn all westbound traffic on Newcastle Road.

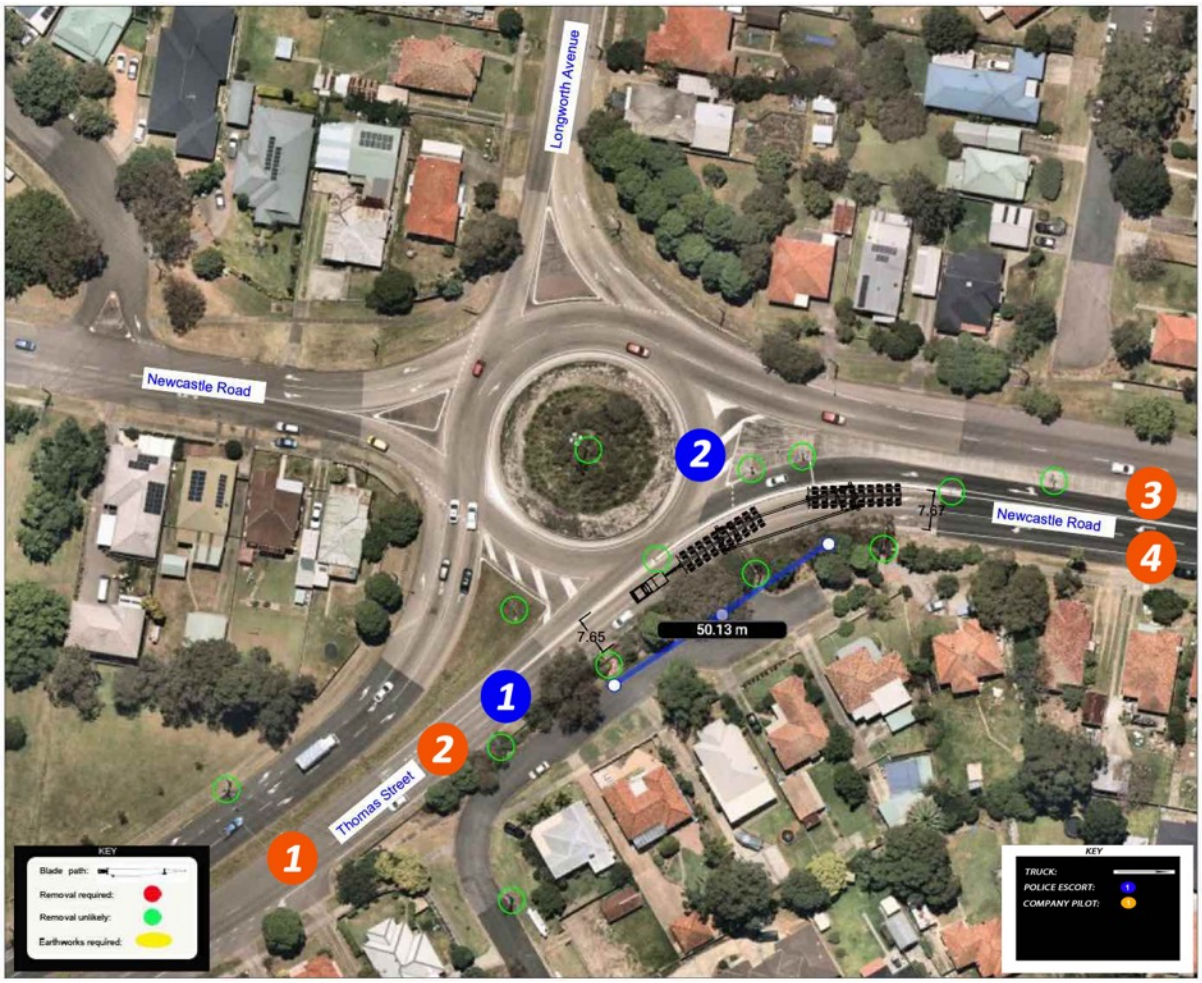
COMPANY PILOT 4: Stay 50 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Right hand turn at the roundabout before taking the second exit onto Newcastle Road

ROAD MODIFICATIONS: Nil.

15.5 Km's: Newcastle Road onto Thomas Street at Wallsend.

Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/1DCZxPpZT41RFd8w7

COMPANY PILOT 1: Warn all eastbound traffic on Newcastle Link Road.

COMPANY PILOT 2: Warn all eastbound traffic on Newcastle Link Road.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

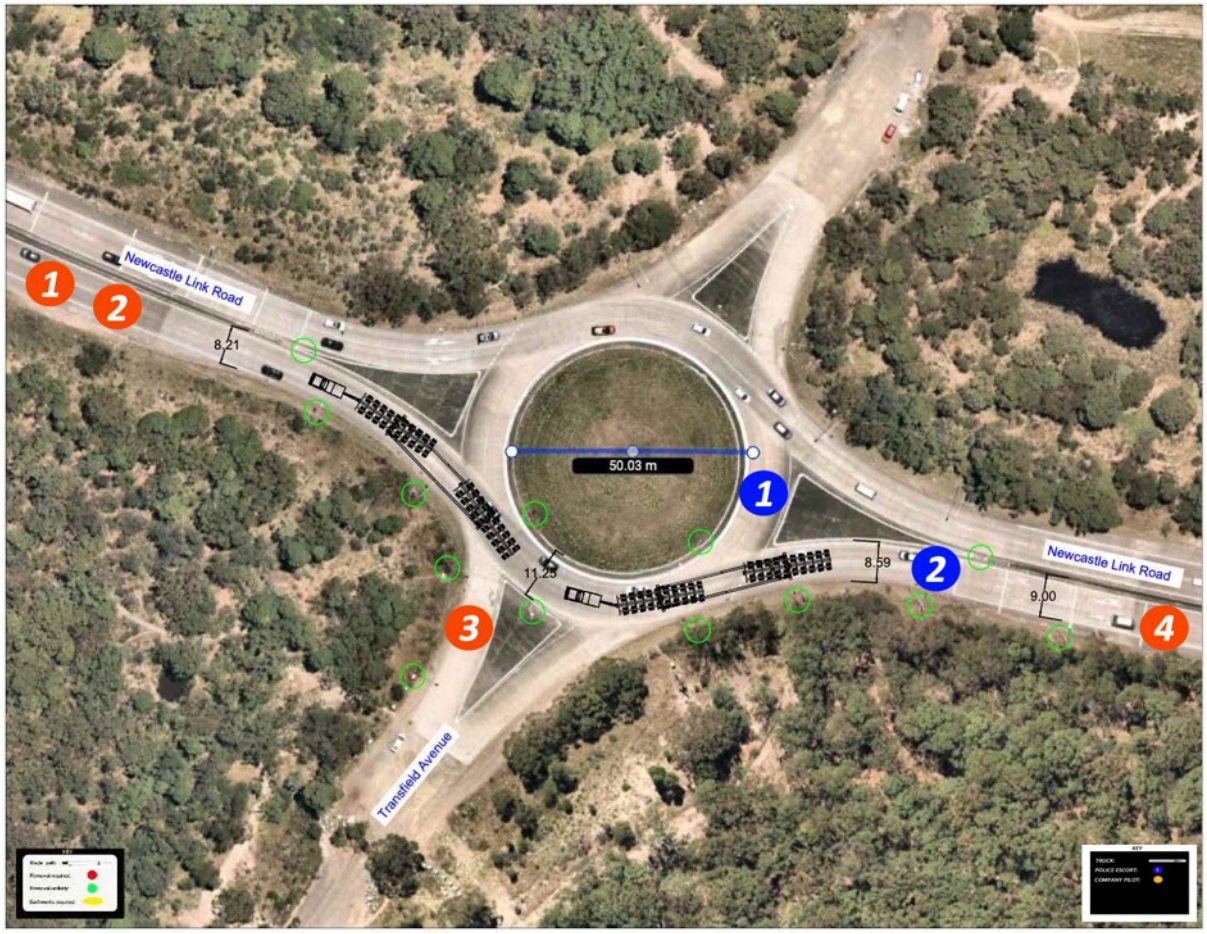
COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Left hand bend from Newcastle Road onto Thomas Street.

ROAD MODIFICATIONS: Nil.

19.0 Km's: Newcastle Link Road intersection of Transfield Avenue at Wallsend.

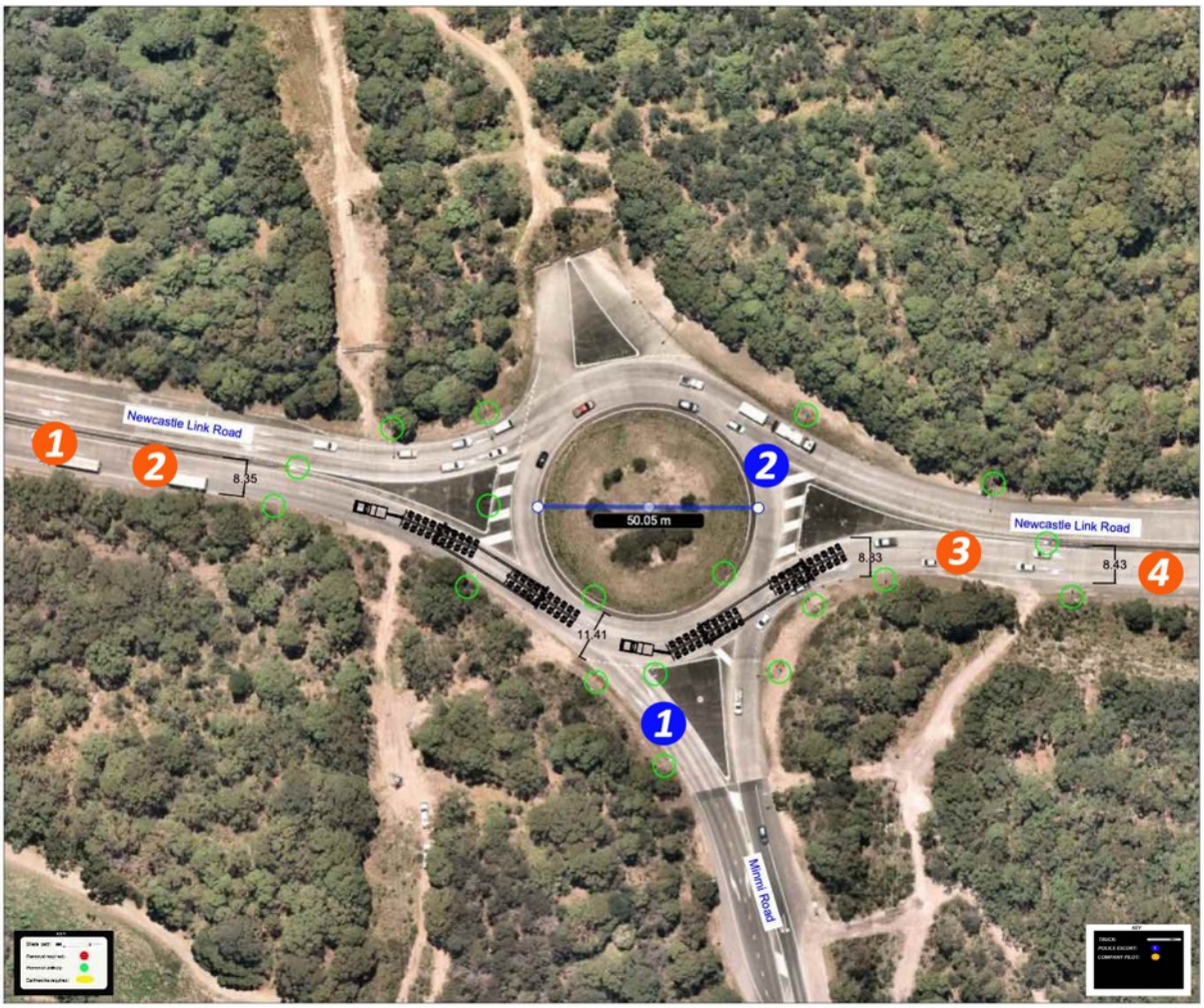
Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/noHnEkQTa641xHT49
COMPANY PILOT 1: Warn all eastbound traffic on Newcastle Link Road.
COMPANY PILOT 2: Warn all eastbound traffic on Newcastle Link Road.
COMPANY PILOT 3: Warn all traffic in Transfield avenue.
COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.
PINCHPOINT PROCEDURE: Travel directly ahead through the roundabout.
ROAD MODIFICATIONS: Nil.

21.0 Km's: Newcastle Link Road intersection of Minmi Road at Cameron Park.

Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/mXYajNbe93622tcLA
COMPANY PILOT 1: Warn all eastbound traffic on Newcastle Link Road.
COMPANY PILOT 2: Warn all eastbound traffic on Newcastle Link Road.
COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.
COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.
PINCHPOINT PROCEDURE: Travel directly ahead through the roundabout.
ROAD MODIFICATIONS: Nil.

72.0 Km's: New England Highway onto the Golden Highway at Whttingham.

Image 1:

GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/nAnfkYfeUn42

COMPANY PILOT 1: Warn all eastbound traffic on the New England Highway.

COMPANY PILOT 2: Warn all eastbound traffic on the Golden Highway.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn left from the New England Highway onto the Golden Highway on the correct side of the road.

ROAD MODIFICATIONS: Nil.

82.4 Km's: Golden Highway at Putty Road intersection at Mount Thorley.

Image 1:

GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/7hQdEmK1EgE2

COMPANY PILOT 1: Warn all eastbound traffic on the Golden Highway.

COMPANY PILOT 2: Warn all eastbound traffic on the Golden Highway.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

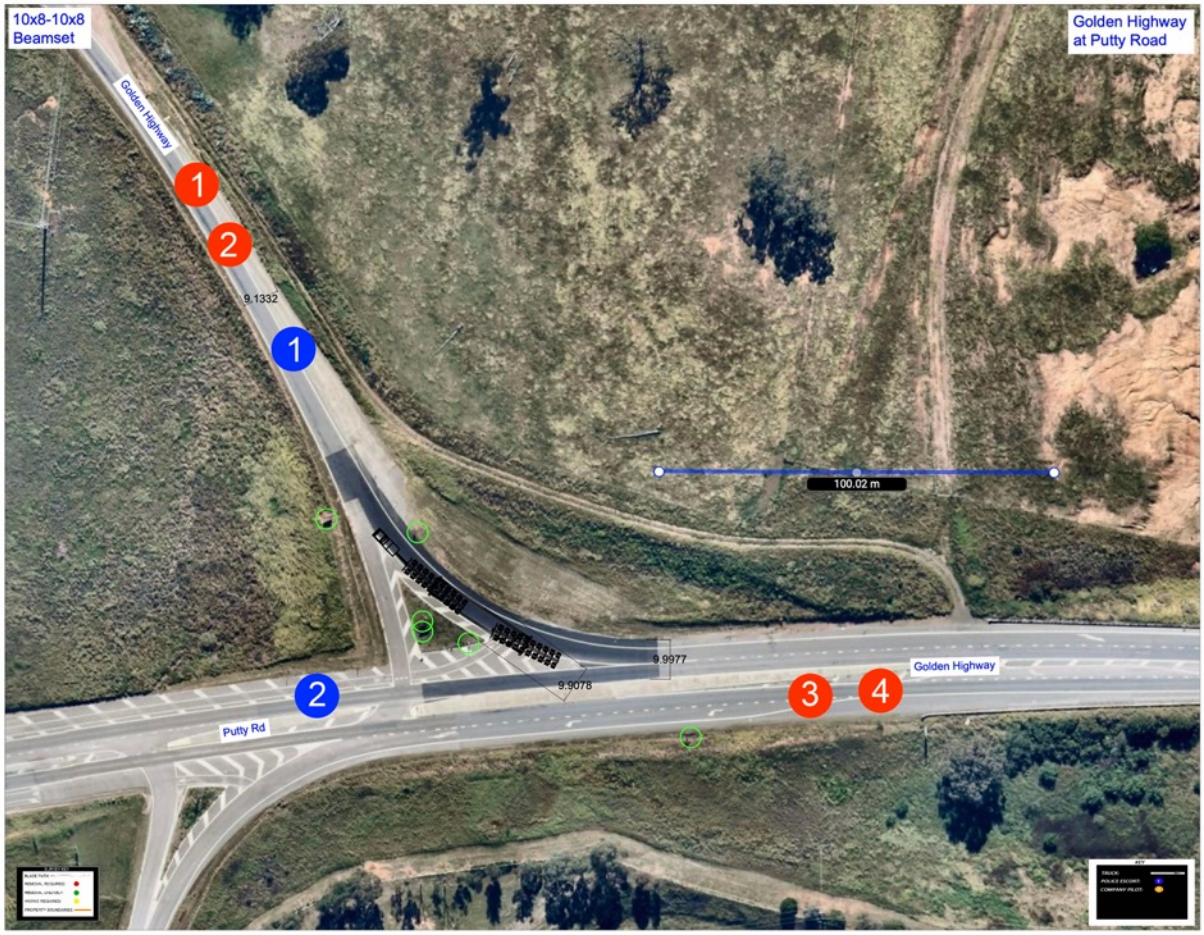
COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn left from the Golden Highway onto the Golden Highway on the correct side of the road.

ROAD MODIFICATIONS: Nil.

85.8 Km's: Golden Highway at Putty Road intersection at Mount Thorley.

Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/QS9quvSyHYWaFHoX9

COMPANY PILOT 1: Warn all eastbound traffic on the Golden Highway.

COMPANY PILOT 2: Warn all eastbound traffic on the Golden Highway.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

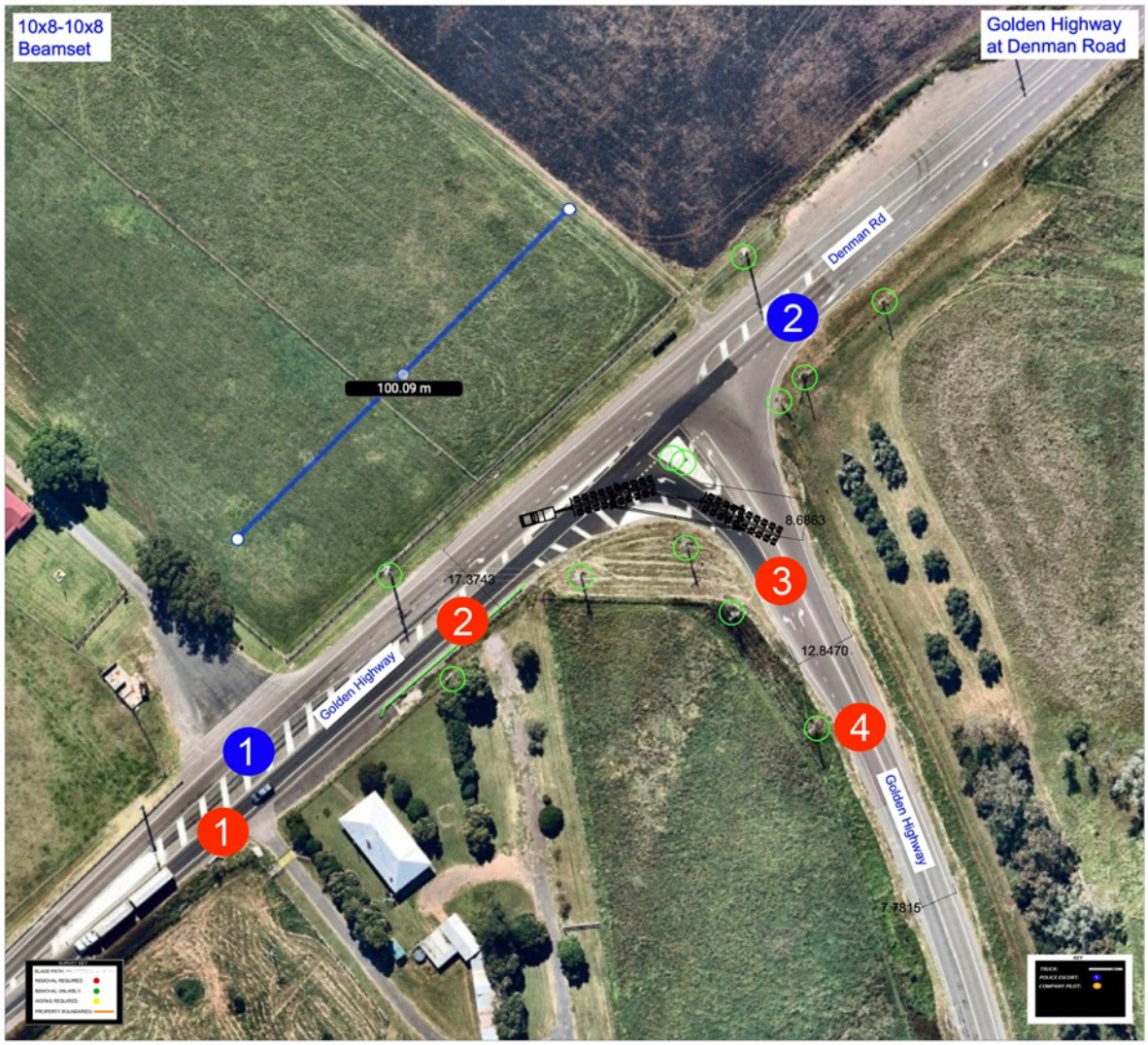
COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn right onto the incorrect side of the Golden Highway. Pilots and police will need to travel 200 metres west of this intersection and warn/hold all oncoming traffic.

ROAD MODIFICATIONS: Nil.

137.0 Km's: Golden Highway at Denman Road intersection at Denman.

Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/sf4PNnycxB32

COMPANY PILOT 1: Warn all eastbound traffic on the Golden Highway.

COMPANY PILOT 2: Warn all eastbound traffic on the Golden Highway.

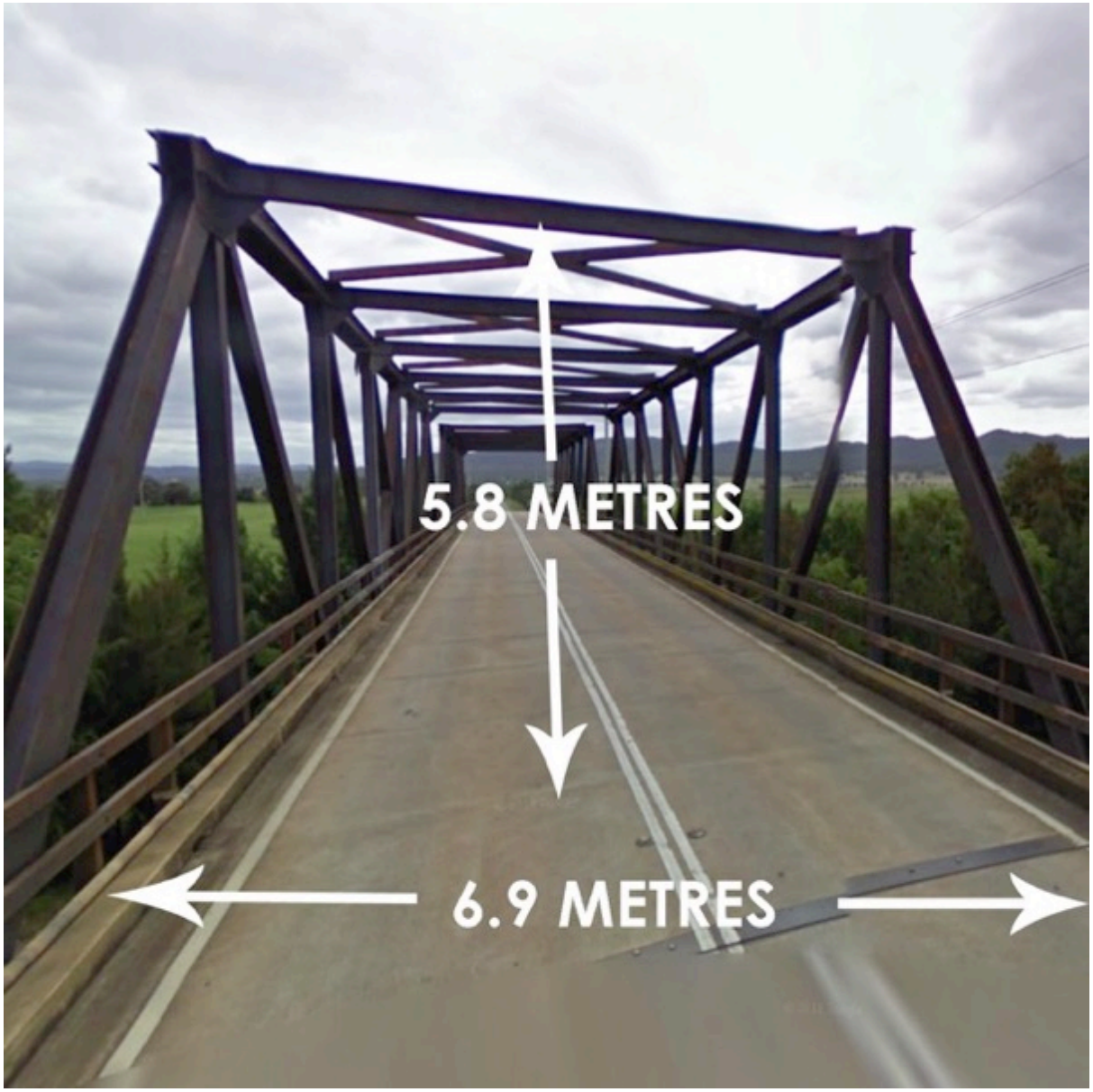
COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn left from the Golden Highway onto the Golden Highway while crossing onto the incorrect side of the road.

ROAD MODIFICATIONS: Nil.

138.0 Km's: Denman Bridge.



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/UToXyFe3QKu

PINCHPOINT PROCEDURE: Travel over the bridge at no more than 10 km's p/hr and on the centre line of the structure.

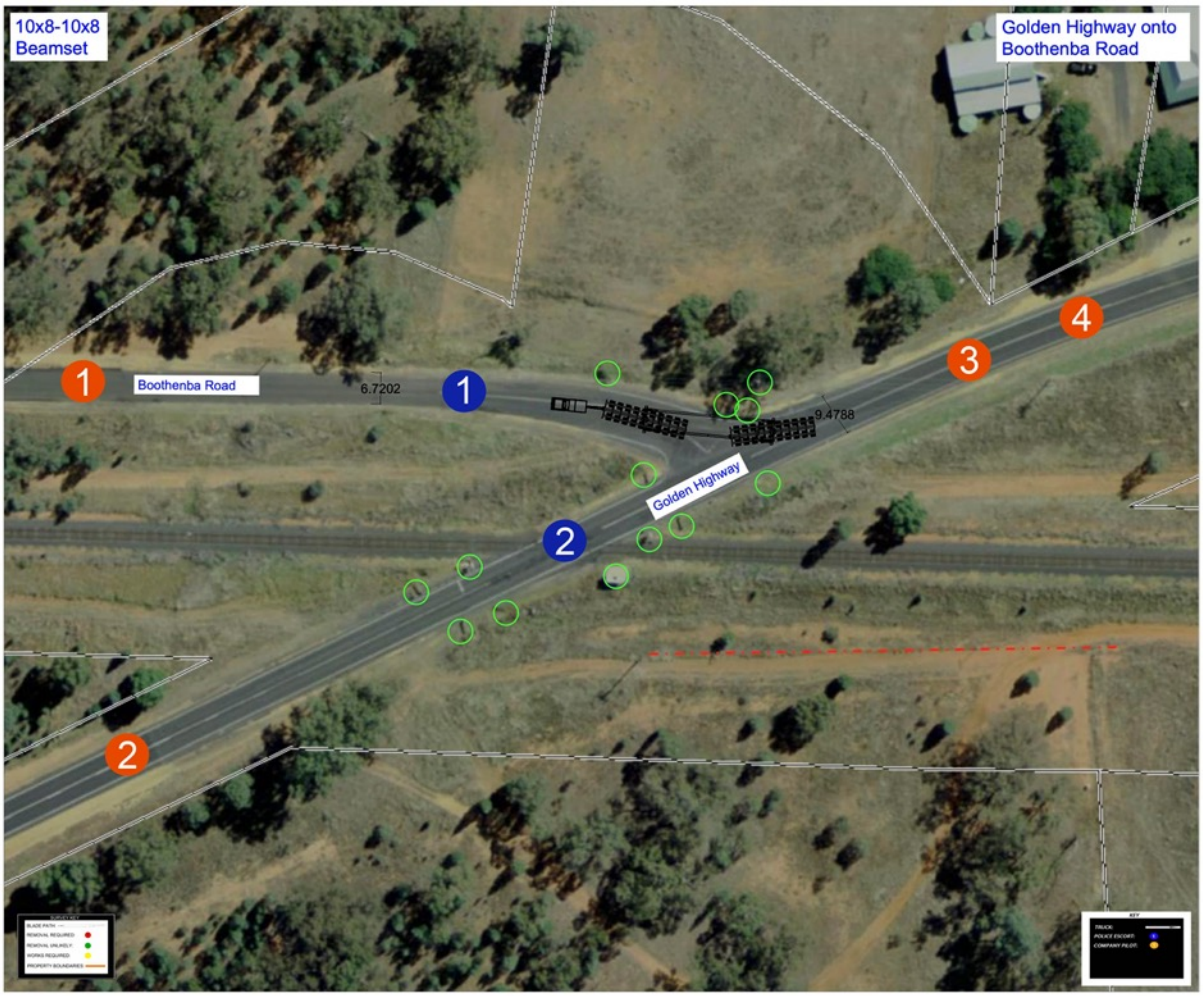
No other vehicles are to be on the structure as at the same time as the load.

Load to hydraulically lower to 5.5 metres before crossing this structure.

ROAD MODIFICATIONS: Nil.

372.0 Km's: Golden Highway onto Boothenba Road at Dubbo.

Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/TJLi5W4ir11ejgtb6

COMPANY PILOT 1: Warn all eastbound traffic on Boothenba Road.

COMPANY PILOT 2: Warn all eastbound traffic on the Golden Highway.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

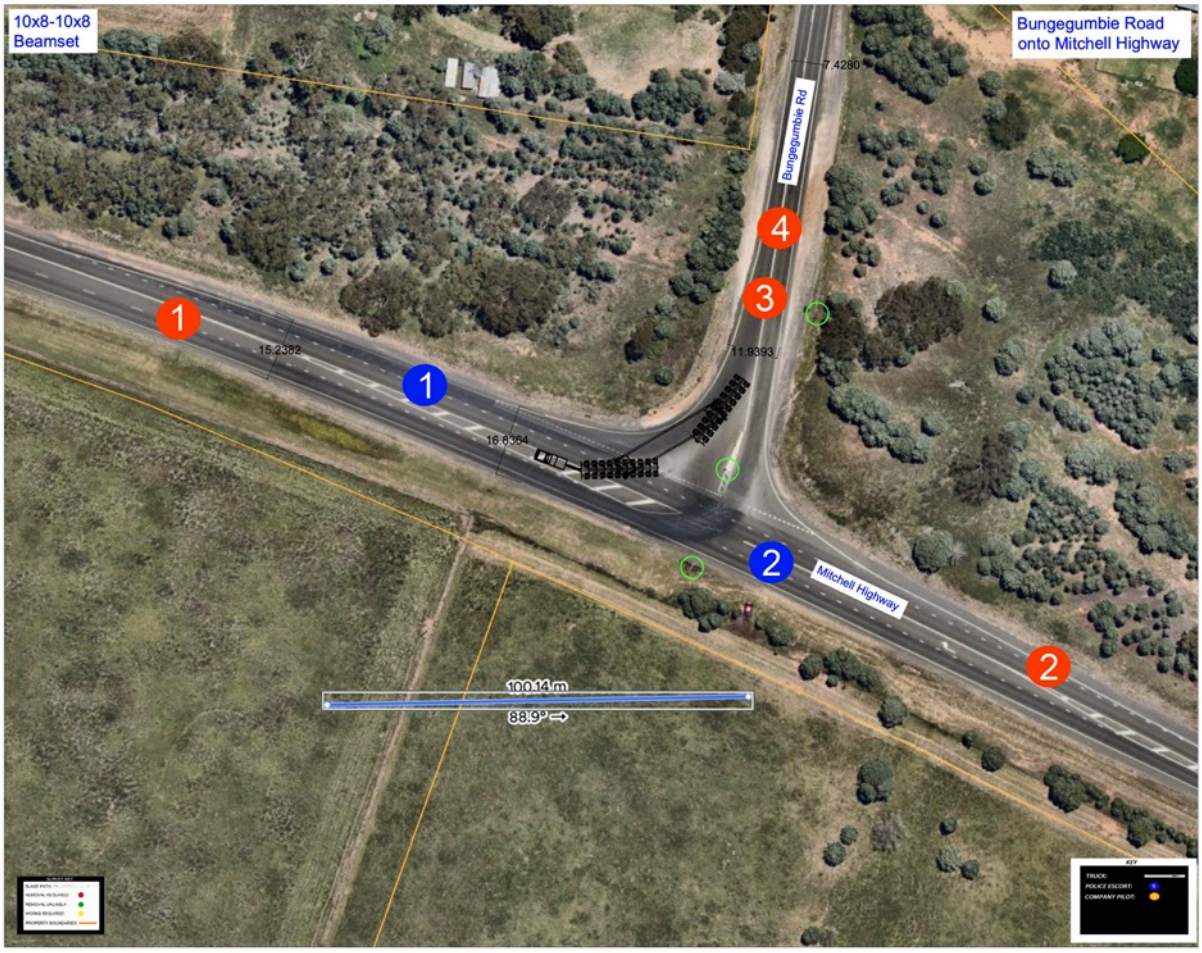
COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn right from the Golden Highway onto Boothenba Road while crossing onto the incorrect side of the road.

ROAD MODIFICATIONS: Nil.

403.0 Km's: Bunglegumbie Road onto the Mitchell Highway at Dubbo.

Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/jCWqmaQsd3fChp837

COMPANY PILOT 1: Warn all eastbound traffic on the Mitchell Highway.

COMPANY PILOT 2: Warn all westbound traffic on the Mitchell Highway.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn right from Bunglegumbie Road onto the Mitchell Highway while crossing onto the incorrect side of the road.

ROAD MODIFICATIONS: Nil.

423.0 Km's: Mitchell Highway onto Manildra Street at Narromine.

Image 1:

GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/WPhQahdAKGjRSNvy8

COMPANY PILOT 1: Warn all traffic 150 Metres in front of the load.

COMPANY PILOT 2: Warn all traffic 100 Metres in front of the load.

COMPANY PILOT 3: Warn all traffic 50 Metres in front of the load.

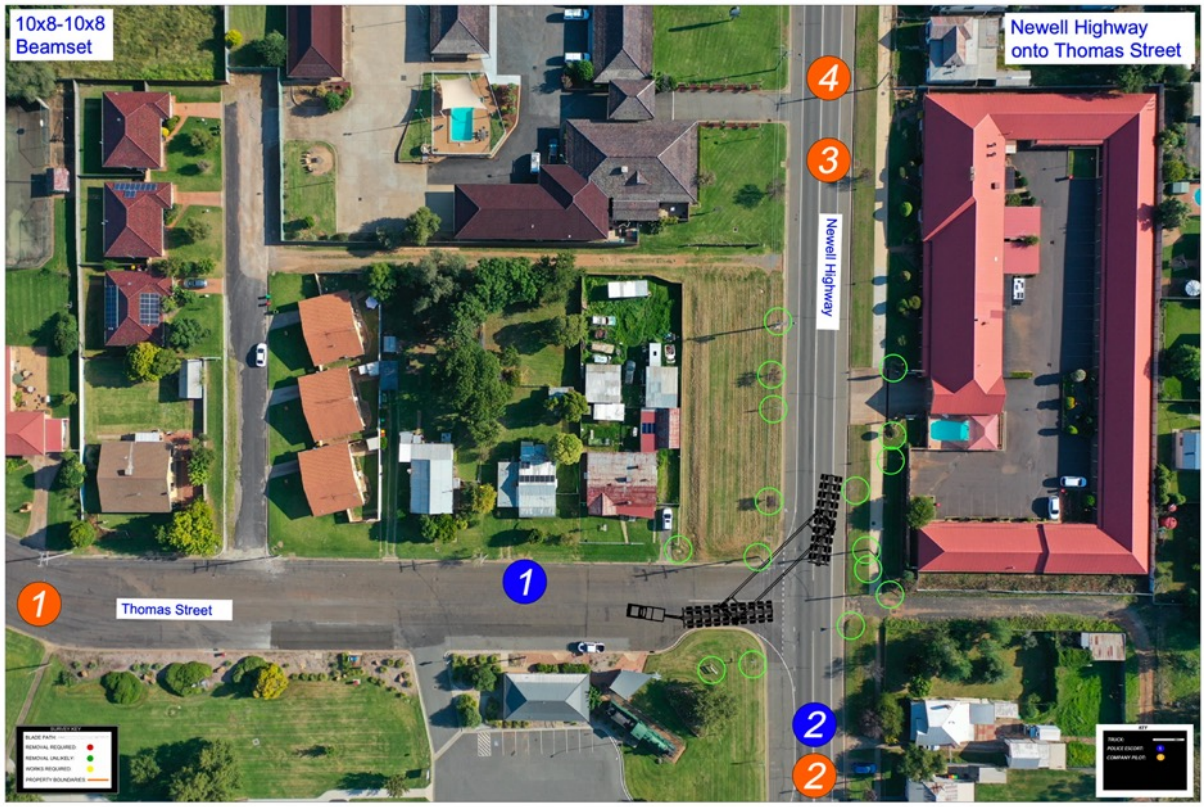
COMPANY PILOT 4: Stay 500 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn left from the Mitchell Highway onto Manildra Street before crossing onto Algalah Street while crossing onto the incorrect side of the road on several intersections.

ROAD MODIFICATIONS: Nil.

525.0 Km's: Newell Highway onto Thomas Street at Parkes.

Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/fSnFVWPr78RePSTz9

COMPANY PILOT 1: Warn all eastbound traffic on Thomas Street.

COMPANY PILOT 2: Warn all northbound traffic on the Newell Highway.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn right from the Newell Highway onto Thomas Street while crossing onto the incorrect side of the road.

ROAD MODIFICATIONS: Nil.

527.4 Km's: Moulden Street onto Back Trundle Road onto Ross Road at Parkes.

Image 1:

GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/1JA2hh5EMZ3G3QfS9

COMPANY PILOT 1: Warn all northbound traffic on Ross Road.

COMPANY PILOT 2: Warn all northbound traffic on Ross Road.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

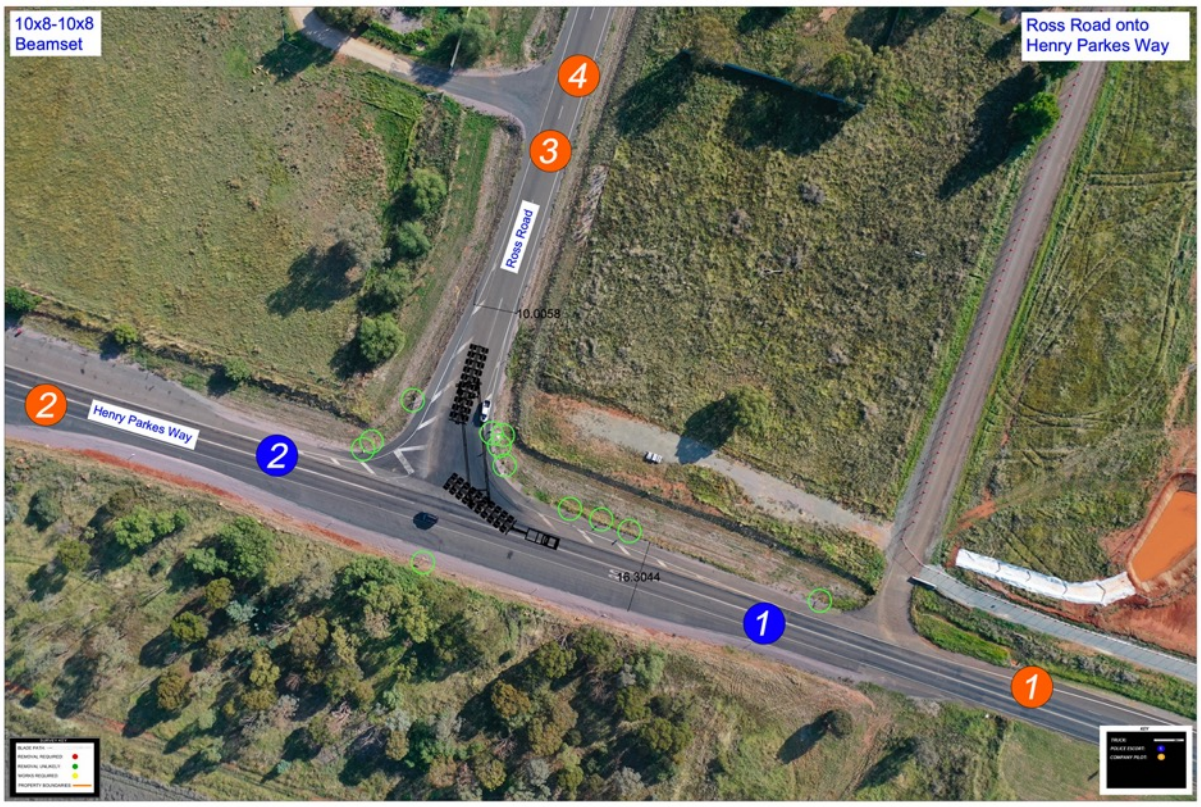
COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn right than left from Moulden Street onto Ross Road via Back Trundle Road while crossing onto the incorrect side of the road.

ROAD MODIFICATIONS: Nil.

527.8 Km's: Ross Road onto Henry Parkes Way at Parkes.

Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/UKvs2QekwwFuP6oS8
COMPANY PILOT 1: Warn all westbound traffic on Henry Parkes Way.
COMPANY PILOT 2: Warn all eastbound traffic on Henry Parkes Way.
COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.
COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.
PINCHPOINT PROCEDURE: Load to turn left from Ross Road onto henry Parkes Way.
ROAD MODIFICATIONS: Nil.

528.0 Km's: Henry Parkes Way onto Westlime Road at Parkes.

Image 1:

GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/QhZmTtpL1vNkUE7i8

COMPANY PILOT 1: Warn all northbound traffic on Westlime Road.

COMPANY PILOT 2: Warn all westbound traffic on Henry Parkes Way.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn right from Henry Parkes Way onto Westlime Road while crossing onto the incorrect side of the road.

ROAD MODIFICATIONS: Nil.

532.0 Km's: Hartigan Avenue onto the Newell Highway at Parkes.

Image 1:

GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/y3rabftt4HGreX9e6

COMPANY PILOT 1: Warn all northbound traffic on the Newell Highway.

COMPANY PILOT 2: Warn all northbound traffic on the Newell Highway.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

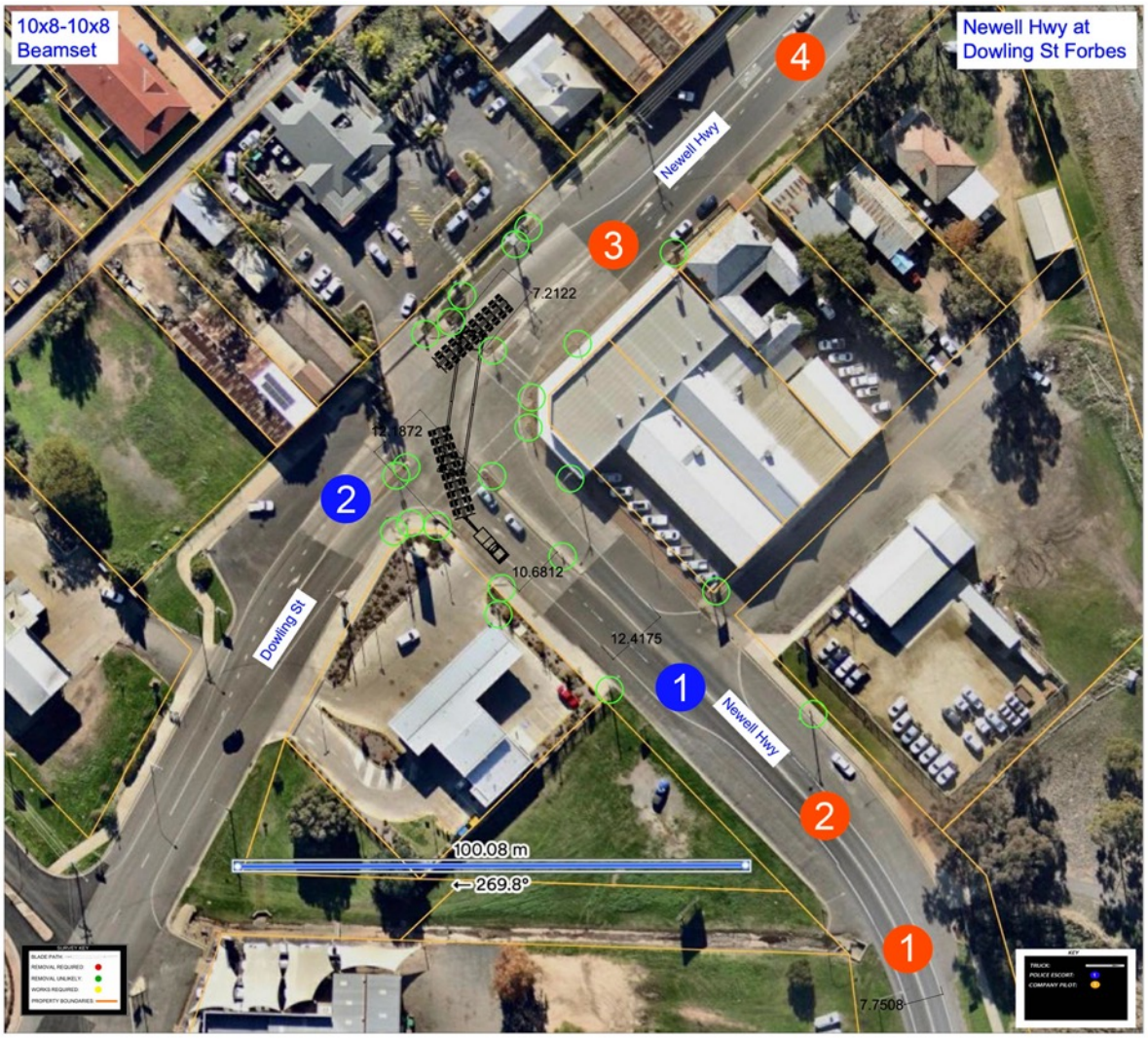
COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn right from Hartigan Avenue onto the Newell Highway while crossing onto the incorrect side of the road.

ROAD MODIFICATIONS: Nil.

563.0 Km's: The Newell Highway intersection with Dowling Street at Forbes.

Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/DqkvxH4qtWnXvLJ26

COMPANY PILOT 1: Warn all northbound traffic on the Newell Highway.

COMPANY PILOT 2: Warn all northbound traffic on the Newell Highway.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn left from the Newell Highway onto the Newell Highway on the incorrect side of the road.

ROAD MODIFICATIONS: Nil.

664.0 Km's: The Newell Highway onto Compton Road at West Wyalong.

Image 1:

GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/PeM4uWg5hLiyZiPd8

COMPANY PILOT 1: Warn all northbound traffic on Compton Road.

COMPANY PILOT 2: Warn all northbound traffic on Compton Road.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

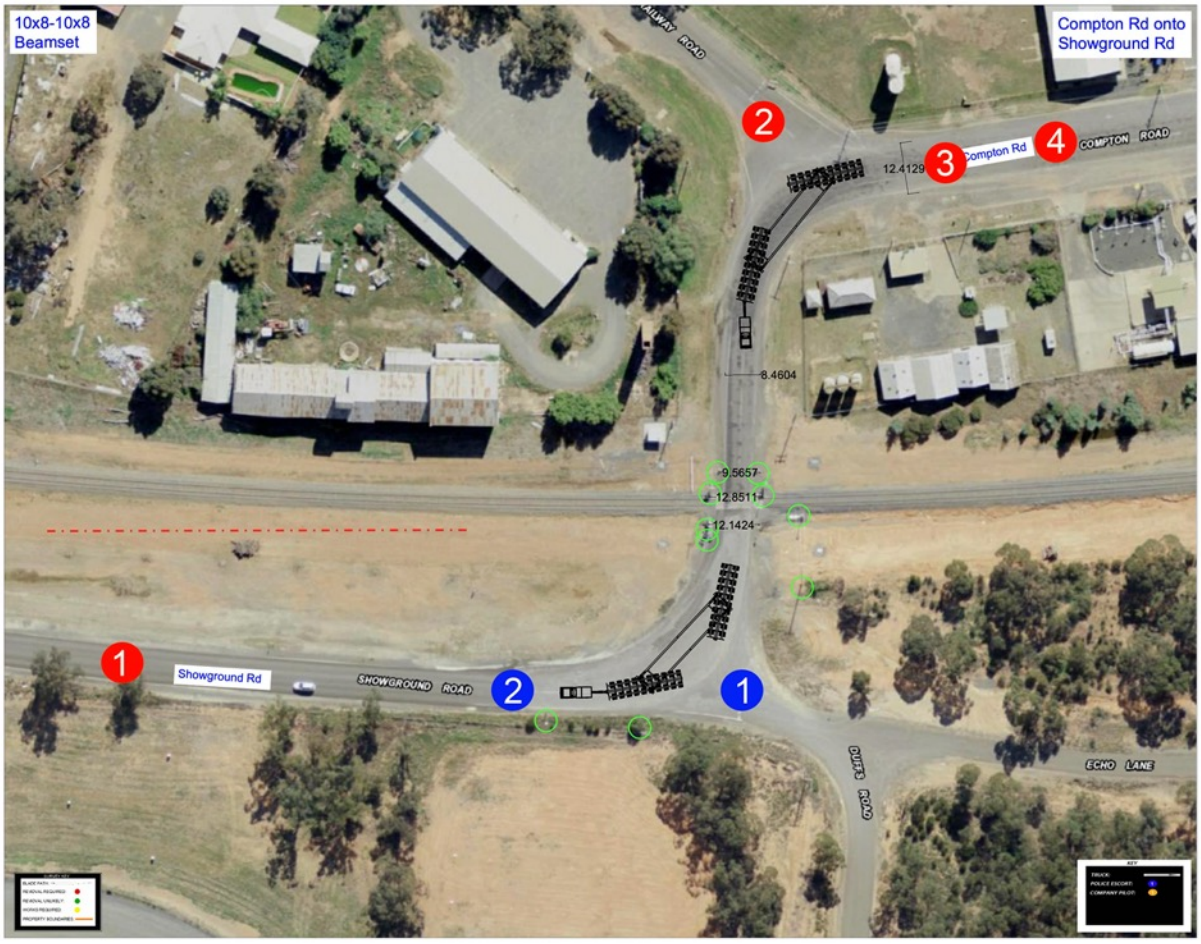
COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn left from the Newell Highway onto Compton Road while crossing onto the incorrect side of the road.

ROAD MODIFICATIONS: Nil.

666.5 Km's: Compton Road onto Showground Road at West Wyalong.

Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/hts5qARMMWZcvW7R7

COMPANY PILOT 1: Warn all northbound traffic on Compton Road.

COMPANY PILOT 2: Warn all northbound traffic on Compton Road.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

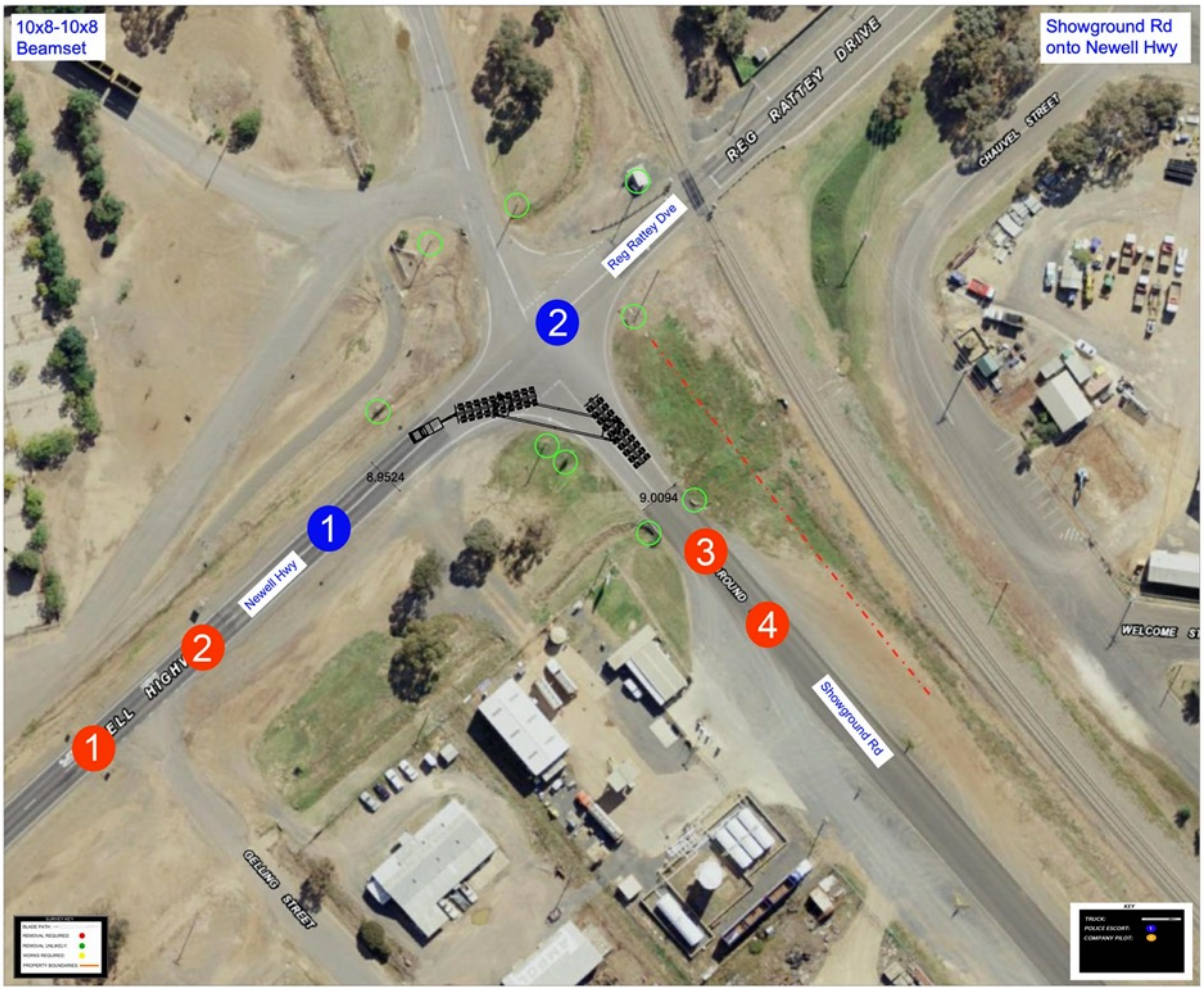
COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Dogleg turn from Compton Road onto Showground Road while crossing onto the incorrect side of the road. Rail protection officer may be required to travel over the rail crossing.

ROAD MODIFICATIONS: Nil.

669.0 Km's: Showground Road onto the Newell Highway at West Wyalong.

Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/yAyBdrZcocEeTBnz6

COMPANY PILOT 1: Warn all northbound traffic on the Newell Highway.

COMPANY PILOT 2: Warn all northbound traffic on the Newell Highway.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

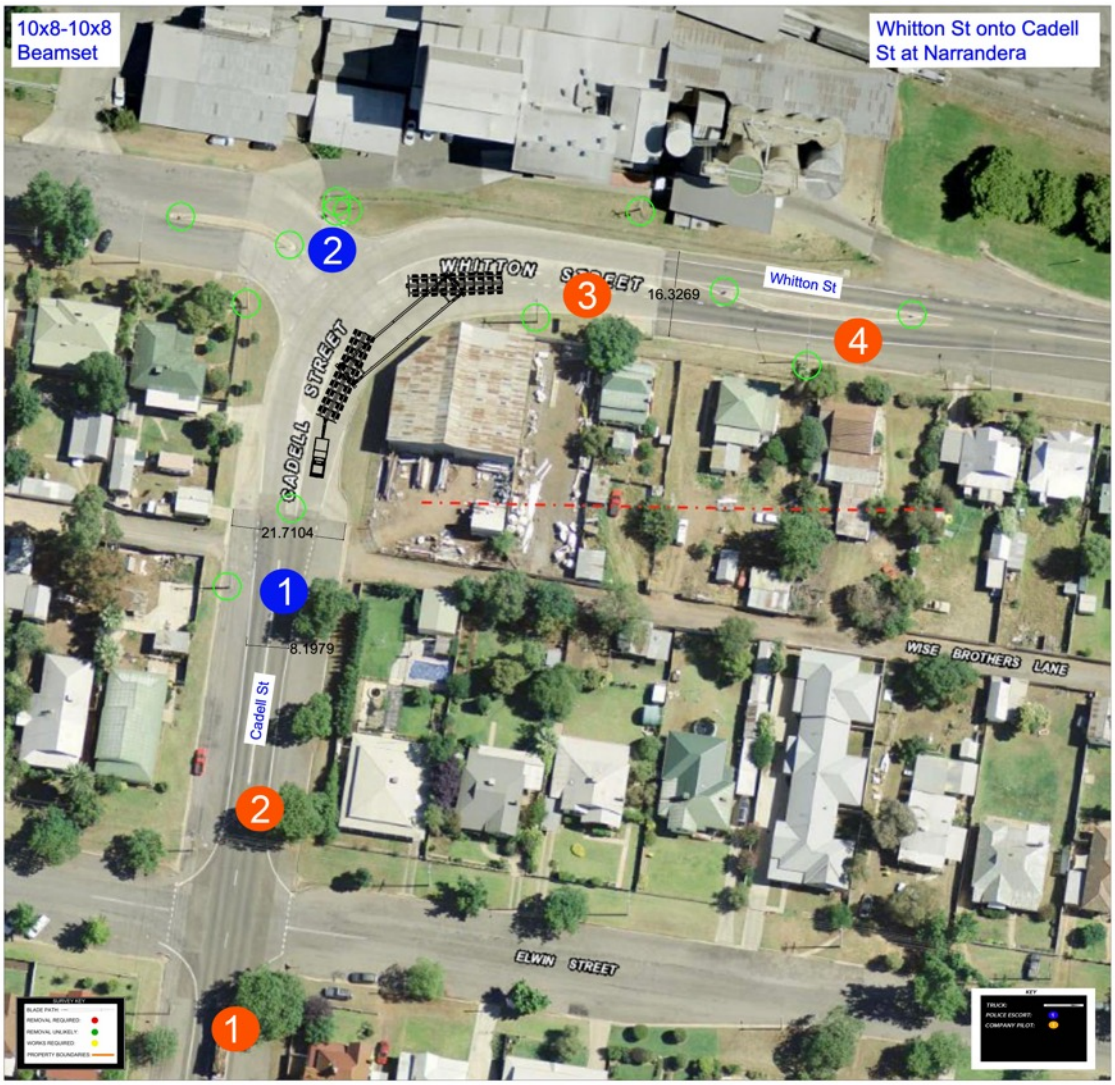
COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn left from Showground Road onto the Newell Highway while crossing onto the incorrect side of the road.

ROAD MODIFICATIONS: Nil.

803.0 Km's: Whitton Street onto Cadell Street at Narrandera. (Newell Highway)

Image 1:



GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/EXcuuBeMsXdhVDtm8

COMPANY PILOT 1: Warn all northbound traffic on Caddell Street.

COMPANY PILOT 2: Warn all northbound traffic on Caddell Street.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn left from Whitton Street onto Caddell Street while staying on the correct side of the road.

ROAD MODIFICATIONS: Nil.

825.0 Km's: The Sturt Highway onto Sandigo Road at Sandigo.

Image 1:

GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/c3ZDZEj78aMwmqEh8

COMPANY PILOT 1: Warn all northbound traffic on Sandigo Road.

COMPANY PILOT 2: Warn all westbound traffic on the Sturt Highway.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn right from the Sturt Highway onto Sandigo Road while crossing onto the incorrect side of the road.

ROAD MODIFICATIONS: Nil.

826.0 Km's: Sandigo Road onto Muntz Road at Sandigo.

Image 1:

GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/WErjz7kPjHWLPRsP6

COMPANY PILOT 1: Warn all eastbound traffic on Muntz Road.

COMPANY PILOT 2: Warn all eastbound traffic on Muntz Road.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn right from Sandigo Road onto Muntz Road while crossing onto the incorrect side of the road.

ROAD MODIFICATIONS: Nil.

828.0 Km's: Muntz Road into Avonleigh Solar Access Road at Sandigo.

Image 1:

GPS LINK FOR SECTION OF ROAD: https://goo.gl/maps/R3T3az3oQiSRg6GV7

COMPANY PILOT 1: Warn all eastbound traffic on Muntz Road.

COMPANY PILOT 2: Warn all eastbound traffic on Muntz Road.

COMPANY PILOT 3: Stay 50 metres behind the load and warn all traffic.

COMPANY PILOT 4: Stay 100 metres behind the load and warn all traffic.

PINCHPOINT PROCEDURE: Load to turn right from Muntz Road onto Avonleigh Solar Access Road while crossing onto the incorrect side of the road.

ROAD MODIFICATIONS: Nil.

15.0 Pinch Points

The following are the pinch points on this route:

- REGULAR ROUTE ASSESMENTS: Prior to the movement Rex J Andrews P/L is to contact TfNSW and local councils regarding any potential roadworks that road stakeholders would have taken place on the route during the proposed delivery dates. Driver/Supervisors are to have full contact details and communicate with these roadwork's managers while on route.

- SWEPT PATH ANALYSIS: This study shows all pinchpoint manoeuvres on route and is a guide to show possible arrangements for traffic control at each of the pinchpoints.

- BRIDGE CROSSINGS: The load is to travel over all structures as per the TfNSW bridge assessment for this movement. Load to take special caution at Denman Bridge and lower the load to 5.5 metres maximum before crossing this structure in the centre of both lanes.

- NEWCASTLE: The load will need to undertake a U-turn on Maitland Road at Sandgate. All personnel are to be tool boxed on the methodology of these procedures.

- NARRENDERA: Some tree pruning is required in Narrendera prior to the load departing Newcastle.

PINCHPOINT PROCEDURES

Whilst some pinch points are known along the route demonstrating a method of negotiating each individual hazard would be flawed as traffic conditions are constantly changing.

It is crucial that appropriate measures are applied to avoid impact to road users and road infrastructure, the chosen route has been assessed and the load is capable of navigating the route, however local traffic conditions can create pinch points.

A pinch point is an area identified by the lead pilot and relayed to the convoy as having the potential to interfere with the swept path of the load, pinch points can be created by road furnishings, roundabouts, narrow sections of road, roadkill, corners, road works, parked vehicles, damaged pavement, this list is not exhaustive.

For the purposes of this traffic management plan identified pinch points will follow the following protocol.

The lead pilot must travel a sufficient distance in front of the load so as to survey the swept path required for the load, this will allow sufficient time to relay back road conditions or choke points to allow the driver to halt the load before causing congestion to other road users.

In the event of parked vehicles or local traffic conditions preventing the load from safely navigating the permitted route, the load cannot proceed until it is safe to do so.

The lead pilot will warn all oncoming traffic of the impending load, when the way forward for the transporter is established as being clear the load may proceed.

If built up queued traffic is behind the load, ensure that an opportunity to allow this traffic to pass is taken at the first safe opportunity.

The procedure for crossing bridges is reliant on only the load being on the bridge during the crossing, this will require a concentrated effort from the escort team to ensure that all vehicular traffic both in front of and behind the load are warned of the hazard.

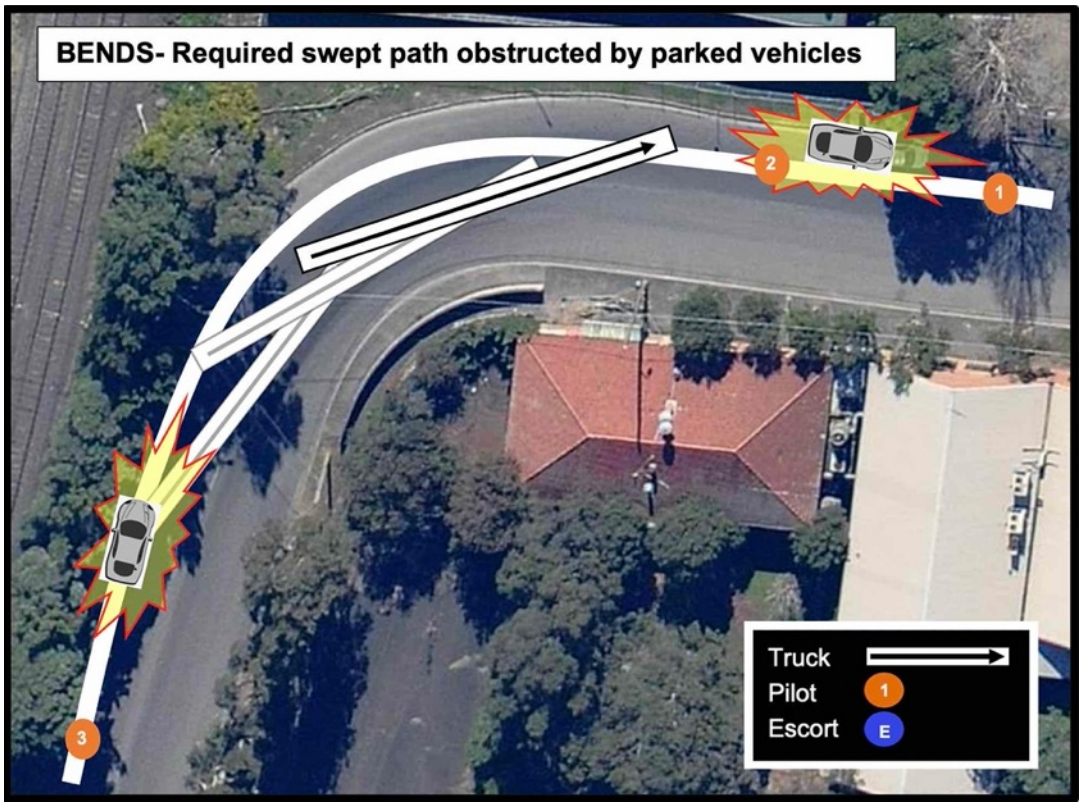
It is crucial that pinch points are discussed at the toolbox briefing and that all parties are aware of the protocols in place.

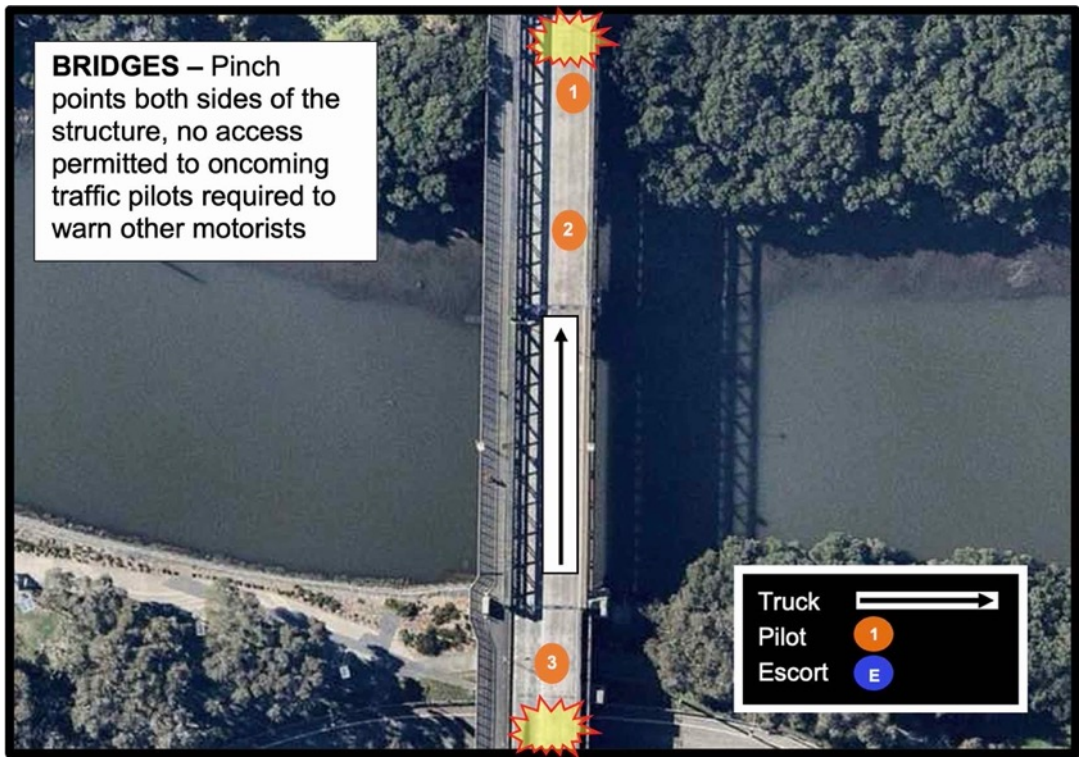
Drivers should familiarise themselves with the route including nominated bypasses for heavy vehicles along the route.

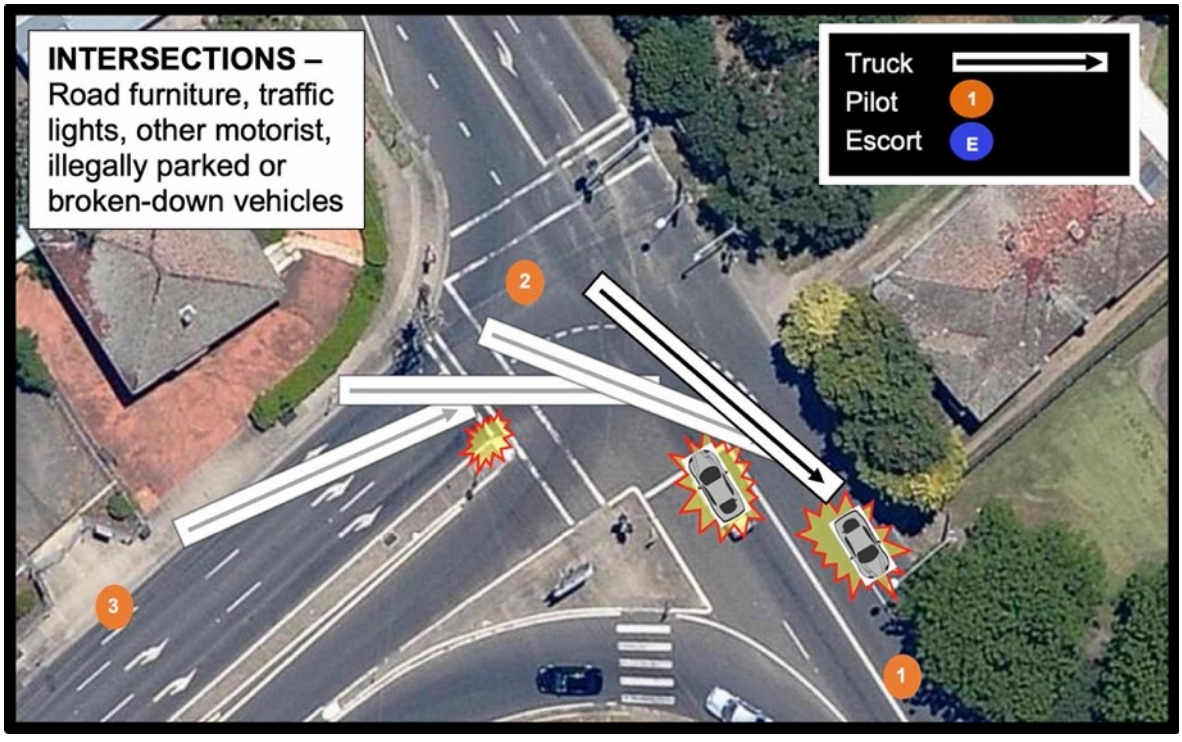
If there is any doubt as to the viability of accessing the permitted route the load must not continue until the way forward has been deemed appropriate.

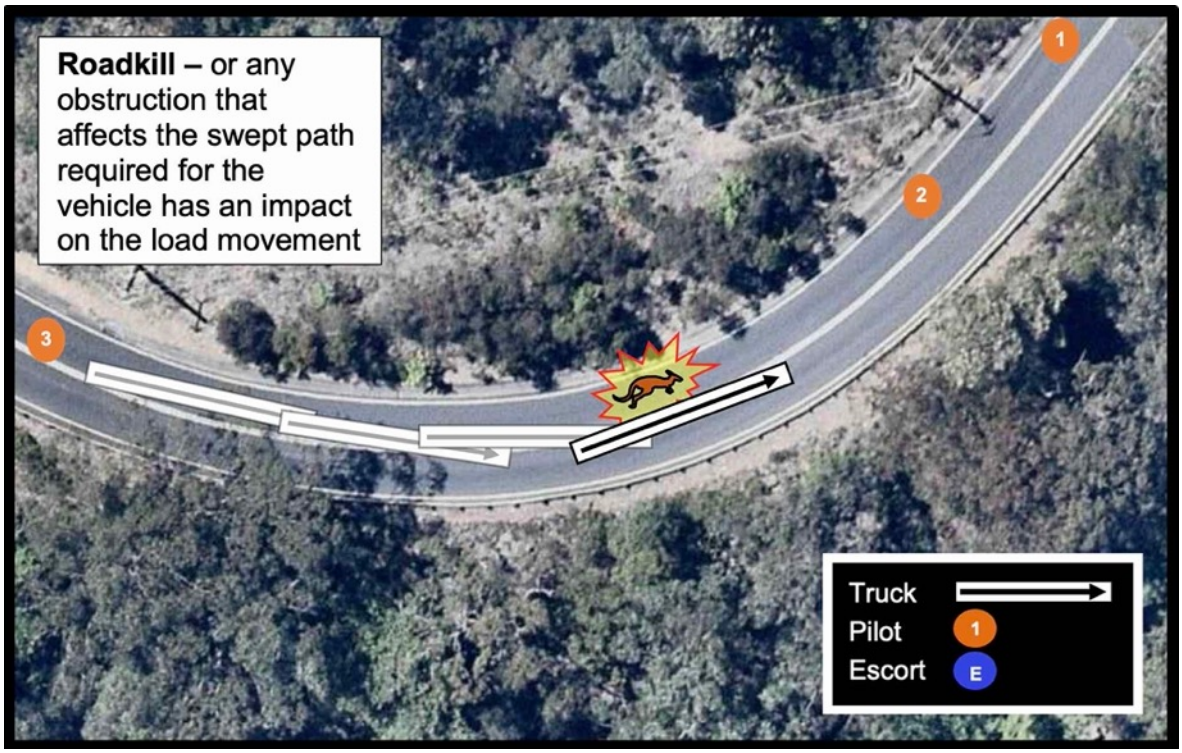
For more detail analysis of coping with roadwork refer to section 11.

Examples of pinch points:




BRIDGES – Pinch points both sides of the structure, no access permitted to oncoming traffic pilots required to warn other motorists
1
2
3
Truck
Pilot
Escort
E

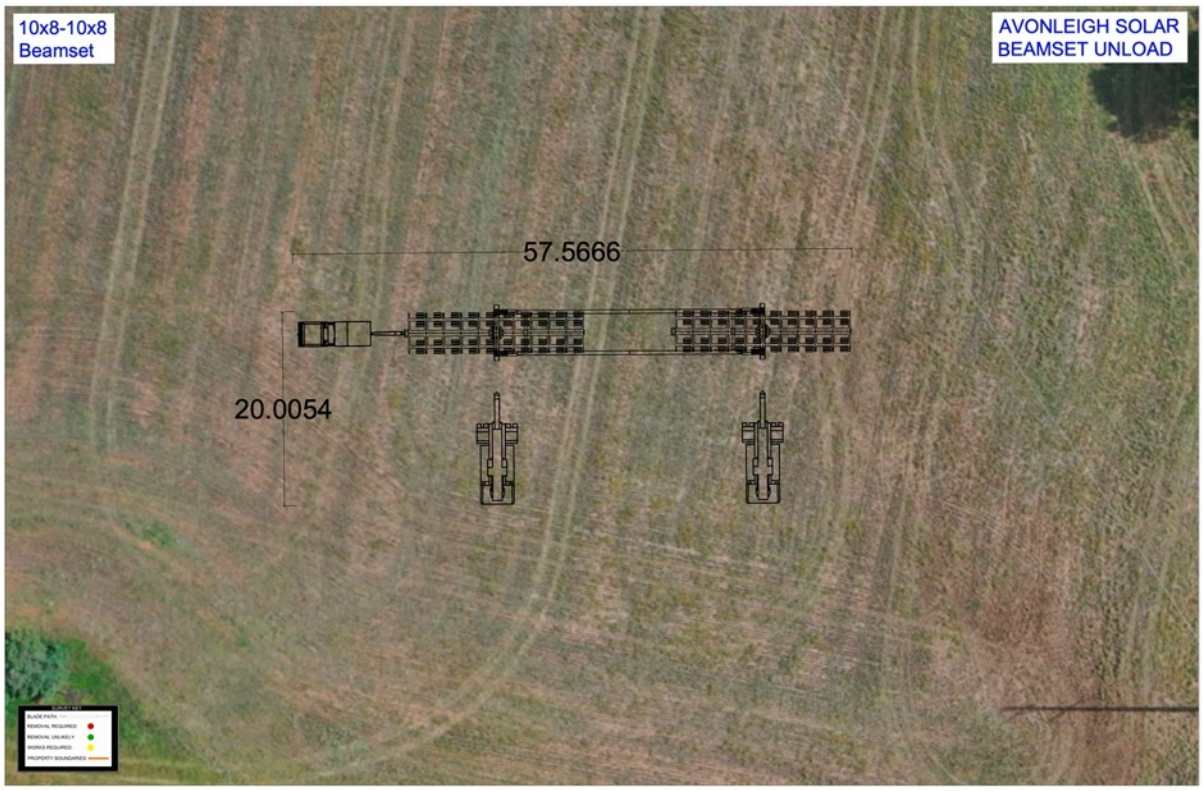

INTERSECTIONS – Road furniture, traffic lights, other motorist, illegally parked or broken-down vehicles
Truck
Pilot
Escort
E
1
2
3


Roadkill – or any obstruction that affects the swept path required for the vehicle has an impact on the load movement
1
2
3
Truck
Pilot
1
Escort
E

16.0 Beamset unload:

The beamset will need to be able to park parallel to the foundation, and enough room provided for 2 x 90T cranes to dissemble the beamset. Please see below image for an idea of the area required to undertake these works.

Image 1:



17.0 TMP Revisions:

Revision number	Revision Date	Author	Description of changes
01	22/02/2022	WA	Section 16: Beamset unload added.

18.0 References:

Australian Load Restraint Guide
Rex J Andrews P/L transport drawing
Hyosung transformer drawing
Rex J Andrews route survey #333 REV00
Google Earth/Maps
Nearmaps
NHVAS Maintenance Management (NHVAS21193)
NHVAS Basic Fatigue Management (NHVAS21193)

19.0 TMP Review:

Final Review	Name	Signature	Date
TMP Checked by:	Warrick Andrews		
	Carl Andrews		
	Mark Sciberras		

Sign On: **I confirm that I have received a hard copy of this TMP, I have read and understood the contents; by signing this document I acknowledge that I am now familiar with the identified pinch points, the route and the conditions relating to time of travel. I understand that prior to travel a supervisor may ask me questions specific to this TMP, in the event that I cannot demonstrate awareness of the conditions of the TMP I must delay my departure until I have reviewed its content.**

Name	Role	Signature	Date	Company

Appendix H Proposed road and culvert upgrades

GOULBURN RIVER SOLAR FARM

WOLLARA ROAD

ROAD UPGRADE

ISSUED FOR INFORMATION

NUMBER	DESCRIPTION			REV
0305-DRG-00-GE-0001	GENERAL	COVER SHEET AND DRAWING INDEX	1 OF 1	A
0305-DRG-00-GE-0031	PAVEMENT	PAVEMENT DETAILS	1 OF 1	A
0305-DRG-00-GE-0051	ROAD	TYPICAL SECTIONS	1 OF 1	A
0305-DRG-00-PV-0101	PAVEMENT	PLAN	1 OF 4	A
0305-DRG-00-PV-0102	PAVEMENT	PLAN	2 OF 4	A
0305-DRG-00-PV-0103	PAVEMENT	PLAN	3 OF 4	A
0305-DRG-00-PV-0104	PAVEMENT	PLAN	4 OF 4	A

FOR INFORMATION ONLY

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CO-ORDINATE SYSTEM: MGA ZONE 56 (GDA2020) HEIGHT DATUM: AHD

PLOT DATE / TIME: 20 September 2022 11:16:35 AM PLOT BY: KateMercer

TITLE	NAME	DATE
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DRG CHECK	B.EVANS	20.09.22
DESIGN	B.DUNLOP	20.09.22
DESIGN CHECK	J.DeWIT	20.09.22
DESIGN MNGR	J.DeWIT	20.09.22
PROJECT MNGR	R.BANZON	20.09.22

DRAWINGS / DESIGN PREPARED BY
DESIGNER
turnbull

DRAWINGS / DESIGN PREPARED FOR
CLIENT

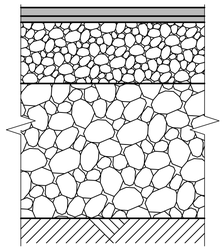
DRAWING TITLE
GOULBURN RIVER SOLAR FARM, EIS
GENERAL
COVER SHEET AND DRAWING INDEX

A1

SHEET
1 OF 1

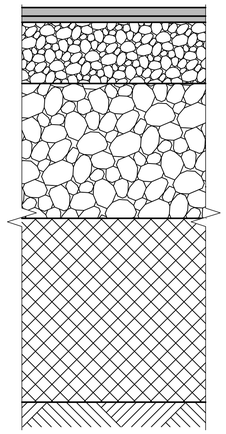
DRAWING NUMBER 0305-DRG-00-GE-0001

ISSUE STATUS: FOR INFORMATION
SHEET No.: 00-GE-0001
ISSUE: A



TYPE 1
GRANULAR BASE SPRAYED SEAL
CH 0 - CH 390, CH 1000 - CH 2420, CH 2840 - CH 3350, CH 4100 - CH 4949.207

SCALE 1:5



TYPE 2
GRANULAR BASE SPRAYED WITH INSITU STABLISED SUBGRADE
CH 390 - CH 1000, CH 2420 - CH 2840, CH 3350 - CH 4100

SCALE 1:5

HOLD - SEE NOTE 1

NOTES

1. PAVEMENT TYPES ARE SUBJECT TO GEOTECHNICAL INVESTIGATION AND ASSUMED BASED ON PAVEMENT REHABILITATION WORKS ON RINGWOOD ROAD COMPLETED IN 2021.

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PLOT DATE / TIME: 20 September 2022 03:48:42 PM PLOT BY: KateMercer

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DRG CHECK	B.EVANS	20.09.22
DESIGN	S.SHAMSODIEN	20.09.22
DESIGN CHECK	J.DeWIT	20.09.22
DESIGN MNGR	J.DeWIT	20.09.22
PROJECT MNGR	R.BANZON	20.09.22

DRAWINGS / DESIGN PREPARED BY
DESIGNER
turnbull

DRAWINGS / DESIGN PREPARED FOR
CLIENT

DRAWING TITLE
GOULBURN RIVER SOLAR FARM, EIS
GENERAL
PAVEMENT DETAILS

A1

SHEET
1 OF 1

DRAWING NUMBER 0305-DRG-00-GE-0031

ISSUE STATUS: FOR INFORMATION
SHEET No.: 00-GE-0031
ISSUE: A

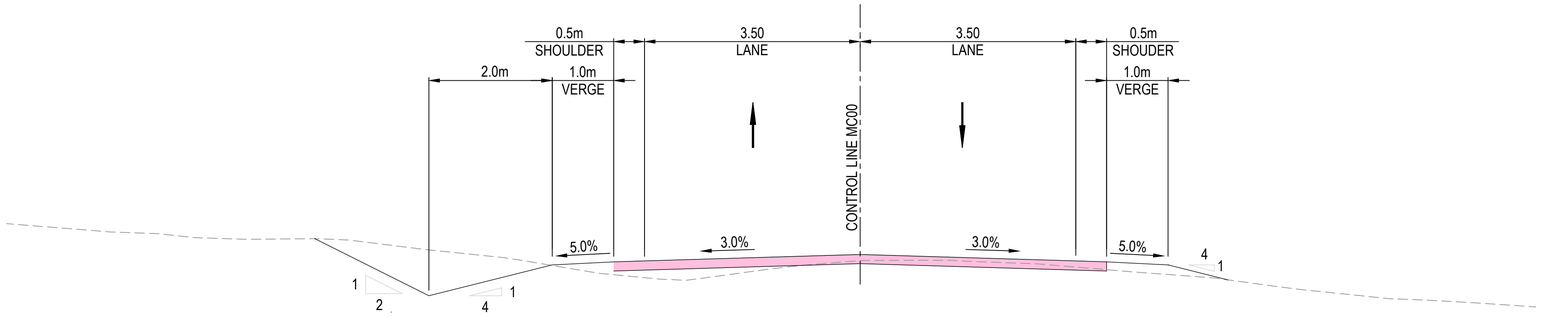
X-DSG-00-GE-A-SHT
X-SDS-PAPER-A1S

LEGEND

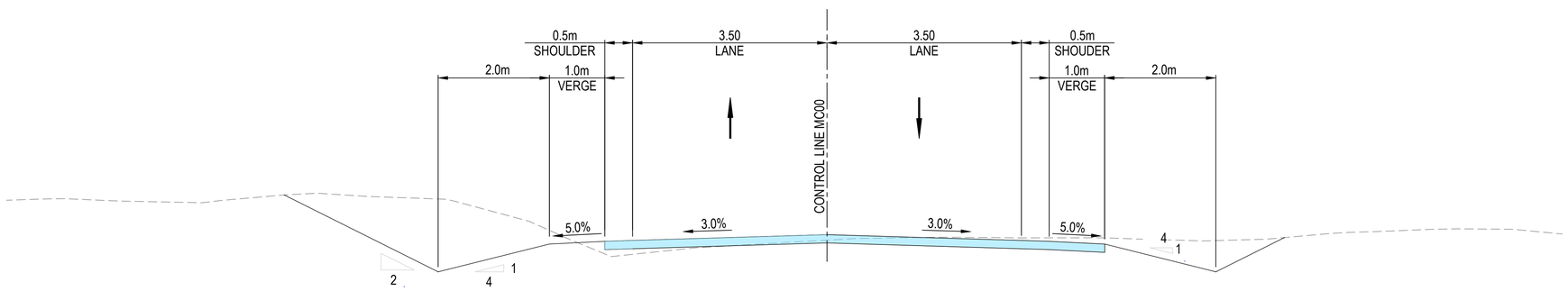
- EXISTING SURFACE
- DESIGN SURFACE
- PAVEMENT TYPE 1
- PAVEMENT TYPE 2

NOTE

1. FOR PAVEMENT TYPE REFER TO 0305-DRG-00-GE-0031.



SECTION 2
SCALE 1:50
PV-0103



SECTION 1
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PV-0102

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						DRG CHECK	B.EVANS	20.09.22
						DESIGN	B.DUNLOP	20.09.22
						DESIGN CHECK	J.DeWIT	20.09.22
						DESIGN MNGR	J.DeWIT	20.09.22
						PROJECT MNGR	R.BANZON	20.09.22

SCALES ON A1 SIZE DRAWING
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SCALE 1:1000m

CO-ORDINATE SYSTEM: MGA ZONE 56 (GDA2020)
HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY
DESIGNER
turnbull

DRAWINGS / DESIGN PREPARED FOR
CLIENT

DRAWING TITLE
GOULBURN RIVER SOLAR FARM, EIS
ROAD
TYPICAL SECTIONS

A1

SHEET
1 OF 1

DRAWING NUMBER 0305-DRG-00-GE-0051

ISSUE STATUS: FOR INFORMATION
SHEET No.: 00-GE-0051
ISSUE: A

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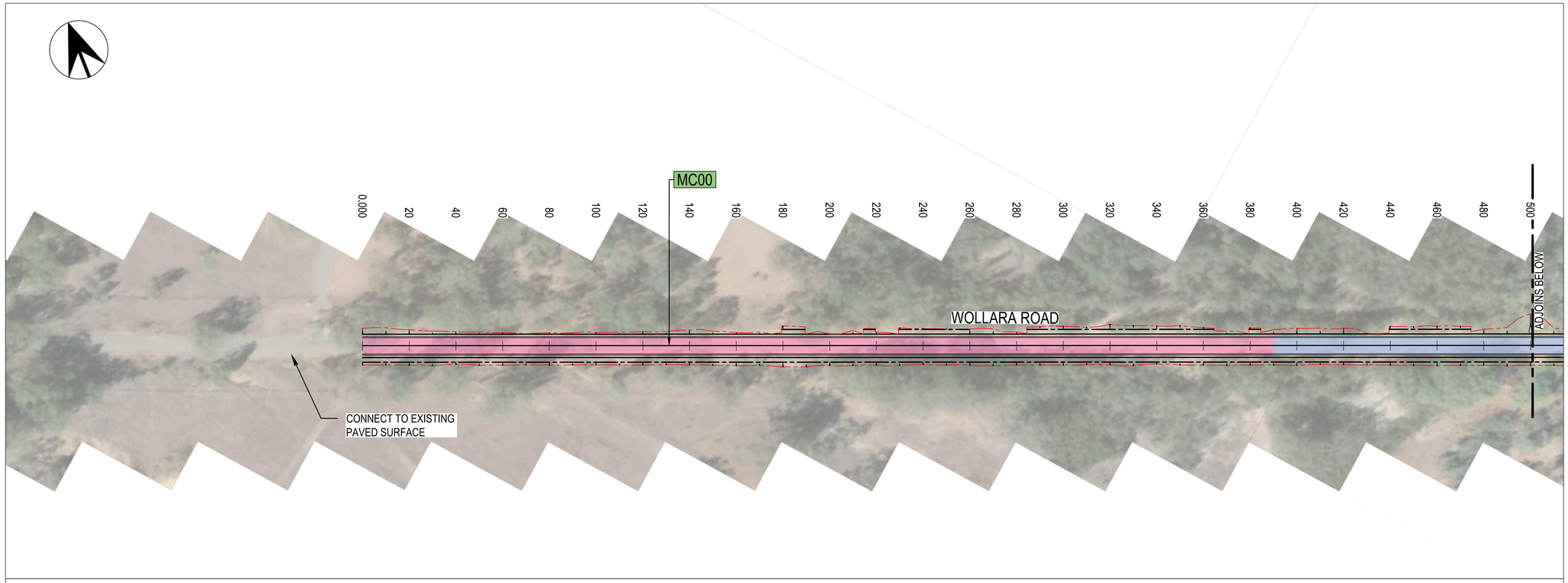

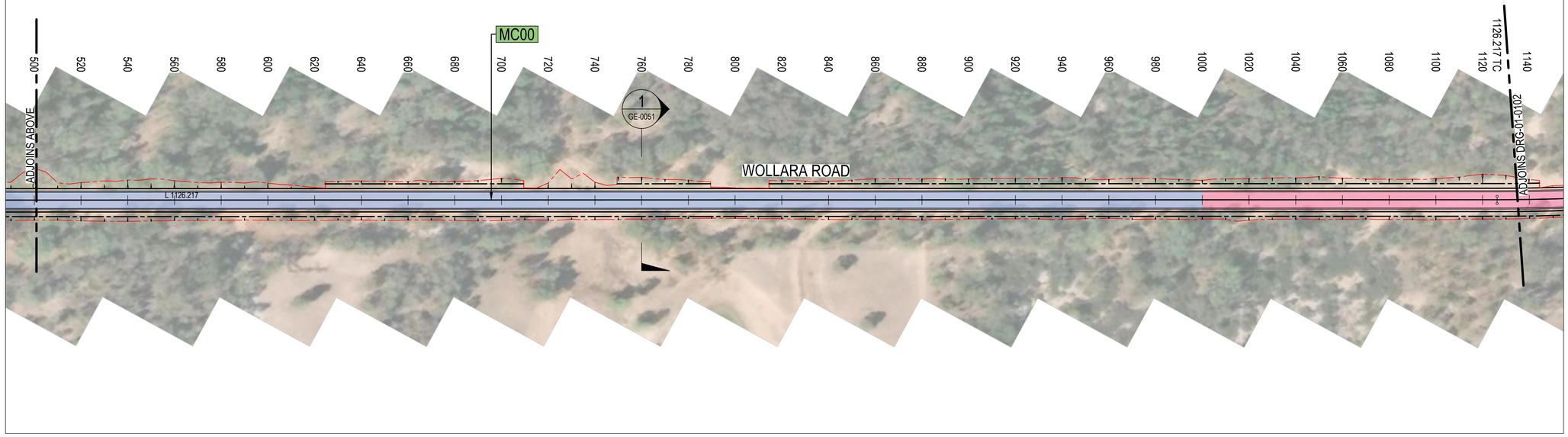

LEGEND

GENERAL

- REF BOUNDARY
- DESIGN

ROAD GEOMETRY

- CONTROL LINE AND CHAINAGE (20)
- MCXX — CONTROL LINE LABEL

PAVEMENT AND KERBS

- TYPE 1
- TYPE 2

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50mm ON A3 SIZE ORIGINAL

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							DRG CHECK	B.EVANS	20.09.22				
							DESIGN	S.SHAMSODIEN	20.09.22				
							DESIGN CHECK	J.DeWIT	20.09.22				
							DESIGN MNGR	J.DeWIT	20.09.22			ISSUE STATUS FOR INFORMATION	SHEET No. 00-PV-0102 ISSUE A
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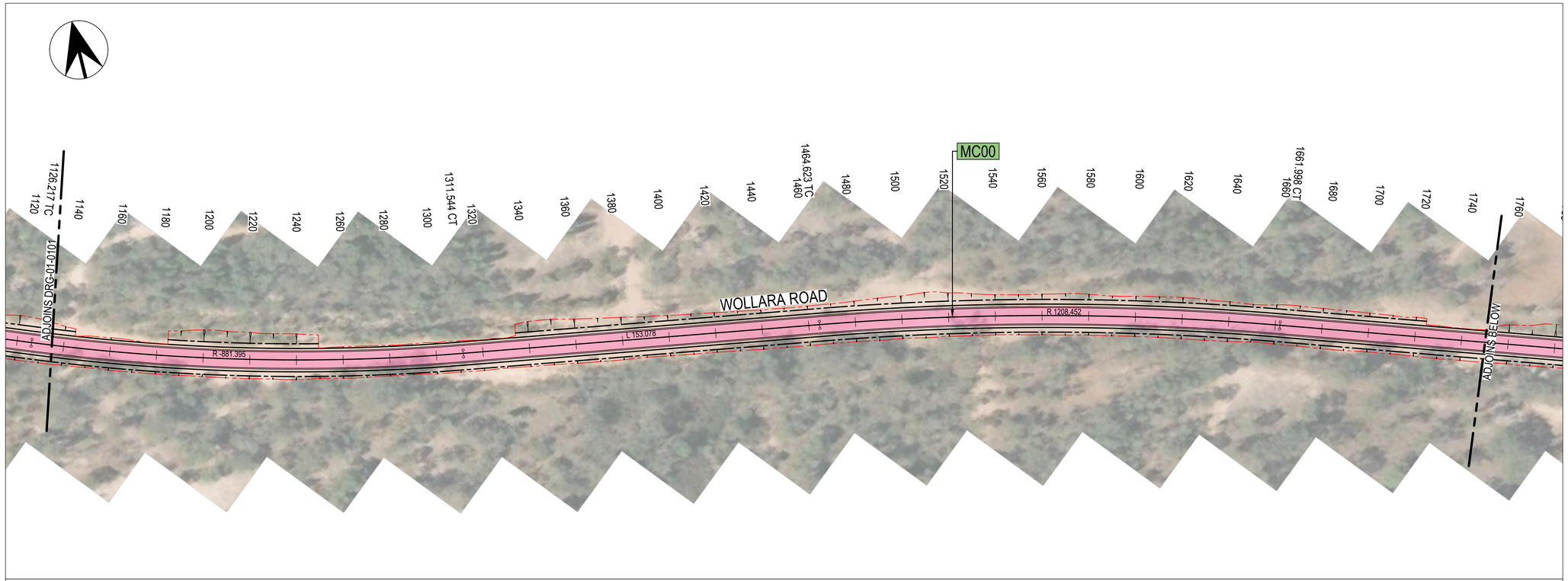
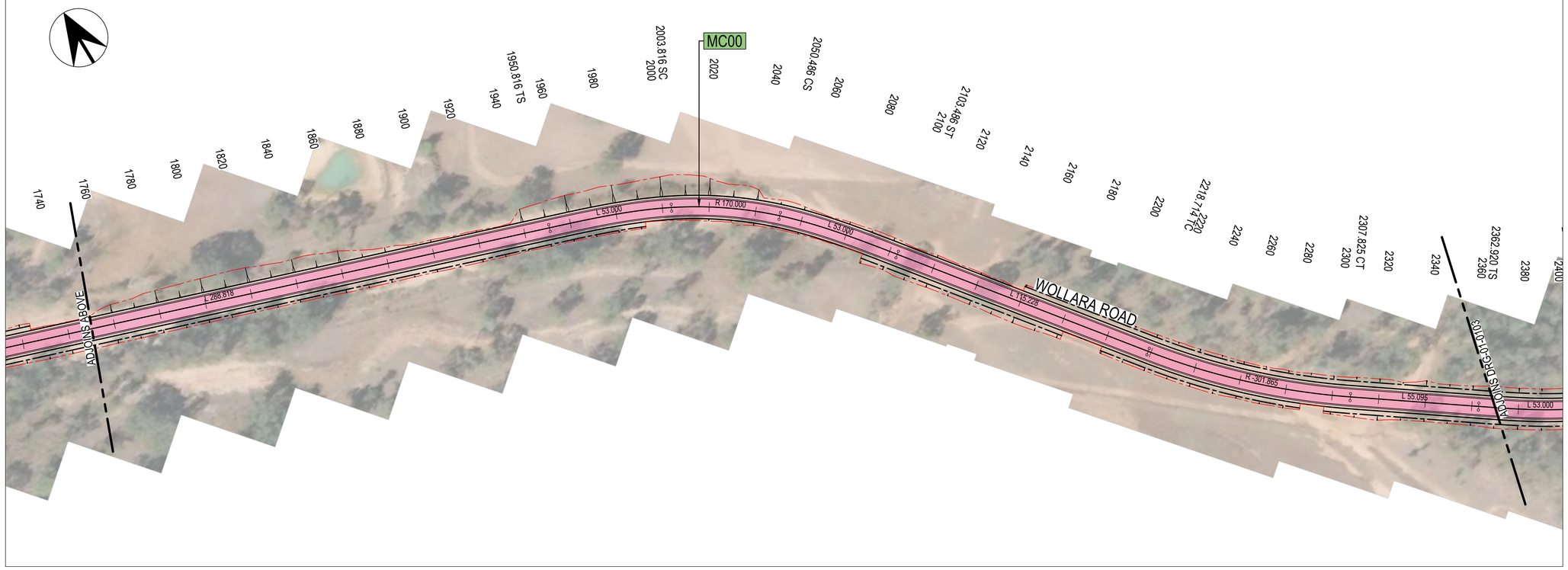
						HEIGHT DATUM AHD							





LEGEND

GENERAL

- REF BOUNDARY
- DESIGN

ROAD GEOMETRY

- CONTROL LINE AND CHAINAGE (20)
- MCXX — CONTROL LINE LABEL

PAVEMENT AND KERBS

- TYPE 1
- TYPE 2

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THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

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X-0305-GE-ANNOTATION
X-0305-PV-HATCH

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
A	20.09.22	ISSUED FOR INFORMATION	-	MD

SCALES ON A1 SIZE DRAWING
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SCALE 1:1000m

CO-ORDINATE SYSTEM: MGA ZONE 56 (GDA2020)
HEIGHT DATUM: AHD

PLOT DATE / TIME: 20 September 2022 12:34:19 PM
PLOT BY: KateMercer

TITLE	NAME	DATE
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DRG CHECK	B.EVANS	20.09.22
DESIGN	S.SHAMSODIEN	20.09.22
DESIGN CHECK	J.DeWIT	20.09.22
DESIGN MNGR	J.DeWIT	20.09.22
PROJECT MNGR	R.BANZON	20.09.22

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DESIGNER
turnbull

DRAWINGS / DESIGN PREPARED FOR
CLIENT

DRAWING TITLE
GOULBURN RIVER SOLAR FARM, EIS
PAVEMENT
PLAN

A1

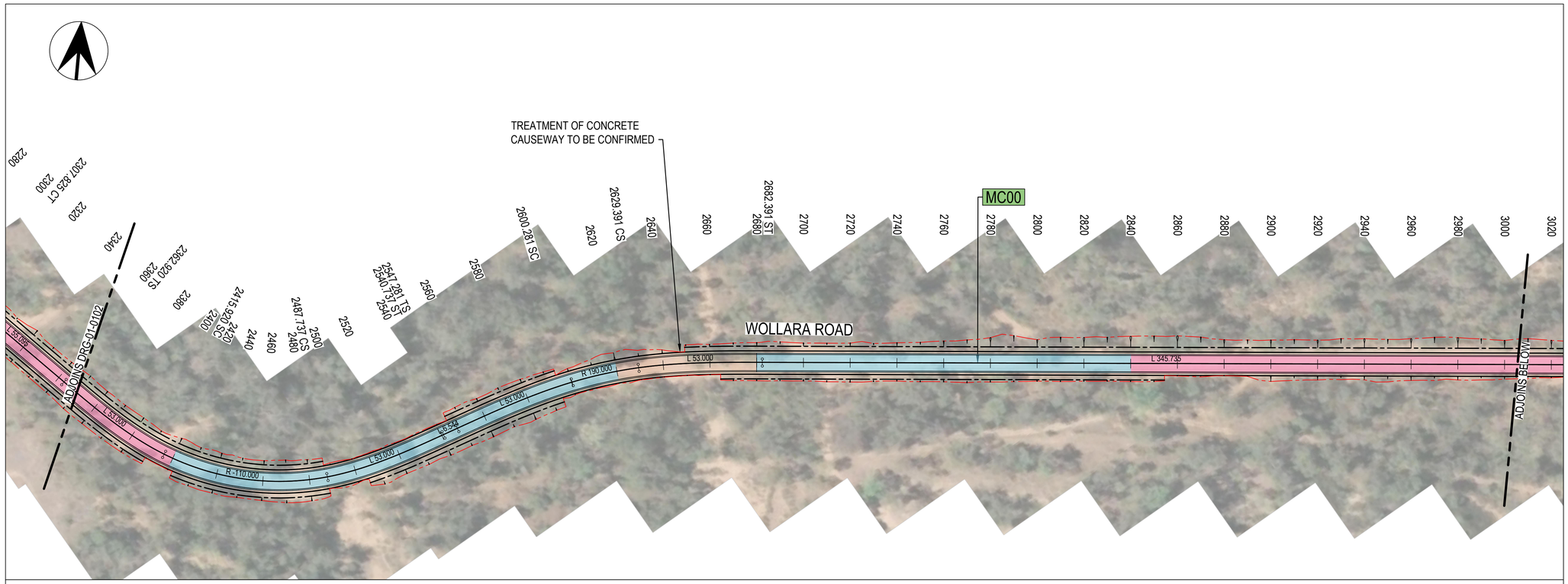
SHEET
2 OF 4

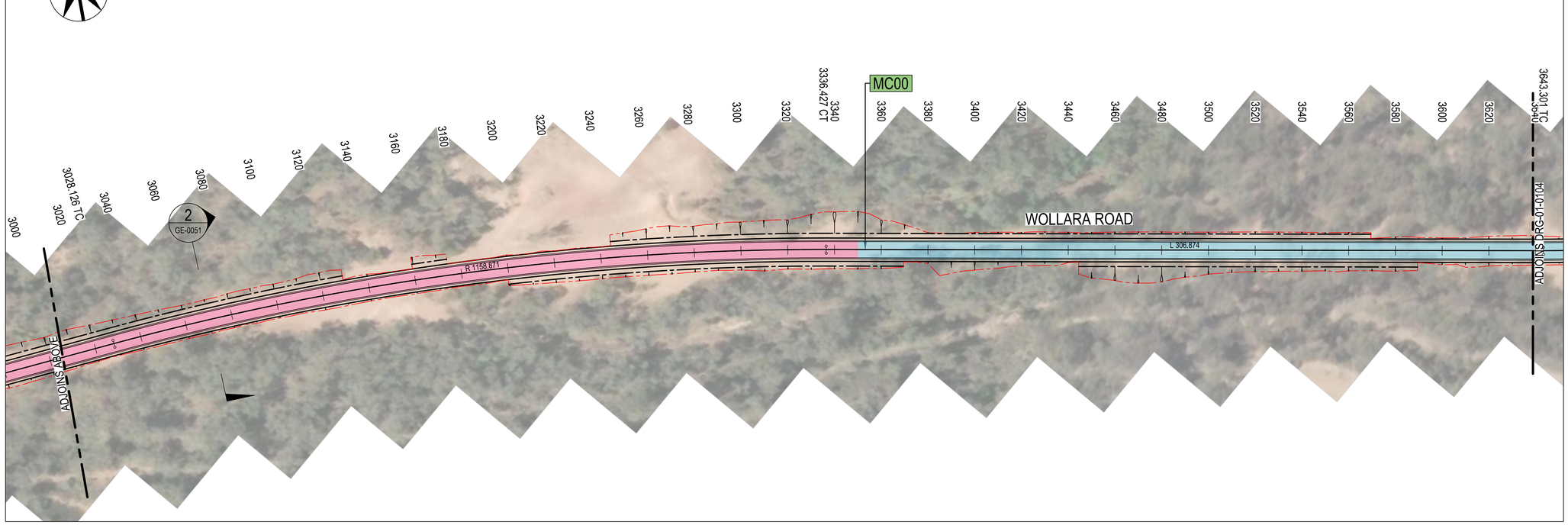
DRAWING NUMBER
0305-DRG-00-PV-0102

ISSUE STATUS
FOR INFORMATION

SHEET No.
00-PV-0102

ISSUE
A





LEGEND

GENERAL

- REF BOUNDARY
- DESIGN

ROAD GEOMETRY

- CONTROL LINE AND CHAINAGE
- MCXX CONTROL LINE LABEL

PAVEMENT AND KERBS

- TYPE 1
- TYPE 2

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50mm ON A3 SIZE ORIGINAL

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REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
A	20.09.22	ISSUED FOR INFORMATION	-	MD

SCALES ON A1 SIZE DRAWING

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SCALE 1:1000m

CO-ORDINATE SYSTEM: MGA ZONE 56 (GDA2020) HEIGHT DATUM: AHD

PLOT DATE / TIME: 20 September 2022 03:18:03 PM PLOT BY: KateMercer

TITLE	NAME	DATE
DRAWN	K.MERCER	20.09.22
DRG CHECK	B.EVANS	20.09.22
DESIGN	S.SHAMSODIEN	20.09.22
DESIGN CHECK	J.DeWIT	20.09.22
DESIGN MNGR	J.DeWIT	20.09.22
PROJECT MNGR	R.BANZON	20.09.22

DRAWINGS / DESIGN PREPARED BY

DESIGNER

turnbull

DRAWINGS / DESIGN PREPARED FOR

CLIENT

DRAWING TITLE

GOULBURN RIVER SOLAR FARM, EIS
PAVEMENT
PLAN

A1

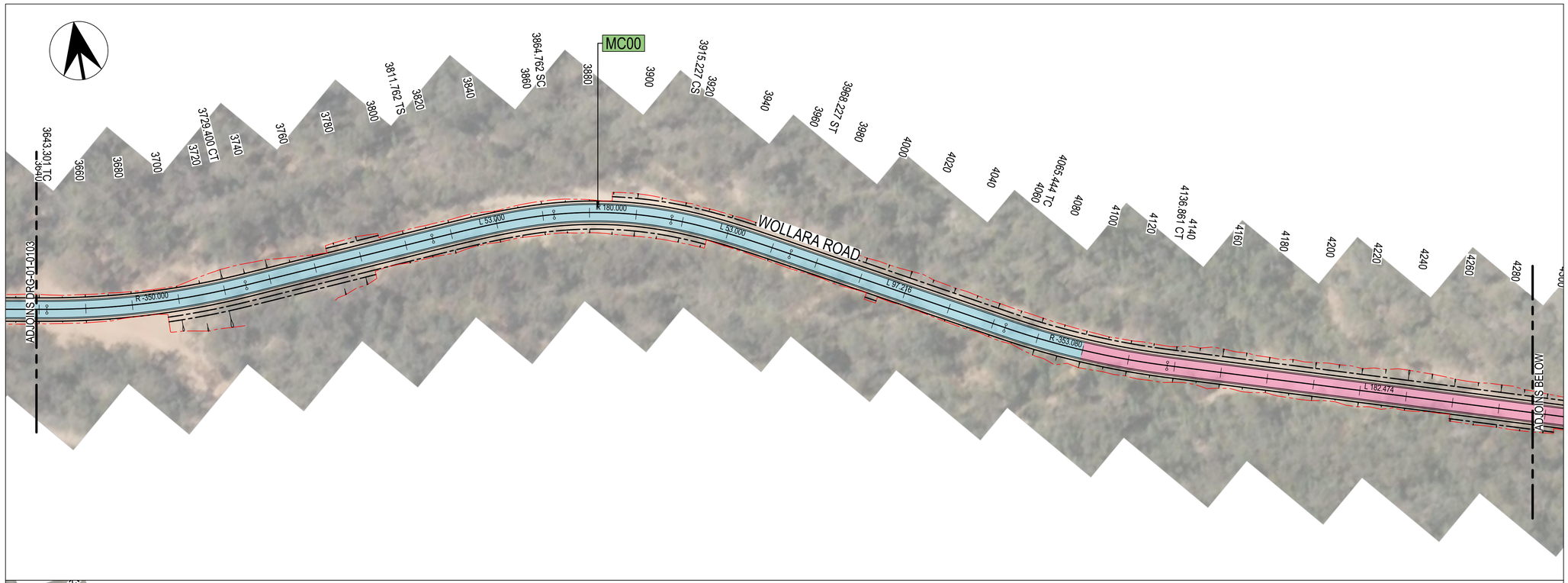
SHEET 3 OF 4

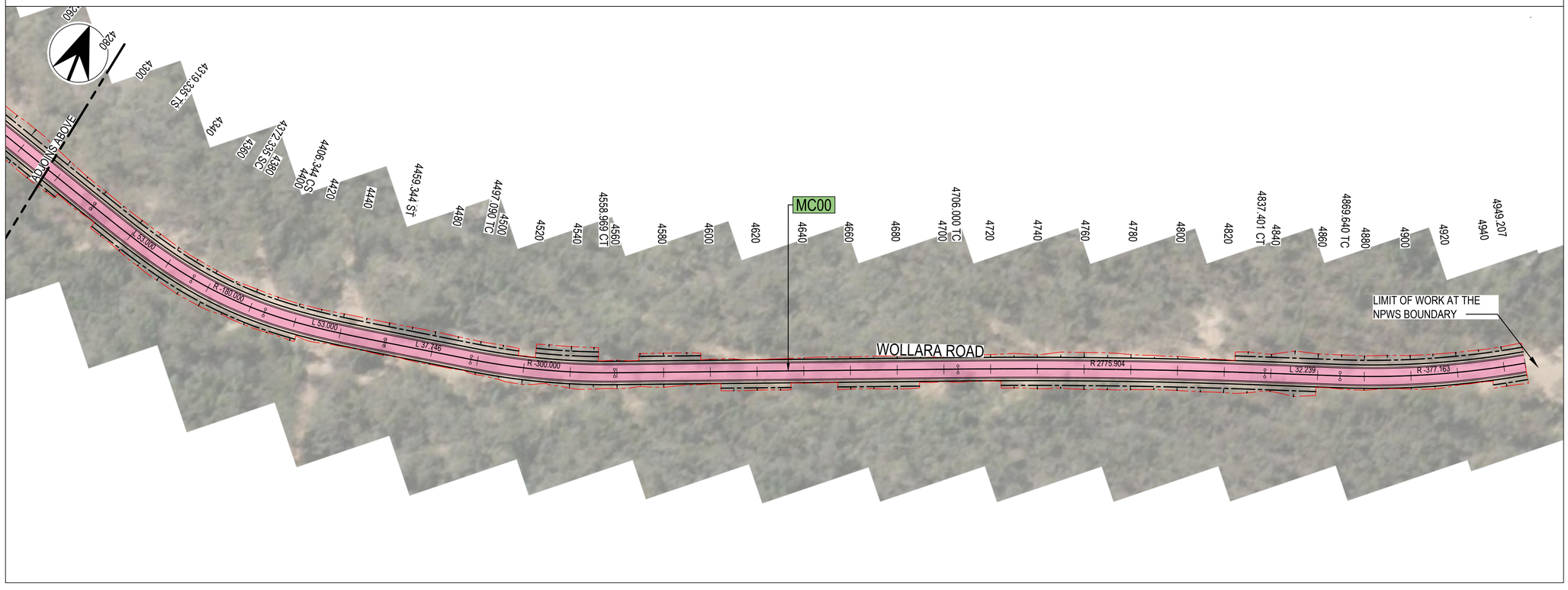
DRAWING NUMBER 0305-DRG-00-PV-0103

ISSUE STATUS: FOR INFORMATION

SHEET No.: 00-PV-0103

ISSUE: A





LEGEND

GENERAL

- REF BOUNDARY
- DESIGN

ROAD GEOMETRY

- CONTROL LINE AND CHAINAGE (20)
- MCXX — CONTROL LINE LABEL

PAVEMENT AND KERBS

- TYPE 1
- TYPE 2

FOR INFORMATION ONLY

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X-0305-GE-SHT-A1.shf
X-0305-DR-GE-A1.shf
X-0305-DR-GE-ELEGEN-1000
X-0305-DR-GE-ANNO-1000
X-0305-PV-MATCH

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
A	20.09.22	ISSUED FOR INFORMATION	-	MD

SCALES ON A1 SIZE DRAWING
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CO-ORDINATE SYSTEM: MGA ZONE 56 (GDA2020) HEIGHT DATUM: AHD

PLOT DATE / TIME: 20 September 2022 12:36:02 PM PLOT BY: KateMercer

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DRG CHECK	B.EVANS	20.09.22
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DESIGN CHECK	J.DeWIT	20.09.22
DESIGN MNGR	J.DeWIT	20.09.22
PROJECT MNGR	R.BANZON	20.09.22

DRAWINGS / DESIGN PREPARED BY
DESIGNER
turnbull

DRAWINGS / DESIGN PREPARED FOR
CLIENT

DRAWING TITLE
GOULBURN RIVER SOLAR FARM, EIS
PAVEMENT
PLAN

A1

SHEET
4 OF 4

DRAWING NUMBER: 0305-DRG-00-PV-0104

ISSUE STATUS: FOR INFORMATION
SHEET No.: 00-PV-0104
ISSUE: A

LEGEND

- CADASTRAL BOUNDARY (DCDB)
- FENCE LINE
- FOG LINE
- CENTRELINE OF ROAD
- EDGE OF BITUMEN
- EDGE OF UNSEALED SHOULDER
- STORMWATER PIPE
- SURVEY CONTROL POINT
- DENOTES TREE
- DENOTES CUT AND FILL

TOWARDS MERRIWA

LOT 16
DP 11212

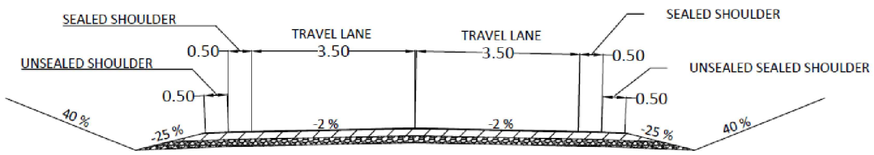
LOT 16
DP 11212

LOT 222
DP 750934

LOT 254
DP 722258

LOT 151
DP 1011943

5+000 5+020 5+040 5+060 5+080 5+100 5+120 5+140 5+160 5+180 5+200 5+220 5+240 5+260 5+280 5+300 5+320 5+340 5+360 5+380 5+400



TYPICAL SECTION
SCALE 1:100

HARRYAN
ENGINEERING COUNSULTING

CLIENT:
lightsourcebp bp

DATE:	REVISION:	DESCRIPTION:
24.01.2023	0	CLIENT REVIEW

PROJECT:
RINGWOOD ROAD UPGRADE

DRAWING TITLE:
Proposed Alignment

ISSUE STATUS:
CONCEPTUAL DESIGN CLIENT REVIEW

SCALE: 1:1000
DWG No: HEC22_
JOB No: 22Q3J3
COORDINATE SYSTEM: MGA ZONE 56 GDA 2020
DATUM: AHD

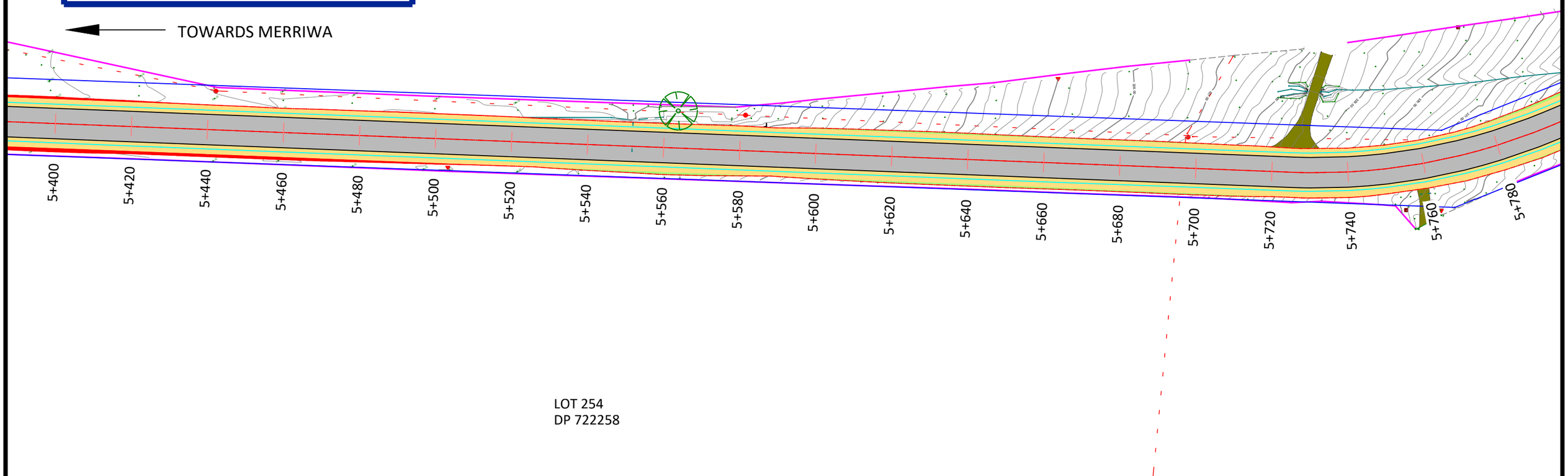
SURVEYED: RAP SURVEYING
DESIGNED: RS
DRAWN: RJ
SHEET: 1
REV: 0

LEGEND

- CADASTRAL BOUNDARY (DCDB)
- FENCE LINE
- FOG LINE
- CENTRELINE OF ROAD
- EDGE OF BITUMEN
- EDGE OF UNSEALED SHOULDER
- STORMWATER PIPE
- SURVEY CONTROL POINT
- DENOTES TREE
- DENOTES CUT AND FILL

TOWARDS MERRIWA

LOT 22
DP 750934



LOT 254
DP 722258

HARRYAN
ENGINEERING COUNSULTING

CLIENT: lightsource bp

DATE:	REVISION:	DESCRIPTION:
24.01.2023	0	CLIENT REVIEW

PROJECT:
RINGWOOD ROAD UPGRADE

DRAWING TITLE:
Proposed Alignment

ISSUE STATUS:
CONCEPTUAL DESIGN CLIENT REVIEW

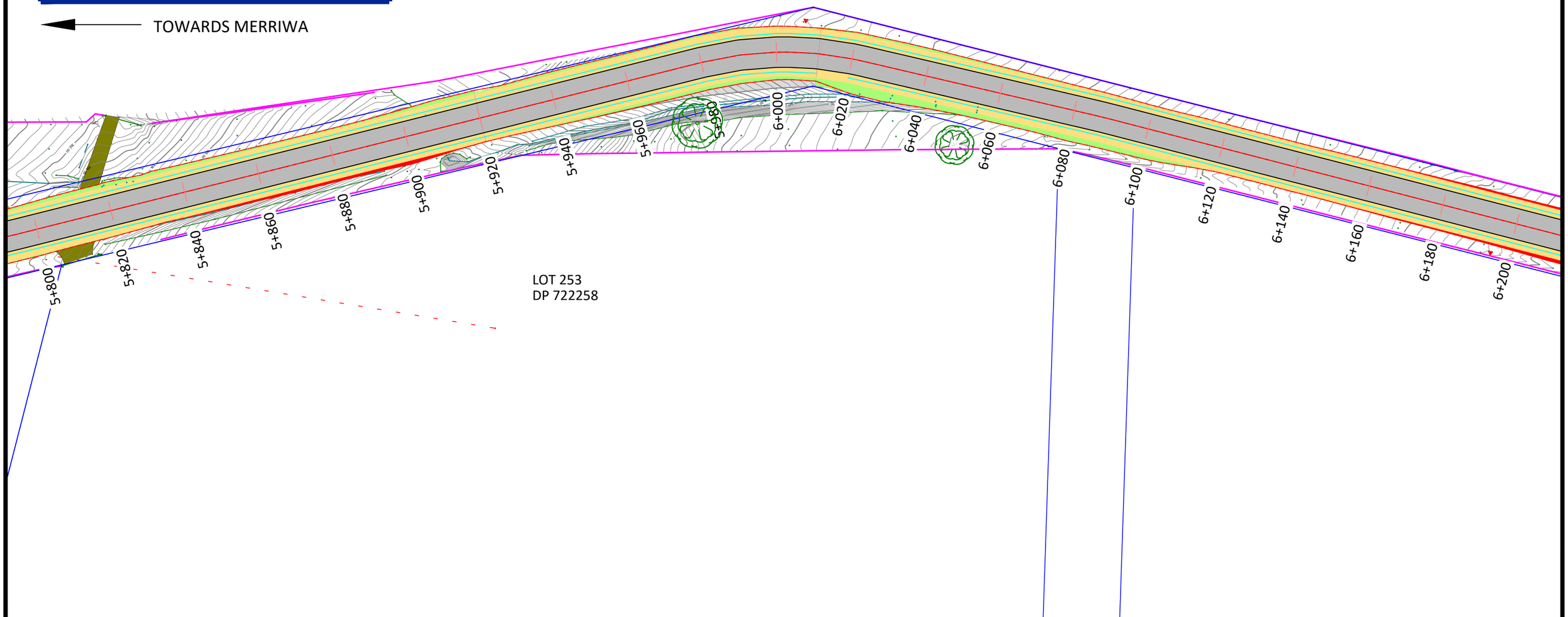
SCALE: 1:1000	SURVEYED: RAP SURVEYING
DWG No: HEC22_	DESIGNED: RS / DRAWN: RJ
JOB No: 22Q3J3	
COORDINATE SYSTEM: MGA ZONE 56 GDA 2020	SHEET: 2 / REV: 0
DATUM: AHD	

LEGEND

- CADASTRAL BOUNDARY (DCDB)
- FENCE LINE
- FOG LINE
- CENTRELINE OF ROAD
- EDGE OF BITUMEN
- EDGE OF UNSEALED SHOULDER
- STORMWATER PIPE
- SURVEY CONTROL POINT
- DENOTES TREE
- DENOTES CUT AND FILL

TOWARDS MERRIWA

LOT 222
DP 750934



LOT 253
DP 722258

HARRYAN
ENGINEERING COUNSULTING

CLIENT: lightsource bp

DATE:	REVISION:	DESCRIPTION:
24.01.2023	0	CLIENT REVIEW

PROJECT:
RINGWOOD ROAD UPGRADE

DRAWING TITLE:
Proposed Alignment

ISSUE STATUS:
CONCEPTUAL DESIGN CLIENT REVIEW

SCALE: 1:1000
DWG No: HEC22_
JOB No: 22Q3J3
COORDINATE SYSTEM: MGA ZONE 56 GDA 2020
DATUM: AHD

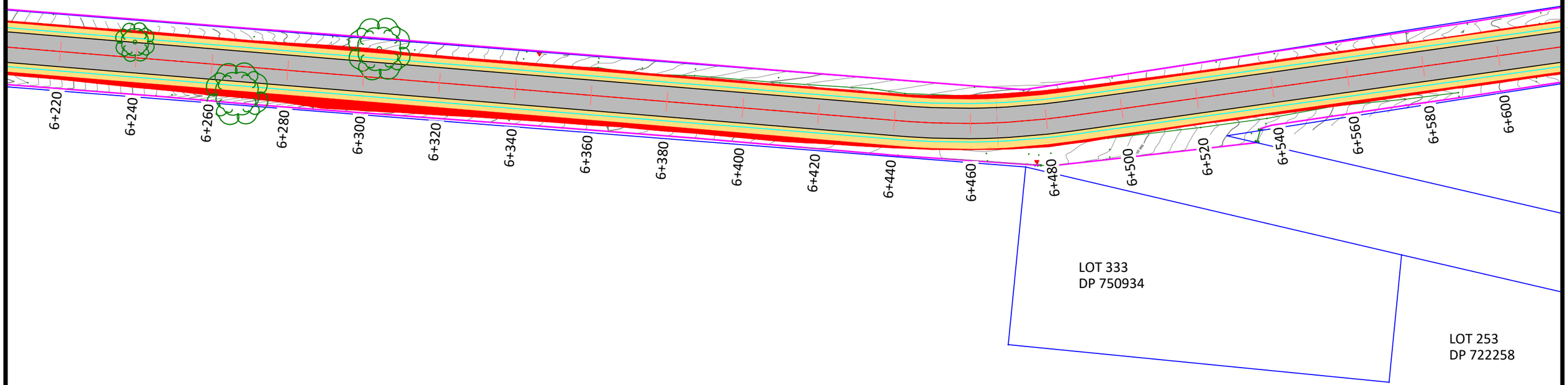
SURVEYED: RAP SURVEYING
DESIGNED: RS
DRAWN: RJ
SHEET: 3
REV: 0

LEGEND

- CADASTRAL BOUNDARY (DCDB)
- FENCE LINE
- FOG LINE
- CENTRELINE OF ROAD
- EDGE OF BITUMEN
- EDGE OF UNSEALED SHOULDER
- STORMWATER PIPE
- SURVEY CONTROL POINT
- DENOTES TREE
- DENOTES CUT AND FILL

TOWARDS MERRIWA

LOT222
DP 750934



HARRYAN ENGINEERING COUNSULTING

CLIENT: lightsource bp

DATE:	REVISION:	DESCRIPTION:
24.01.2023	0	CLIENT REVIEW

PROJECT: RINGWOOD ROAD UPGRADE

DRAWING TITLE: Proposed Alignment

ISSUE STATUS: CONCEPTUAL DESIGN CLIENT REVIEW

SCALE: 1:1000
DWG No: HEC22_
JOB No: 22Q3J3
COORDINATE SYSTEM: MGA ZONE 56 GDA 2020
DATUM: AHD

SURVEYED: RAP SURVEYING
DESIGNED: RS
DRAWN: RJ
SHEET: 4
REV: 0

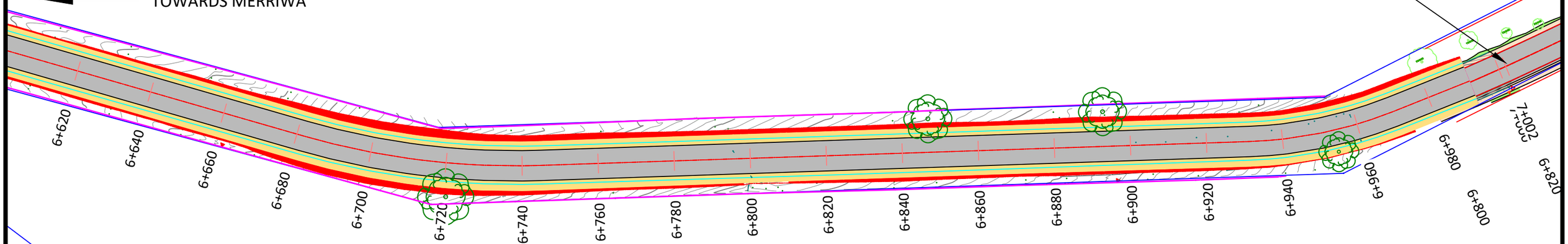
LEGEND

- CADASTRAL BOUNDARY (DCDB)
- FENCE LINE
- FOG LINE
- CENTRELINE OF ROAD
- EDGE OF BITUMEN
- EDGE OF UNSEALED SHOULDER
- STORMWATER PIPE
- SURVEY CONTROL POINT
- DENOTES TREE
- DENOTES CUT AND FILL

TOWARDS MERRIWA

LOT 222
DP 750934

TIE INTO EXISTING CONSTRUCTED ROAD. DESIGNED BY HEC



LOT 216
DP 750934

HARRYAN ENGINEERING COUNSULTING

CLIENT: lightsource bp

DATE:	REVISION:	DESCRIPTION:
24.01.2023	0	CLIENT REVIEW

PROJECT: RINGWOOD ROAD UPGRADE

DRAWING TITLE: Proposed Alignment

ISSUE STATUS: CONCEPTUAL DESIGN CLIENT REVIEW

SCALE: 1:1000
DWG No: HEC22_
JOB No: 22Q3J3
COORDINATE SYSTEM: MGA ZONE 56 GDA 2020
DATUM: AHD

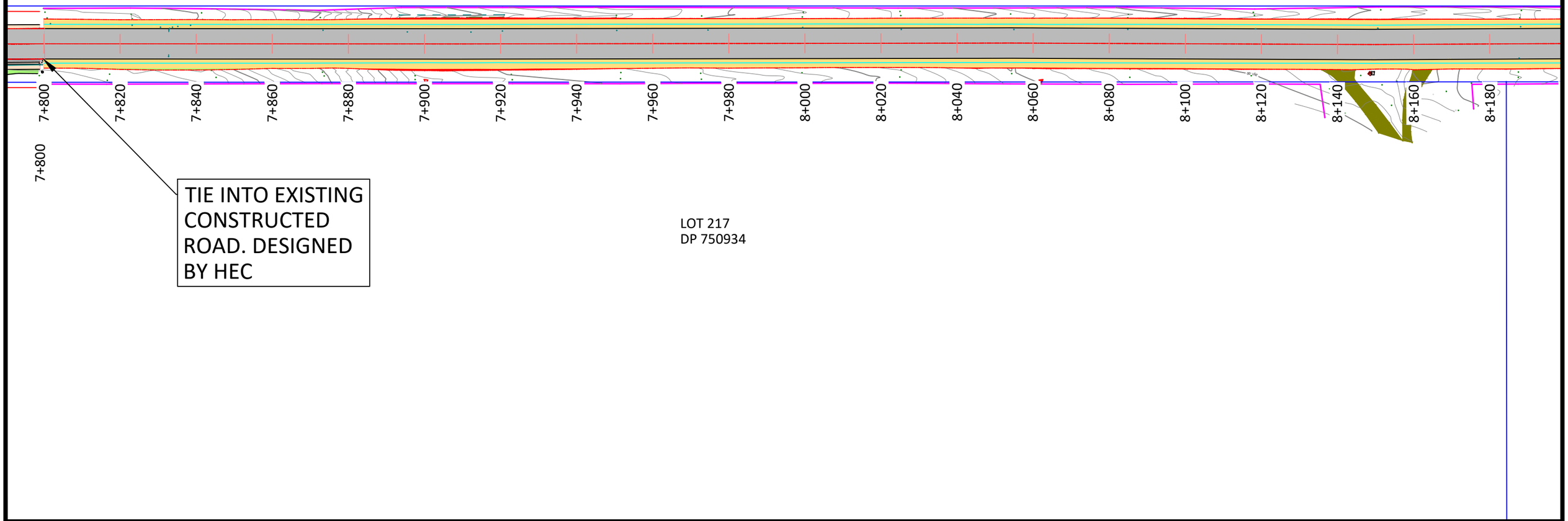
SURVEYED: RAP SURVEYING
DESIGNED: RS
DRAWN: RJ
SHEET: 5
REV: 0

LEGEND

- CADASTRAL BOUNDARY (DCDB)
- FENCE LINE
- FOG LINE
- CENTRELINE OF ROAD
- EDGE OF BITUMEN
- EDGE OF UNSEALED SHOULDER
- STORMWATER PIPE
- SURVEY CONTROL POINT
- DENOTES TREE
- DENOTES CUT AND FILL

TOWARDS MERRIWA

LOT 246
DP 750934



TIE INTO EXISTING CONSTRUCTED ROAD. DESIGNED BY HEC

LOT 217
DP 750934

HARRYAN
ENGINEERING COUNSULTING

CLIENT:
lightsource bp

DATE:	REVISION:	DESCRIPTION:
24.01.2023	0	CLIENT REVIEW

PROJECT:
RINGWOOD ROAD UPGRADE

DRAWING TITLE:
Proposed Alignment

ISSUE STATUS:
CONCEPTUAL DESIGN CLIENT REVIEW

SCALE: 1:1000
DWG No: HEC22_
JOB No: 22Q3J3
COORDINATE SYSTEM: MGA ZONE 56 GDA 2020
DATUM: AHD

SURVEYED: RAP SURVEYING
DESIGNED: RS
DRAWN: RJ
SHEET: 6
REV: 0

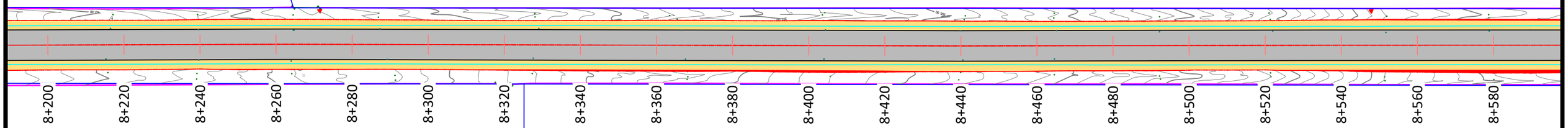
LEGEND

- CADASTRAL BOUNDARY (DCDB)
- FENCE LINE
- FOG LINE
- CENTRELINE OF ROAD
- EDGE OF BITUMEN
- EDGE OF UNSEALED SHOULDER
- STORMWATER PIPE
- SURVEY CONTROL POINT
- DENOTES TREE
- DENOTES CUT AND FILL

TOWARDS MERRIWA

LOT 222
DP 750934

LOT 223
DP 750934



LOT 237
DP 750934

LOT 217
DP 750934

HARRYAN
ENGINEERING COUNSULTING

CLIENT:

lightsource bp

DATE:	REVISION:	DESCRIPTION:
24.01.2023	0	CLIENT REVIEW

PROJECT:
RINGWOOD ROAD UPGRADE

DRAWING TITLE:
Proposed Alignment

ISSUE STATUS:
CONCEPTUAL DESIGN CLIENT REVIEW

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JOB No: 22Q3J3
COORDINATE SYSTEM: MGA ZONE 56 GDA 2020
DATUM: AHD

SURVEYED: RAP SURVEYING
DESIGNED: RS
DRAWN: RJ
SHEET: 7
REV: 0

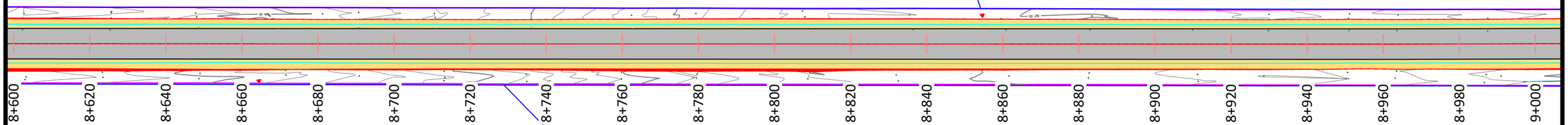
LEGEND

- CADASTRAL BOUNDARY (DCDB)
- FENCE LINE
- FOG LINE
- CENTRELINE OF ROAD
- EDGE OF BITUMEN
- EDGE OF UNSEALED SHOULDER
- STORMWATER PIPE
- SURVEY CONTROL POINT
- DENOTES TREE
- DENOTES CUT AND FILL

TOWARDS MERRIWA

LOT 223
DP 750934

LOT 224
DP 750934



LOT 217
DP 750934

LOT 220
DP 750934

HARRYAN
ENGINEERING COUNSULTING

CLIENT:
lightsource bp

DATE:	REVISION:	DESCRIPTION:
24.01.2023	0	CLIENT REVIEW

PROJECT:
RINGWOOD ROAD UPGRADE

DRAWING TITLE:
Proposed Alignment

ISSUE STATUS:
CONCEPTUAL DESIGN CLIENT REVIEW

SCALE: 1:1000
DWG No: HEC22_
JOB No: 22Q3J3
COORDINATE SYSTEM: MGA ZONE 56 GDA 2020
DATUM: AHD

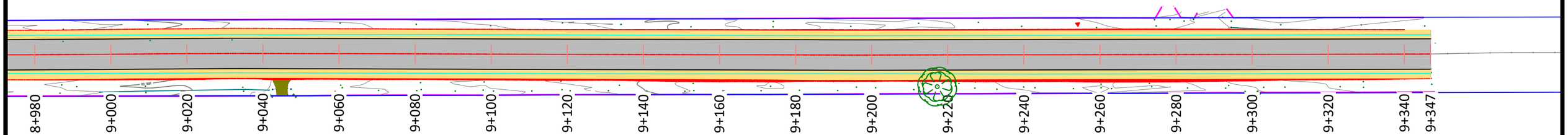
SURVEYED: RAP SURVEYING
DESIGNED: RS
DRAWN: RJ
SHEET: 8
REV: 0

LEGEND

- CADASTRAL BOUNDARY (DCDB)
- FENCE LINE
- FOG LINE
- CENTRELINE OF ROAD
- EDGE OF BITUMEN
- EDGE OF UNSEALED SHOULDER
- STORMWATER PIPE
- SURVEY CONTROL POINT
- DENOTES TREE
- DENOTES CUT AND FILL

TOWARDS MERRIWA

LOT 224
DP 750934



LOT 220
DP 750934

HARRYAN ENGINEERING COUNSULTING

CLIENT: lightsource bp

DATE:	REVISION:	DESCRIPTION:
24.01.2023	0	CLIENT REVIEW

PROJECT: RINGWOOD ROAD UPGRADE

DRAWING TITLE: Proposed Alignment

ISSUE STATUS: CONCEPTUAL DESIGN CLIENT REVIEW

SCALE: 1:1000		SURVEYED: RAP SURVEYING	
DWG No: HEC22_		DESIGNED: RS	DRAWN: RJ
JOB No: 22Q3J3			
COORDINATE SYSTEM: MGA ZONE 56 GDA 2020		SHEET: 9	REV: 0
DATUM: AHD			

Appendix I Site access swept paths

N

WOLLARA ROAD

T2-25

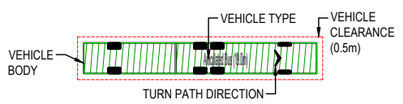
TRAFFIC MANAGEMENT WOULD BE USED TO CONTROL SINGLE VEHICLE MOVEMENTS AND NO VEGETATION REMOVAL IS REQUIRED FOR SINGLE VEHICLE MOVEMENTS

WOLLARA ROAD

T2-25

FOR INFORMATION ONLY

VEHICLE TURN PATH LEGEND



SIGNAGE

PROPOSED SIGN POST LOCATION

R4-1

PROPOSED SIGN

EXISTING SIGN POST LOCATION

R4-1

EXISTING SIGN

5 0 5 10 15 20m

1 : 1000 FULL SIZE A3

GOULBURN RIVER SOLAR FARM
SIGNAGE & SWEPT PATH
SHEET 1 OF 2

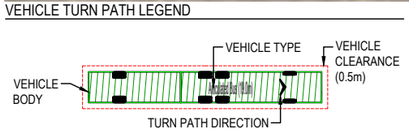
25/01/2023

turnbull

0305-INF-RD-SWEPT-PATH-02

FOR INFORMATION ONLY

VEHICLE TURN PATH LEGEND



SIGNAGE

PROPOSED SIGN POST LOCATION

PROPOSED SIGN

R4-1

EXISTING SIGN POST LOCATION

EXISTING SIGN

R4-1

5 0 5 10 15 20m

1 : 1000 FULL SIZE A3

GOULBURN RIVER SOLAR FARM
SIGNAGE & SWEPT PATH
SHEET 2 OF 2

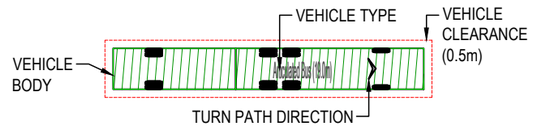
25/01/2023

turnbull

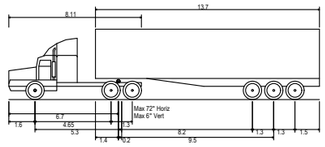
0305-INF-RD-SWEPT-PATH-03

Appendix J Barnett Street swept paths

VEHICLE TURN PATH LEGEND



VEHICLE TURN PATH PROFILE



Prime mover and semi-trailer (19 m)

Overall Length	19.000m
Overall Width	2.500m
Overall Body Height	4.300m
Min Body Ground Clearance	0.540m
Track Width	2.500m
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	12.500m

GENERAL NOTES

1. NO ASSESSMENT HAS BEEN UNDERTAKEN OF EXISTING INTERSECTION ARRANGEMENT OR EXISTING PAVEMENTS.
2. TURN PATHS PRESENTED IS THE INTENDED OPERATIONS OF TRAFFIC ASSOCIATED WITH GOULBURN SOLAR FARM. ONLY THE DISPLAYED MOVEMENTS WILL BE PERMITTED.

FOR INFORMATION ONLY

3.75 0 3.75 7.5 11.25 15m
1 : 750 FULL SIZE A3

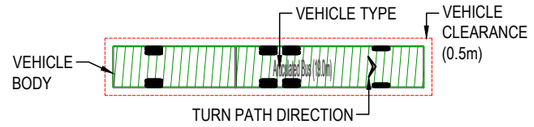
GOULBURN RIVER SOLAR FARM
GOLDEN HIGHWAY AND BARNETT STREET INTERSECTION TURN PATHS
SHEET 1 OF 2

25/09/2023

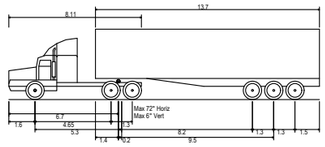
turnbull

0305-INF-RD-SWEPT-PATH-BARNETT-01

VEHICLE TURN PATH LEGEND



VEHICLE TURN PATH PROFILE



Prime mover and semi-trailer (19 m)

Overall Length	19.000m
Overall Width	2.500m
Overall Body Height	4.300m
Min Body Ground Clearance	0.540m
Track Width	2.500m
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	12.500m

GENERAL NOTES

1. NO ASSESSMENT HAS BEEN UNDERTAKEN OF EXISTING INTERSECTION ARRANGEMENT OR EXISTING PAVEMENTS.
2. TURN PATHS PRESENTED IS THE INTENDED OPERATIONS OF TRAFFIC ASSOCIATED WITH GOULBURN SOLAR FARM. ONLY THE DISPLAYED MOVEMENTS WILL BE PERMITTED.

FOR INFORMATION ONLY

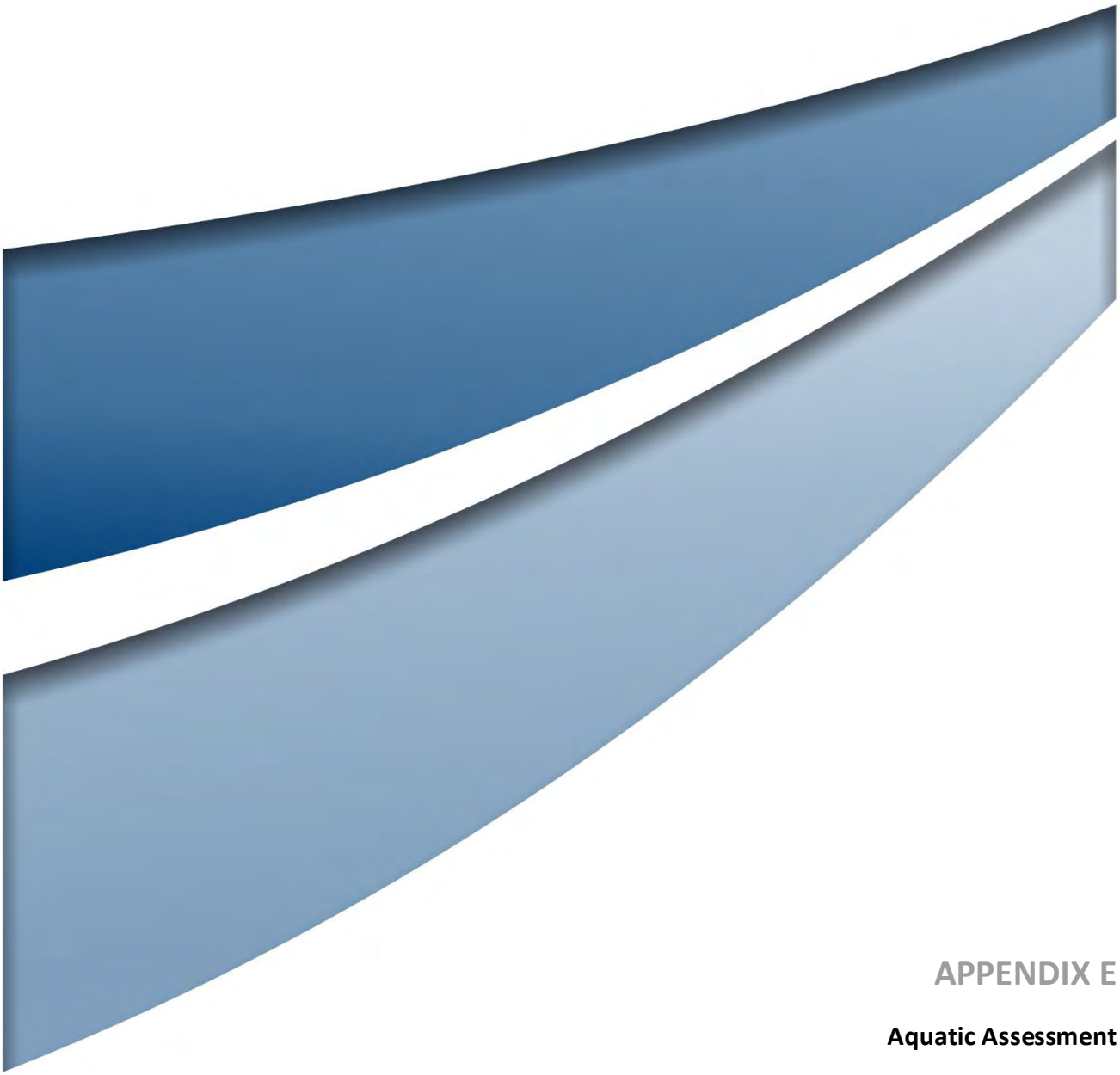
3.75 0 3.75 7.5 11.25 15m
1 : 750 FULL SIZE A3

GOULBURN RIVER SOLAR FARM
BARNETT STREET TURN AROUND FACILITY TURN PATHS
SHEET 2 OF 2

25/09/2023

turnbull

0305-INF-RD-SWEPT-PATH-BARNETT-02



APPENDIX E

Aquatic Assessment

UMWELT

Wollara Road, Merriwa

Goulburn River Solar Farm

Aquatic Assessment

Job No: 220222

Date: 01/12/2023

COAST ECOLOGY
ENVIRONMENTAL ASSESSMENTS

PO Box 3005 Wamberal NSW 2260

T: 0404 858573 E: kristy@coastecology.com.au W: www.coastecology.com.au

Kristy McQueen operates as a Sole Trader under registered business name Coast Ecology ABN: 24 924 674 371

Goulburn River Solar Farm: Aquatic Assessment

Version	Date	Description	Author
1	27/05/2022	1st Draft	K. McQueen
2	28/09/2022	Final	K. McQueen
3	04/11/2022	Final – updated Project Area	K. McQueen
4	03/02/2023	Final – included cumulative impacts	K. McQueen
5	10/03/2023	Final – updated Project Area (09/03/2023)	K. McQueen
6	20/04/2023	Final – updated Project Area (09/03/2023)	K. McQueen
7	28/04/2023	Final – updated access roads (09/03/2023)	K. McQueen
8	20/11/2023	Final – updated development footprint (17/11/2023) and to support the Amendment Report	K. McQueen
9	01/12/2023	Final – updated development footprint (21/11/2023) and to support the Amendment Report	K. McQueen

PO Box 3005 Wamberal NSW 2260

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Kristy McQueen operates as a Sole Trader under registered business name Coast Ecology ABN: 24 924 674 371

Executive Summary

The project

Lightsource Development Services Australia Pty Ltd (Lightsource bp) proposes to develop a solar farm in the Upper Hunter region of New South Wales (NSW), approximately 28 kilometres (km) south-west of the township of Merriwa within the Upper Hunter Local Government Area (LGA).

The proposed Goulburn River Solar Farm (the project) includes the construction, operation, maintenance and decommissioning of solar photovoltaic (PV) generation with a Battery Energy Storage System (BESS) with 450 MWp and 900 megawatt hour (MWh) capacity along with the option of a decentralised BESS (including the option to host both centralised and decentralised BESS) units with an approximate 580 MWp and 1,160 MWh capacity. The project will also include supporting infrastructure, a transmission tower, a substation and connection to an existing 500 kilovolt (kV) transmission line.

This report

This Aquatic Biodiversity Impact Assessment has been prepared on behalf of Umwelt to support the Environmental Impact Statement (EIS) for the project and responds to the Secretary's Environmental Assessment Requirements (SEARs) for the aquatic ecosystem. This assessment has been updated to address project changes made in response to submissions during the public exhibition and supports the Project Amendment Report. This report only addresses aquatic values associated with the solar farm. Aquatic values associated with road upgrades are assessed in the Public Roads and Culverts Biodiversity Development Assessment Report (BDAR).

The assessment presented in this report has included a review of relevant legislation, consideration of the existing conditions, an impact assessment to determine the significance of impacts to aquatic biodiversity as a direct result of the construction, operation and decommissioning of the project and the potential impacts of the project on threatened aquatic species which are predicted to occur within the study area (defined here as a 10 kilometre (km) buffer around the Project Area). Recommended mitigation and management measures are identified.

This report builds on findings of both BDARs and the Water Resources Assessment prepared by Umwelt (2023).

Existing aquatic environment

The Project Area is located within the catchment of the Goulburn River in east New South Wales, which is in the Hunter/Central Rivers Catchment Management Authority. The Goulburn River is the largest tributary of the Hunter River and accounts for 40 per cent of the Hunter Rivers catchment area but contributes only 23 per cent of its flow.

Within the Project Area, there are 90 mapped hydrolines including 69 first order watercourses, 18 second order watercourses and three third order watercourses which eventually flow into the Goulburn River. Five watercourses have been mapped as key fish habitat (KFH) (DPI, 2007) within the Project Area, however, except for Redlynch Creek, all are highly ephemeral, only holding water for a short time following rainfall and receding rapidly, leaving very few remnant pools for fish refuge. Redlynch Creek contained remnant pools and some flowing water at the time of survey and has a farm dam constructed within the watercourse. None of the watercourses within the Project Area contained important habitat features such as aquatic plants (macrophytes), bank overhang, trailing bank vegetation, riffle sections or woody debris/snags (except for Monaghans Creek which was dry at the time of survey but did contain woody debris). All watercourses and riparian zones were modified by agricultural land practices, including complete removal of the riparian vegetation to top of bank in most areas.

Potential impacts from the project

The three watercourses (or sections of) mapped as KFH (DPI,2007) that occur within the Development Footprint include:

- Redlynch Creek, including unnamed tributaries
- an unnamed tributary of Poggy Creek
- an unnamed tributary of Rocky Creek.

The design phase of the project has mostly excluded these three watercourses from the Development Footprint. It is noted that while they are mapped by DPI (2007) as KFH, following assessment they were defined as Type 3 minimally sensitive KFH due to their highly ephemeral nature and lack of important habitat features.

Twenty-two farm dams occur in the Project Area, however following design changes, only two farm dams occur within the Development Footprint and subsequently would require dewatering.

Direct impacts from the project on aquatic biodiversity would include potential blockage of fish passage (during floods) where filling is required for access roads infrastructure across KFH watercourses, potential modification to riparian habitat through the spread of exotic flora, potential mortality to protected aquatic fauna during farm dam dewatering and filling and potential impacts on water quality through disturbance of soil on waterfront land. Potential indirect impacts to aquatic biodiversity relate to the mobilisation of poor-quality stormwater runoff from construction activities including vegetation removal, earthworks, establishment and use of construction compounds, trenching and access roads and pollution downstream and potential mortality to aquatic flora and fauna.

Following assessment, all watercourses within the study area were considered to have a low or negligible risk of potential impact from the project during construction, operation and decommissioning due to the highly ephemeral nature of the watercourses, the lack of important KFH features and or the minor nature of works proposed within the catchment of these watercourses.

Potential risks can be managed in ephemeral watercourses by:

- undertaking construction when watercourses are dry (where practicable) as aquatic fauna species would not be present
- implementing appropriate erosion and sediment control measures
- installing fish friendly crossings (in accordance with relevant guidelines) where filling for access roads is proposed across watercourses mapped as KFH (DPI, 2007)
- avoiding all construction activities, including tree removal and re-fuelling of vehicles and other machinery, on waterfront land (i.e., land 40 metres from the top of bank, where watercourses have a defined bed and banks)
- re-instating watercourse bed and banks where these are disturbed by project construction activities in areas mapped as KFH (DPI, 2007).

Potential indirect risks to the perennial watercourse (Goulburn River), which occurs outside of the Project Area, can be managed through the implementation of appropriate erosion and sediment control measures on upstream watercourses during construction.

Threatened species, populations and ecological communities

Following a likelihood of occurrence assessment, the broader study area was considered to provide possible or likely habitat for the following two threatened entities listed under the *Fisheries Management Act 1994* (FM Act):

1. Darling River Hardyhead (*Craterocephalus amniculus),* Endangered population
2. Southern Purple-Spotted Gudgeon (*Mogurnda adspersa)*, Endangered species.

Fisheries Management Act

Assessments of significance of impact under the FM Act concluded that the project was unlikely to have an adverse effect on the life cycle of Darling River Hardyhead or Southern Purple Spotted Gudgeon such that a viable local population of these species is likely to be placed at risk of extinction. This was based on the lack of important habitat features for these species within the Project Area and the relatively minor nature of works. Potential indirect impacts on water quality associated with the mobilisation of sediments is relevant to all watercourses within the study area, however, this can be managed using standard erosion and sediment control measures during the construction, operation and decommissioning phases of the Project. Thus, the level of impact to the aquatic environment and threatened aquatic species is considered minor.

In relation to the habitat of threatened species/populations, only Goulburn River contained potential habitat for these two threatened entities. The project does not result in any direct impacts to the Goulburn River and potential indirect impacts can be mitigated through appropriate erosion and sediment control. Thus, the habitat of these threatened species/populations will not be removed or significantly modified, nor will the habitat become fragmented or isolated from other areas of habitat because of the project.

In terms of the importance of the habitat for these species, Goulburn River was mapped as within the indicative distribution for the Darling River Hardyhead but not the Southern Purple Spotted Gudgeon. It is noted that many sections of the Goulburn River within the study area have been highly modified through land use practices in the catchment, with intensive farming practices including extensive clearing of riparian vegetation to the bank, reducing the presence of aquatic vegetation, detritus, trailing bank vegetation and snags, which are important habitat features for these species. Thus, the existing habitat in the Goulburn River within the study area is likely to be of low importance to the long-term survival of these threatened species/populations.

The project is not inconsistent with any priority action statements for the assessed threatened species and population as most recovery actions listed are not directly relevant to the project, except for habitat rehabilitation, which would be undertaken in accordance with the Biodiversity Management Plan for the project. The key threatening process (KTP) 'installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams' is the only KTP that would be impacted by the project. Any crossings over KFH would be designed to minimise impacts to natural flows.

Environment Protection and Biodiversity Conservation Act

No Matters of National Environmental Significance (MNES) relevant to this aquatic ecology study were identified as likely to occur within the study area during desktop review. As such, no further assessment was required under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Impacts on sensitive areas

KFH within the study area was based on existing KFH mapping by DPI (2007), watercourse sensitivity type (DPI, 2013) and class (Fairfull and Witheridge, 2003), which were defined following site inspection. Only instream habitat (top of bank to top of bank) is defined as KFH.

All watercourses within the Project Area were defined as Type 3 minimally sensitive KFH due to their highly ephemeral nature and the absence of fish habitat features. Regardless, the Development Footprint covers mapped KFH along the following watercourses:

- Redlynch Creek
- unnamed tributary of Poggys Creek
- unnamed tributary of Rocky Creek.

Where filling of watercourses mapped as KFH is proposed for the construction of access roads, appropriate fish passage would be maintained through the installation of a high flow design culvert. As such, fish passage would be maintained and KFH would not be permanently lost or disrupted so no aquatic biodiversity offset would be required.

Waterfront land includes the bed and bank of watercourses and all land within 40 metres of the highest bank (DPI, 2012). However, watercourses lacking defined bed and banks are not typically associated with waterfront land. Within the Development Footprint, only Redlynch Creek and an unnamed tributary of Rocky Creek have defined bed and banks and as such, these watercourses have associated waterfront land. Where possible, construction works would not be undertaken on waterfront land. Any disturbance to waterfront land would be remediated as detailed in the Biodiversity Management Plan.

No aquatic groundwater dependent ecosystems (GDEs) were identified in the study area.

This assessment also concluded that the potential cumulative impacts of the project (known at the time of assessment) combined with four other major projects occurring within the Goulburn River catchment was unlikely to be significant, provided the biodiversity management plans for each project are implemented, maintained and monitored.

Recommended mitigation measures

Potential impacts to aquatic ecosystems during construction would be reduced if:

- appropriate erosion and sediment controls are implemented
- construction works, including refuelling of machinery, avoid waterfront land
- there are onsite spill kits for construction works within 100 metres of a watercourse
- instream construction works (for access roads) are conducted when watercourses are dry (where practicable)
- any instream structures are designed using relevant guidelines (to maintain fish passage and minimise impacts to natural flow regimes), particularly on watercourses mapped as KFH
- disturbed bed and banks of watercourses mapped as KFH are rehabilitated with stabilising vegetation.

During operation and decommissioning, potential impacts would be reduced through:

- the routine maintenance of vehicles (to reduce the risk of oil spills etc)
- the routine maintenance of culverts under access roads (to ensure they are clear of debris)
- minimal use of herbicides to control exotic species (to reduce pollutants entering downstream watercourses)
- the re-establishment of native riparian vegetation endemic to the region and aquatic habitat features within and on the banks of any watercourses directly impacted.

Conclusion

The aquatic biodiversity impact assessment concludes that the impacts of the project would not significantly compromise the functionality, long-term connectivity or viability of habitats, or ecological processes within watercourses in the study area. Most of the potential construction impacts are associated with indirect impacts on water quality and would therefore be temporary and managed through the adoption of recommended mitigation measures. Impacts on threatened species and endangered populations listed under the FM Act are considered unlikely due to the minor nature of works and the highly ephemeral nature of most watercourses within the Project Area. The Goulburn River is the only perennial watercourse in the study area, however direct instream impacts at this location will not occur and potential indirect impacts can be managed. As such, the project is unlikely to significantly impact the habitat of threatened aquatic species or endangered populations.

Glossary and abbreviations

ALA	Atlas of living Australia
AUSRIVAS	Australian River Assessment System
BC Act	*Biodiversity Conservation Act 2016 (NSW)*
BDAR	Biodiversity Development Assessment Report
BESS	Battery Energy Storage System
CEMP	Construction Environmental Management Plan A site-specific plan developed for the construction phase of a project, to ensure that all contractors and sub-contractors comply with the environmental conditions of approval for the project and manage environmental risks properly.
CMA	Subregion Catchment Management Authority Subregion
Cumulative impacts	Impacts that, when considered together, have different and/or more substantial impacts
DCCEEW	Department of Climate Change, Energy, the Environment and Water
Development Footprint	The area directly impacted by the project, being approximately 792.19 ha.
DPE	Department of Planning and Environment
DPI	Department of Primary Industries – Fisheries NSW
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EPs	Endangered Populations
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FM Act	*Fisheries Management Act 1994* (NSW)
IBRA	Interim Biogeographic Regionalisation for Australia (Version 7)
KFH	Key Fish Habitat
KTP	Key Threatening Process
Locality	Includes the four Local Government Areas (LGAs) surrounding the Project Area: Upper Hunter, Warrumbungle, Mid-Western Regional and Muswellbrook.
MGA	Map Grid of Australia 94, Zone 56 (easting-northing)
MNES	Matters of national environmental significance
MWh	Megawatt hour
MWp	Megawatt peak

NRAR	Natural Resources Access Regulator
NSW	New South Wales
NPW Act	*National Parks and Wildlife Act*
OEH	Office of Environment and Heritage (NSW) (NB. The functions of OEH were transferred to the Environment, Energy & Science Group within DPIE (now DPE) on 1 July 2019)
PCT	Plant Community Type
PMST	Protected Matters Search Tool
the Project	the Project would include the construction, operation, civil works, maintenance and decommissioning of the proposed solar farm and Battery Energy Storage System (BESS), as well as associated infrastructure.
the Project Area	the Project Area comprises two freehold properties that span across multiple lots, covering an area of approximately 1,996.5 ha.
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State Significant Development
Strahler Stream Order	Classification system that gives a waterway an 'order' according to the number of tributaries associated with it. Mapped at 1:50 000 scale
study area	The wider area, including and surrounding the Project Area, with the potential to be directly or indirectly affected by the project and the area defined for desktop studies. The extent of the study area for the Aquatic Assessment includes a 10 km buffer around the Project Area.
Survey site	The location (100 metre reach along watercourses crossed by the study area) within which habitat assessments and surveys were undertaken.
TEC	Threatened Ecological Community

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1. Introduction

Lightsource Development Services Australia Pty Ltd (Lightsource bp) proposes to develop a solar farm in the Upper Hunter region of New South Wales (NSW), approximately 28 kilometres (km) south-west of the township of Merriwa within the Upper Hunter Local Government Area (LGA).

The proposed Goulburn River Solar Farm (the project) includes the construction, operation, maintenance and decommissioning of approximately 1,030 megawatt peak (MWp) of solar photovoltaic (PV) generation with a centralised Battery Energy Storage System (BESS) and the option of a decentralised BESS including the option to host both centralised and decentralised BESS units. The project will also include supporting infrastructure, a transmission tower, a substation and connection to an existing 500 kilovolt (kV) transmission line.

The project location and regional context are shown in Figure 1-1.

1.1 Background

The Project Area is located between Merriwa (to the north-east) and Coggan (to the south-east) NSW, surrounded by the Goulburn River National Park. The main Project Area is located on freehold land, while parts of Wollara Road which provides access to the site, are located on Crown land. The Project Area comprises two freehold properties that span across multiple lots, covering an area of approximately 1,996.5 ha with the development footprint occupying approximately 792.19 ha (Figure 1-2).

The Project Area is near the Central West Orana Renewable Energy Zone (REZ) however the Project is not related to the REZ, nor is it dependent on the REZ establishment. The REZ location was selected because of the benefits of relatively low transmission build costs due to its proximity to the existing transmission network structures. Similarly, the Project Area benefits from the existing 500 kV transmission line crossing the south-east portion of the site, allowing easy connection to the national electricity grid.

Based on the proximity of the project to the REZ, it is also expected to support the local uptake and use of renewable energy, contribute to achieving State and Federal targets for establishing renewable energy generation within NSW, and provide similar economic and social benefits to the regional community. As part of the Upper Hunter region, the Project Area is also in proximity to the Hunter-Central Coast REZ .

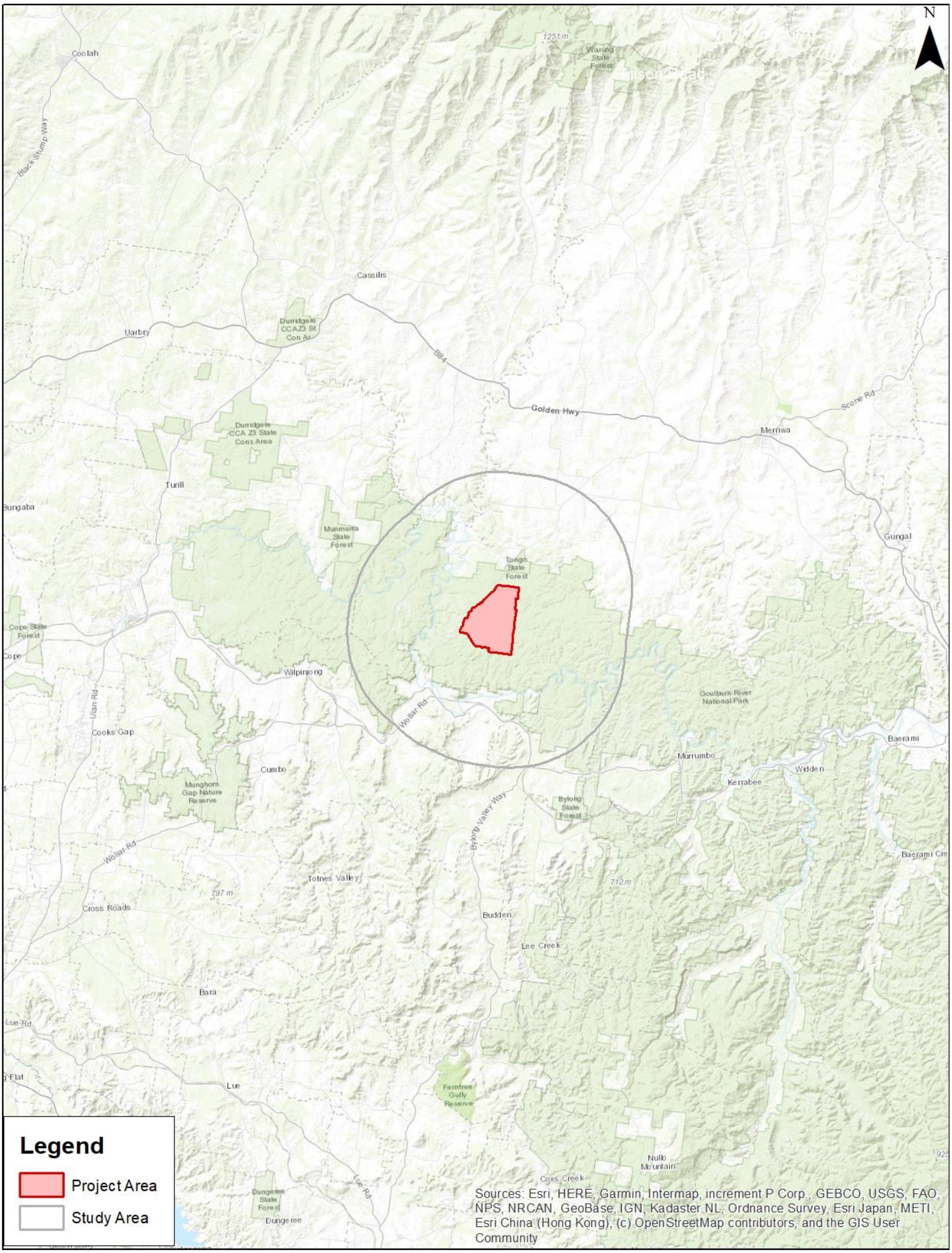
1.2 Project Overview

Subject to the final design process, the key components of the Project include:

- Approximately 1 million bifacial solar PV modules in an east-west single-axis tracking arrangement
- A centralised BESS with an approximate 450 MWp and 900 MWh capacity, housed in a series of outdoor containers, either distributed across the site or aggregated in one central location
- The option of a decentralised BESS (instead of or in combination with centralised BESS) with an approximate 580 MWp and 1,160 MWh capacity involving 560 individual 6.1 m battery containers and DC-DC converters, and associated infrastructure being situated next to the PV inverter stations located throughout the solar arrays, rather than in a centralised location
- Onsite 500 kV switchyard and substation, with underground electrical conduits and cabling leading into the yard and overhead lines reaching above to the existing transmission line
- Communications tower, up to 30 m high, providing communications, radio and cellular services to the site and the wider region
- Internal and perimeter gravel access roads allowing for site maintenance
- Temporary construction facilities
- Site office and operations and maintenance building with parking for the operations team

- Primary access point from existing driveway off Wollara Road, with two additional emergency access points proposed along the north-western boundary of the Project Area and upgrades to Ringwood Road. Note that these are assessed in the Public Roads and Culverts Biodiversity Development Assessment Report (BDAR).
- Drainage line crossings, if and where required, to manage existing surface water flows
- Perimeter security fencing, crossing gates, water tanks or dams, and internal access points to facilitate sheep grazing.

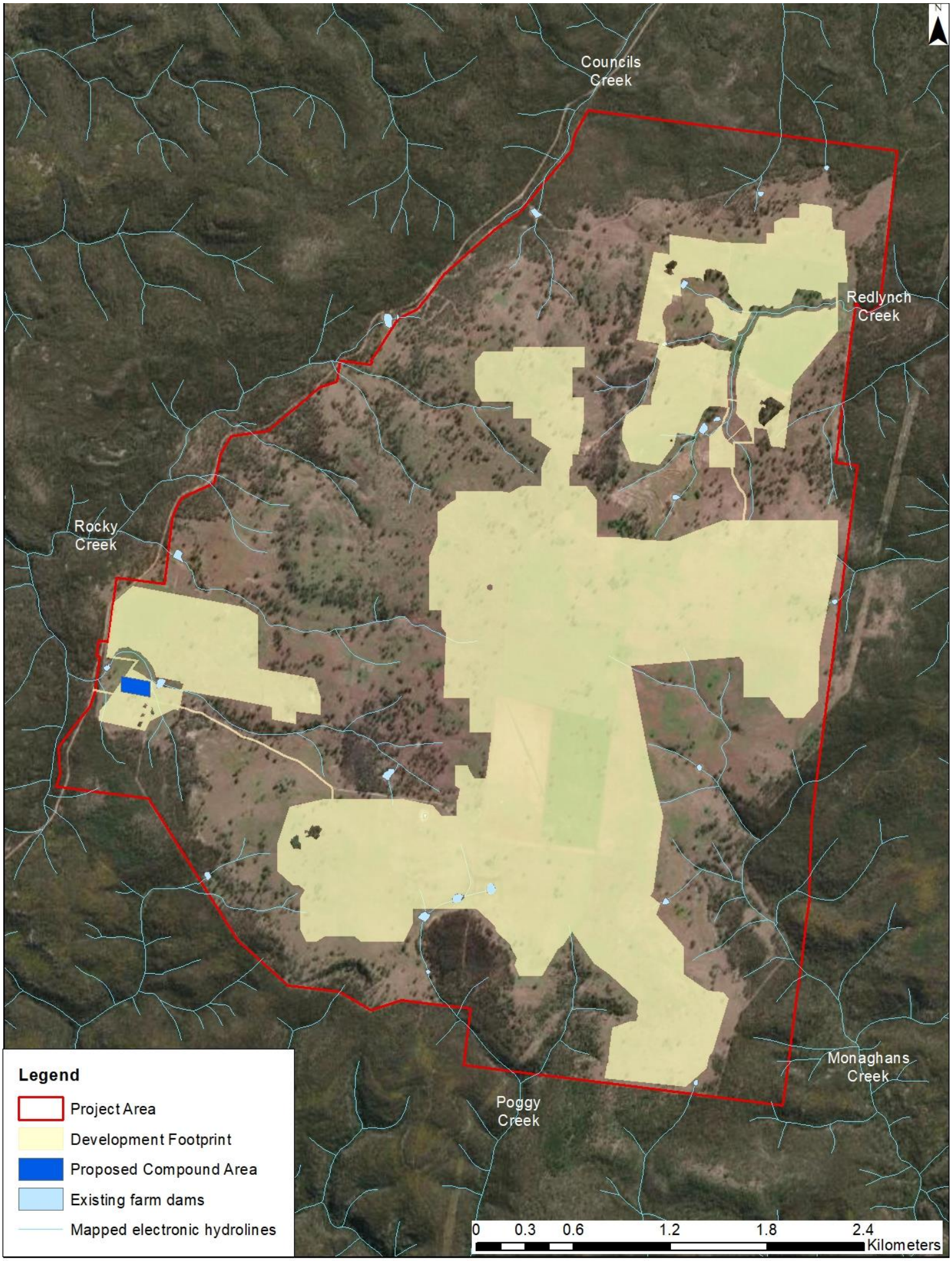
Detailed descriptions of the project components are contained in the Environmental Impact Statement (EIS) and Amendment Report.



COAST ECOLOGY
ENVIRONMENTAL ASSESSMENTS

0 2.75 5.5 11 16.5 22 Kilometers

Figure 1.1. Locality
Goulburn River Solar Farm
Job No. 220222 Date. 19/04/2023



COAST ECOLOGY
ENVIRONMENTAL ASSESSMENTS

Figure 1.2. Project Area and Development Footprint
Goulburn River Solar Farm
Job No. 220222 Date. 01/12/2023

1.2.1 Timing

The project is expected to operate for 40 years or more. After the initial 40-year operating period, the solar farm would either be decommissioned, removing all above ground infrastructure, and returning the site to its existing land capability, or repurposed with new PV equipment subject to technical feasibility and planning consents.

1.3 Purpose and scope of this report

The EIS has been prepared in line with the State Significant Development Guidelines – Preparing an Environmental Impact Statement (DPIE, 2021) and assesses the potential impacts associated with the project in accordance with the Secretary's Environmental Assessment Requirements (SEARs), issued on 1 February 2022. This assessment has been updated to address project changes made in response to submissions during the public exhibition and supports the Project Amendment Report. This report only addresses aquatic values associated with the solar farm. Aquatic values associated with road upgrades are assessed in the Public Roads and Culverts BDAR.

The aquatic assessment specifically addresses the SEARs relevant to the assessment of the aquatic environment (refer Table 1-1).

Specifically, this assessment:

- Describes the existing aquatic environment in terms of ecological values, including type and condition of aquatic habitats.
- Determines the presence or likelihood of occurrence of threatened species, populations and endangered ecological communities (EECs) as listed under the *Fisheries Management Act 1994* (FM Act).
- Determines the presence or likelihood of occurrence of matters of national environmental significance (MNES) as listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Identifies threatened fish species, populations and EECs within the locality that have the potential to be impacted by the project.
- Assesses the impact of the project on threatened fish species, populations and ecological communities.
- Assesses the impact of the project on protected and sensitive lands.

Table 1-1. SEARs relevant to the assessment of aquatic biodiversity

Key Issue	Report Reference
Biodiversity The EIS must include: • an assessment of the likely impacts on listed aquatic threatened species, populations or ecological communities, scheduled under the *Fisheries Management Act 1994* (FM Act), and a description of the measures to minimise and rehabilitate impacts, and • if an offset is required, details of the measures proposed to address the offset obligations.	Section 5.4 includes assessment of impacts on threatened aquatic species, populations and ecological communities (listed under the FM Act) that are predicted in the study area. Section 5.6.1 addresses offset requirements

1.4 Structure of this report

The structure of the report is outlined below:

Chapter 1 – provides an introduction to the report and outlines relevant SEARs to be addressed.

Chapter 2 – provides an overview of relevant legislation, policies and guidelines applicable to the assessment.

Chapter 3 – describes the methodology and approach for the assessment.

Chapter 4 – describes the existing environment with respect to catchments, watercourses and threatened aquatic species and ecological communities found within the study area.

Chapter 5 – provides an assessment of the impacts to aquatic biodiversity from the construction, operation and decommissioning of the project and potential impacts on threatened species, populations and EECs. It also considers cumulative impacts on aquatic biodiversity from the combined effects of the project and any adjacent projects.

Chapter 6 - provides recommended avoidance and mitigation measures.

Chapter 7 – provides a summary of findings and conclusion.

Chapter 8 - provides a full reference list.

2. Legislative and policy context

2.1 Legislation

2.1.1 NSW legislation

2.1.1.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) and *Environmental Planning and Assessment Regulation 2021* (EP&A Regulation) establish a framework for the assessment and approval of developments in NSW. They also provide for the making of environmental planning instruments, including state environmental planning policies (SEPPs) and local environmental plans (LEPs), which determine the permissibility and approval pathway for development proposals and form a part of the environmental assessment process.

Section 4.36 of the EP&A Act provides for the declaration of a project as State Significant Development (SSD). Under the EP&A Act, the declaration of a project as SSD can be made by meeting the requirements of a SEPP or by the Minister for Planning and Homes.

Clause 20 of Schedule 1 of Planning Systems SEPP prescribes that development for the purpose of 'electricity generating works' that has a capital investment value of more than $30 million is SSD. The project has a capital investment value of greater than $30 million. Therefore, the project is declared as SSD and the development application for the project will be subject to the requirements of Division 4.7 of the EP&A Act. The development application will be lodged with the Planning Secretary of the Department of Planning and Environment (DPE).

The Minister for Planning and Homes is the consent authority for SSD projects. Section 4.5(1) of the EP&A Act also provides that the Independent Planning Commission (IPC) is the consent authority for SSD where it is declared to be the consent authority under an EPI. The Minister for Planning and Public Spaces has issued a general delegation of the consent authority function for SSD projects to the IPC in instances where more than 50 public objections are received on the application, where the applicant has made a reportable political donations disclosure and/or where the Local Council objects to the Project.

Section 4.41 of the EP&A Act identifies various authorisations which are not required for an SSD project. Of relevance to this assessment, the following authorisations are not required for approved SSD (and accordingly the provisions of any Act that prohibit an activity without such an authority do not apply):

- a permit under section 201, 205 or 219 of the FM Act
- a water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the *Water Management Act 2000* (WM Act).

2.1.1.2 Fisheries Management Act 1994

The FM Act provides for the conservation, protection and management of fisheries, aquatic systems and habitats in NSW. The FM Act establishes mechanisms for:

- the listing of threatened species, populations and ecological communities or key threatening processes,
- the declaration of critical habitat, and
- consideration and assessment of threatened species impacts in the development assessment process.

Part 7A, section 221ZT(a) of the FM Act relates to the environmental assessment under Part 4 of the EP&A Act. Section 4 of this report identifies threatened species, populations and ecological communities listed under Schedule 4, 4A and 5 of the FM Act which are predicted to occur in the locality. In accordance with sections 221ZV and 221ZX of the FM Act, Appendix A of this report assesses likely impacts of the project (assessment of significance) on these listed species and Section 5 summarises the impacts of the project on threatened entities.

Construction works on watercourses do not require a permit for 'dredging' or 'reclamation' (section 201), harm to marine vegetation (section 205) or blockage of fish passage (section 219) in accordance with section 4.41 of the EP&A Act (approvals/legislation that do not apply for SSD). Regardless of the exemption to obtain permits, this assessment has considered potential impacts on watercourses based on fish habitat type as defined in *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013).

Schedule 6 of the FM Act outlines the key threatening processes (KTPs) related to aquatic species and ecological communities. These are considered in section 5.4.2.

2.1.1.3 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) aims to avoid, minimise and offset impacts on biodiversity from development and conserve biodiversity at a bioregional and state scale. It lists a number of threatened species, populations and ecological communities to be considered in deciding whether there is likely to be a significant impact on threatened biota, or their habitats.

A Biodiversity Development Assessment Report (BDAR) has been prepared by Umwelt (2023) in accordance with Section 7.9 of the BC Act as part of the EIS. No threatened aquatic species listed under the BC Act were identified within the locality during database searches (section 4.8.1).

Groundwater dependent ecosystems (GDEs) protected under the BC Act have been identified within the study area and considered in section 4.4.

2.1.1.4 Water Management Act 2000

The WM Act recognises the need to allocate and provide water for the environmental health of our rivers and groundwater systems, while also providing licence holders with access to water. The object of the WM Act is the sustainable and integrated management of the state's water sources for the benefit of present and future generations.

Part 3 of the WM Act establishes three types of approvals that may be required to obtain. These are:

- water use approvals
- water management work approvals (water supply work approvals, drainage work approvals and flood work approvals)
- activity approvals (controlled activity approvals and aquifer interference approvals).

As noted above, under section 4.41 of the EP&A Act, approved SSD does not require a water use approval under section 89, a water management work approval under section 90 or an activity approval under section 91 of the WM Act. The aquifer interference approval provisions of the WM Act have not been activated in NSW at this stage, so there is no requirement for an aquifer interference approval.

The design and construction of the project would consider the *Guidelines for Controlled Activities on Waterfront Land: Riparian Corridors* (Department of Industry 2018; section 2.1.2.5) to enable the mitigation of potential impacts to water quality.

The impacts of the project on waterfront land are considered in section 5.6.2.

2.1.2 Policy and guidelines

Policy and guidelines are discussed in the following sections.

2.1.2.1 Policy and Guidelines for Fish Habitat Conservation and Management

The *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013) outlines policies and guidelines aimed at maintaining and enhancing fish habitat for the benefit of native fish species, including threatened species, in marine, estuarine and freshwater environments.

It is applicable to all planning and development proposals and various activities that affect aquatic ecosystems in NSW.

One of the key objectives of the FM Act is to conserve 'key fish habitats' (KFH). KFH's are defined in the policy and guidelines to include all marine and estuarine habitats up to highest astronomical tide level (that reached by 'king' tides) and most permanent and semi-permanent freshwater habitats including rivers, creeks, lakes, lagoons, billabongs, weir pools and impoundments up to the top of the bank. Small headwater creeks and gullies (known as first and second order streams), that only flow for a short period after rain are generally excluded, as are farm dams constructed on such systems. Wholly artificial waterbodies such as irrigation channels, urban drains and ponds, salt and evaporation ponds are also excluded except where they are known to support populations of threatened fish or invertebrates.

The Department of Primary Industries - Fisheries (DPI) assesses activity and development proposals in relation to consideration for the 'sensitivity' of the affected fish habitat. In this context, 'sensitivity' is defined by the importance of the habitat to the survival of fish and ability to withstand disturbance.

If the aquatic habitat in question is defined as KFH, it is then assigned a fish habitat sensitivity ranking which is used within the policy and guideline statements to differentiate between permissible and prohibited activities or developments related to the importance of the 'type' of KFH. Table 2-1 defines those types of habitats that are considered KFH for the purpose of the application of the FM Act.

It is noted that for the purposes of the policy and guidelines, first and second order streams on gaining streams (streams where the channel bottom is lower than the level of the surrounding groundwater table so that water potentially moves from the ground into the channel) are not considered KFH. In addition, the definition of "fish" includes not only fin fish, but also crustaceans, molluscs, worms, insects and other invertebrates that spend all or part of their life cycle in aquatic habitats.

Table 2-1. Key fish habitat and sensitivity classification scheme (DPI, 2013)

Sensitivity Ranking	Waterway Description
TYPE 1 Highly sensitive key fish habitat	• Freshwater habitats that contain in-stream gravel beds, rocks greater than 500 mm in two dimensions, snags greater than 300 mm in diameter or 3 metres in length, or native aquatic plants • Any known or expected protected or threatened species habitat or area of declared 'critical habitat' under the FM Act
TYPE 2 Moderately sensitive key fish habitat	• Freshwater habitats and brackish wetlands, lakes and lagoons other than those defined in TYPE 1 • Weir pools and dams up to full supply level where the weir or dam is across a natural waterway
TYPE 3 Minimally sensitive key fish habitat may include	• Coastal and freshwater habitats not included in TYPES 1 or 2 • Ephemeral aquatic habitat not supporting native aquatic or wetland vegetation

The policy and guidelines also state that *"to ensure "no net loss" of aquatic habitats, NSW DPI requires that proponents should, as a first priority, aim to avoid impacts upon KFH. Where avoidance is impossible or impractical, proponents should then aim to minimise impacts. Any remaining impacts should then be offset with compensatory works"*.

KFH maps have been compiled by DPI and are considered in section 3.4.1 and the impacts of the project on KFH are discussed in section 5.6.1.

2.1.2.2 Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings

Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge, 2003*)* provides guidelines for the planning, design, construction and maintenance of watercourse crossings aimed at minimising impacts on fish passage and aquatic biodiversity. The guidelines outline types of potential impacts from instream structures and subsequently provides guidance on suitable crossing structures to avoid barriers to fish passage.

DPI considers proposals in relation to habitat sensitivity type (Table 2-1) and also waterway class. The waterway classification scheme has been adapted from Fairfull and Witheridge (2003) and factors in the functionality of the waterway as fish habitat (Table 2-2). Watercourses are classified using indicators such as:

- hydraulic geometry (stream shape and size),
- frequency of stream flows (perennial, intermittent or ephemeral),
- presence of aquatic habitat units (pools, riffles, vegetation, snags),
- presence of threatened or protected fish species and other native fish, and
- connection to adjacent habitats (e.g. floodplain wetlands).

Waterway class can be used to assess the impacts of certain activities on fish habitats in conjunction with the habitat sensitivity type. The waterway class scheme can also be used to make management recommendations to minimise impacts on different fish habitats.

Table 2-2. Classification of waterways for fish passage (Fairfull & Witheridge, 2003)

Classification	Characteristics of waterway class	Minimum [1] Recommended Crossing type
Class 1 Major key fish habitat	Marine or estuarine waterway or permanently flowing or flooded freshwater waterway (e.g. river or major creek), habitat of a threatened or protected fish species or 'critical habitat'.	Bridge, arch structure or tunnel
Class 2 Moderate key fish habitat	Non-permanently flowing (intermittent) stream, creek or waterway (generally named) with clearly defined bed and banks with semi-permanent to permanent waters in pools or in connected wetland areas. Freshwater aquatic vegetation is present. TYPE 1 and 2 habitats present.	Bridge, arch structure, culvert [2] or ford.
Class 3 Minimal key fish habitat	Named or unnamed waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies). Semi-permanent pools form within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or other CLASS 1-3 fish habitats.	Culvert [3] or ford
Class 4 Unlikely key fish habitat	Waterway (generally unnamed) with intermittent flow following rain events only, little or no defined drainage channel, little or no flow or free standing water or pools post rain events (e.g. dry gullies or shallow floodplain depressions with no aquatic flora present).	Culvert [4], causeway or ford
Notes [1] In all cases bridges are preferred to arch structures, culverts, fords and causeways (in that order).		

Classification	Characteristics of waterway class	Minimum [1] Recommended Crossing type
[2] High priority given to the "High Flow Design" procedures presented for the design of these culverts - refer to Design Considerations section of this document, or engineering guidelines (Witheridge, 2002). [3] Minimum culvert design using the "Low Flow Design" procedures; however, "High Flow Design" and "Medium Flow Design" should be given priority where affordable (refer to Witheridge (2002)). [4] Fish friendly waterway crossing designs possibly unwarranted. Fish passage requirements should be confirmed with the local fisheries department/authority.		

2.1.2.3 Threatened Species Survey and Assessment Guidelines

The NSW threatened species survey and assessment guidelines are referred to as the *Threatened Species Test of Significance Guidelines* (OEH, 2018).

The objective of section 7.3 of the BC Act, the test of significance, is to provide standardised and transparent consideration of threatened species and ecological communities, and their habitats, through the development assessment process.

The guidelines help applicants or proponents of a development or activity to interpret and apply the factors in the test. They also provide guidance for consent authorities to encourage a consistent method of assessment for applications that may have an impact on threatened species and ecological communities or their habitats. The guidelines relate to the determination of whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats, within the meaning of that phrase in section 7.3.

No aquatic threatened species or ecological communities listed under the BC Act were identified in desktop studies, hence these guidelines were not required for the aquatic impact assessment. These guidelines are relevant and considered further in the BDAR.

2.1.2.4 Aquatic Ecology in Environmental Impact Assessment – EIA Guideline

The aim of the guideline *Aquatic Ecology in Environmental Impact Assessment - EIA guideline* (NSW Department of Planning, 2003) (the EIA guideline) is to:

- Encourage a standardised, rigorous approach to aquatic investigations in environmental impact assessment.
- Provide information which can be used to understand and manage changes to the aquatic environment in NSW.

The guidelines provide reference for:

- The extent to which the existing environment needs to be described.
- The extent to which a proposal is likely to affect aquatic biodiversity.
- The minimal acceptable standard for assessment of potential impacts on aquatic biodiversity.
- Predicting cumulative impacts within a body of water.
- When monitoring should be done and what components of the aquatic environment (biotic and abiotic) should be monitored.
- Requirements for adequate information to manage potential impacts and initiate feedback from monitoring to management.

The existing environment, assessment and sampling methodology, potential impacts, as well as recommendations for mitigation measures which are outlined in this report have taken into consideration the EIA guidelines.

2.1.2.5 Guidelines for controlled activities on waterfront land

The *Guidelines for controlled activities on waterfront land: Riparian corridors* (DPI, 2018) include provision for the protection of waterfront land. Controlled activities include any works or any activity which affects the quantity or flow of water in a water source, carried out in, on, or under waterfront land.

Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40m of the highest bank of the river, lake or estuary.

A key objective of these guidelines is to establish and preserve the integrity of riparian corridors. Ideally, the environmental functions of riparian corridors should be maintained or rehabilitated by applying the following principles:

- Identify whether or not there is a watercourse present and determine its order in accordance with the Strahler System.
- If a watercourse is present, define the riparian corridor/vegetated riparian zone (VRZ) on a map in accordance with Table 2-3.
- Seek to maintain or rehabilitate a riparian corridor/VRZ with fully structured native vegetation in accordance with Table 2-3.
- Seek to minimise disturbance and harm to the recommended riparian corridor/VRZ.
- Minimise the number of creek crossings and provide perimeter road separating development from the riparian corridor/VRZ.
- Locate services and infrastructure outside of the riparian corridor/VRZ. Within the riparian corridor/VRZ provide multiple service easements and/or utilise road crossings where possible.
- Treat stormwater run-off before discharging into the riparian corridor/VRZ.

Non-riparian corridor works such as infrastructure, can be authorised within the outer riparian corridor, so long as the average width of the VRZ can be achieved over the length of the watercourse within the development site.

While non-native vegetation may provide some bank stability, the objectives of the guidelines relate to the preservation and rehabilitation of native riparian vegetation in accordance with the minimum riparian corridor requirements.

Table 2-3. Recommended riparian corridor widths (DPI, 2018)

Watercourse type	VRZ width (each side of watercourse)	Total RC width
First order	10 metres	20 metres + channel width
Second order	20 metres	40 metres + channel width
Third order	30 metres	60 metres + channel width
Fourth order and greater	40 metres	80 metres + channel width

Note: Where a watercourse does not exhibit the features of a defined channel with bed and banks, the Natural Resources Access Regulator (NRAR) may determine that the watercourse is not waterfront land for the purposes of the WM Act.

The impacts of the project on riparian vegetation are considered in section 5.1.

2.1.3 Commonwealth legislation

2.1.3.1 Environment Protection and Biodiversity Conservation Act 1999

The objective of the EPBC Act is to protect and manage prescribed MNES. Under the EPBC Act, proposed 'actions' that have the potential to significantly impact on MNES, the environment of Commonwealth land, or that are being carried out by an Australian Government agency, must be referred to the Commonwealth Minister for the Environment for assessment.

On 2 February 2022, the project was determined to be a Controlled Action, requiring approval under the EPBC Act due to its potential impact on listed threatened species and ecological communities. The project will therefore be assessed under the bilateral agreement between the Commonwealth and NSW Governments. The Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) (formerly the Department of Agriculture, Water, and the Environment) has issued its assessment requirements which have been incorporated into the SEARs for the project.

This aquatic biodiversity impact assessment concluded that there is unlikely to be any significant impacts to MNES relevant to aquatic biodiversity resulting from the project (refer section 5.5).

3. Methodology

3.1 Study area

The study area for the assessment included watercourses either directly or indirectly affected by the project, which was identified by application of a 10-km buffer around the Project Area (Figure 1-1). Section 3.5 describes the criteria for the selection of watercourses considered suitable for habitat assessments and fauna surveys.

Survey sites included a 100m reach along each watercourse (subject to property access and other constraints), within which habitat assessments and surveys were undertaken.

3.2 Desktop assessment

A desktop review of relevant guidelines, previous species sighting records, documents and reports relevant to the project was undertaken from the locality on 24/04/2022 using the following public ecological databases and websites:

- A search of the NSW Fisheries threatened species list (DPI, undated a) and Spatial Data Portal within the locality (which includes the four Local Government Areas (LGAs) surrounding the Project Area: Upper Hunter, Warrumbungle, Mid-Western Regional and Muswellbrook (DPI, undated b)), for Threatened species indicative distribution maps. The mapping provides the indicative (or known and expected) distributions for a number of NSW freshwater threatened species based on modelling. The indicative distribution means there is a high probability that the species would occur in a stream segment, given the species has been recorded there or the environmental conditions are the same as a stream segment where the species is already known to occur. Modelled indicative distribution maps are not available for all NSW freshwater threatened species due to the limited number of records for some species or the limited number of correlated environmental attributes (section 4.8.4). For threatened species where distribution maps were not available, habitat assessment and review of Primefacts (electronic resource produced by DPI) for each individual species were used to determine their likely presence (DPI, undated c).
- A search of the Spatial Data Portal (DPI, undated b) was undertaken for KFH mapping (section 3.4.1) and Fish Community Status of NSW mapping and Fish Communities and Threatened Species Distribution of NSW Report prepared by DPI (DPI, 2016). The report rates the condition of fish communities as either Very Good, Good, Moderate, Poor or Very Poor (section 3.8).
- A search on the DCCEEW Protected Matters Search Tool (PMST) for MNES within 10 km of the Project Area (section 4.8.3).
- Species Profile and Threats Database, profiles and references therein for federally listed threatened species were used to determine likely occurrence and provide distribution and habitat information (Table 4-3).
- An area search was conducted within the BioNet website for the Atlas of NSW Wildlife (OEH, 2022). BioNet is a portal for accessing government held information about plants and animals in NSW. It is supported by several NSW government held agencies. BioNet contains records for aquatic threatened species and EECs listed under the BC Act, the FM Act and the EPBC Act which have been recorded within the locality. The search was conducted for all protected species (threatened and non-threatened) within a 10 km buffer of the Project Area (section 4.8.1)
- A search of Atlas of Living Australia (ALA) records. ALA is a collaborative, digital, open infrastructure that pulls together Australian biodiversity data from multiple sources. A search of the ALA was conducted within a 10 km buffer for threatened species and protected species such as platypus and turtles (section 4.8.2).
- Review of Survey Guidelines for Australia's threatened fish (DSEWPC, 2011) to determine the likelihood of a species presence or absence at a site. The guidelines are not mandatory however, and desktop analysis of historic data can be used as an alternative survey approach.

- Review of DAWE Directory of Important Wetlands (DAWE 2022).

The information obtained was used to inform survey design and assist in the description of ecological context, assessment of potentially occurring threatened species, endangered populations (EPs) and threatened ecological communities (TECs).

3.3 Stream order mapping

The Strahler ordering system (Strahler, 1952), as described in NSW Government Gazette no. 37 on 24 March 2006 was used to characterise the watercourses within the study area.

The Strahler ordering system is a hierarchical numbering system based on the degree of branching within a watercourse and provides an indication of the complexity of a creek system. For the purposes of this order, watercourses are deemed to be continuous even if they lose definition and then reappear downstream. The methodology used is as follows:

- Starting at the top of a catchment, any watercourse which has no other watercourses flowing into it is classed as a first order stream (1).
- Where two first order streams join, the stream becomes a second order stream (2).
- If a second order stream is joined by a first order stream - it remains a second order stream.
- When two second order streams join, they form a third order stream (3).
- A third order stream does not become a fourth order stream until it is joined by another third order stream and so on.

Strahler stream orders for watercourses within the study area are listed in Table 3-2 and shown in Figure 3-2.

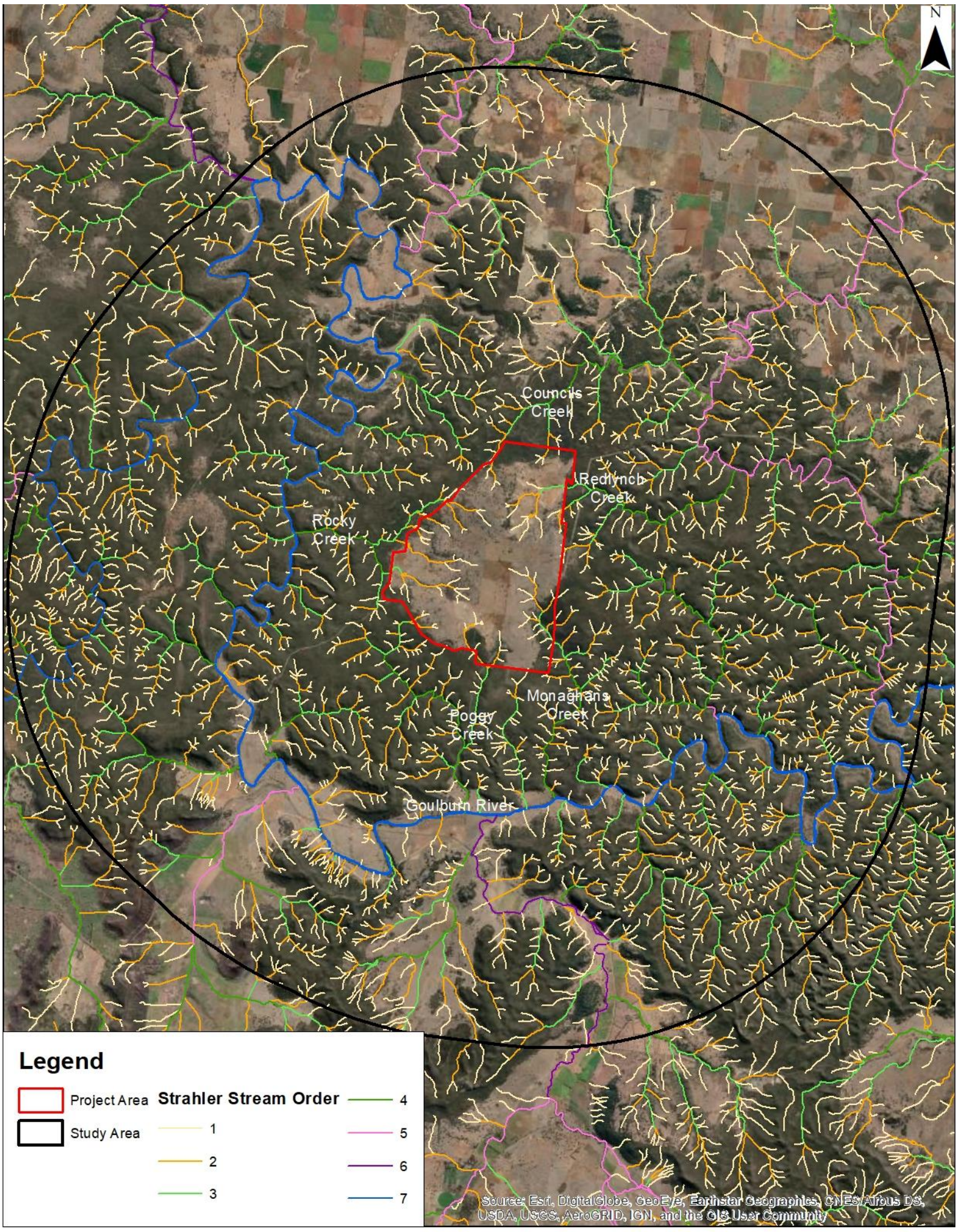


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Figure 3.1. Strahler Stream Order within the Study Area
Goulburn River Solar Farm
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3.4 Watercourse classification

3.4.1 Key fish habitat mapping

To meet the objectives of the FM Act to 'conserve key fish habitats', DPI identified KFH as those aquatic habitats that are important to the sustainability of the recreational and commercial fishing industries, the maintenance of fish populations generally, and the survival and recovery of threatened aquatic species.

A policy definition of the term KFH was developed to guide the compilation of maps. For freshwater environments, KFH was defined to include most permanent and semipermanent freshwater habitats including:

- Permanently flowing rivers and creeks including those where the flow is modified by upstream dam(s), up to the top of the natural bank regardless of whether the channel has been physically modified.
- Intermittently flowing rivers and creeks that retain water in a series of disconnected pools after flow ceases including those where the flow is modified by upstream dam(s), up to the top of the natural bank regardless of whether the channel has been physically modified.
- Billabongs, lakes, lagoons, wetlands associated with other permanent fish habitats (e.g. permanent rivers and creeks, estuaries etc.).
- Flood channels or flood runners that may normally be dry but would be used by fish to move/migrate across or along floodplains between habitats during high flow events.
- Any waterbody, if it is known to support or could be confidently expected (based on predictive modelling) to support threatened species, threatened populations or threatened communities listed under the provisions of Part 7A of the FM Act.

Small headwater creeks and gullies (known as first and second order streams) that only flow for a short period after rain were generally excluded, as were farm dams constructed on such systems. Wholly artificial waterbodies such as irrigation channels, urban drains and ponds, salt and evaporation ponds were also excluded except where they are known to support populations of threatened fish or invertebrates.

DPI KFH mapping for the study area is shown in Figure 3.2 and more detailed mapping at Redlynch Creek, Poggy Creek and Rock Creek is shown in Figure 3.3 to Figure 3.5.

3.4.2 Key fish habitat sensitivity and class analysis

The *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013) provides a framework to classify KFH types based on their aquatic habitat features as described in Table 2-1.

In addition to the habitat sensitivity type, DPI assesses proposals in relation to waterway class. The waterway classification scheme has been adapted from Fairfull and Witheridge (2003) and factors in the functionality of the waterway as fish habitat. The criteria by which the watercourse class is derived are defined in Table 2-2.

Within the Project Area, KFH Type and Class for each watercourse are discussed in section 4.5.

3.5 Determination of survey sites

Using electronic hydroline mapping (available from SIX Maps), 90 mapped hydrolines (including drainage lines) were identified within the study area (Figure 3-1). This included 69 first order watercourses, 18 second order watercourses and three third order watercourses. Five watercourses have been mapped by DPI as KFH (2007) (Figure 3-2).

The criteria in Table 3-1 was used to rank these watercourses into one of three categories – high, moderate and low priority.

Table 3-1. Watercourse categories

Priority ranking	Criteria
High	• Key Fish Habitat (DPI, 2007). • Threatened fish species predicted to occur based on DPI mapping (DPI, 2016) and results of database searches (Protected Matters Search Tool and ALA (2021) records).
Medium	• Key Fish Habitat (DPI, 2007). • Third order or above (Strahler stream ordering system). • Identified as having nearby wetland habitat.
Low	• Threatened fish species unlikely to occur based on DPI (2016) mapping and results of database searches (Protected Matters Search Tool and ALA (2021) records). • Not Key Fish Habitat (DPI, 2007). • First or second watercourses order based on Strahler stream order.

Watercourses with a moderate or high priority ranking were assessed further and used for the selection of survey sites and potential targeted threatened species survey. Survey sites are summarised in Table 3-2, including coordinates and Strahler stream order. All watercourses within the project area flow into Goulburn River.

Table 3-2. Survey site identification, co-ordinates, watercourse, Strahler stream order

Survey Site	Latitude	Longitude	Map X	Map Y	Watercourse	Strahler Stream Order
1	-32.264574	150.122678	228956	6426603	Redlynch Creek (outside development footprint)	3
2	-32.264169	150.120131	228714	6426641	Redlynch Creek	3
3	-32.295687	150.113879	228219	6423130	Unnamed tributary of Monaghans Creek	3
4	-32.299578	150.092402	226208	6422643	Unnamed tributary of Poggy Creek	2
5	-32.283825	150.072266	224263	6424339	Unnamed tributary of Rocky Creek	3
6	-32.277082	150.076840	224674	6425099	Unnamed tributary of Rocky Creek	2
7	-32.258019	150.100655	226861	6427274	Unnamed tributary of Councils Creek	2
8	-32.355998	150.066366	223927	6416319	Goulburn River	7

[a] Coordinates taken from field Garmin GPS Map Datum GDA 1994 zone 56

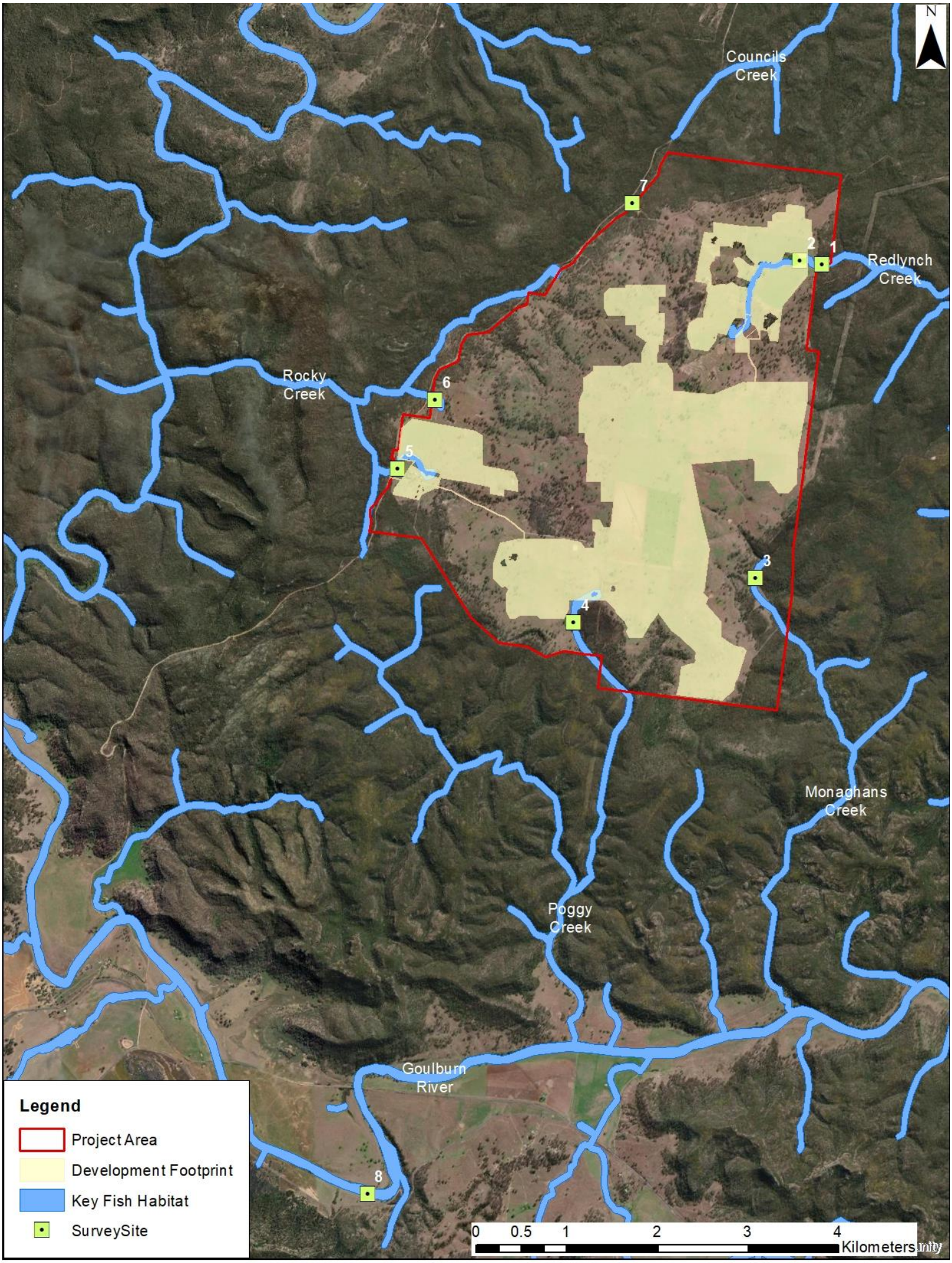

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Figure 3.2. Key Fish Habitat (DPI, 2007) and Survey Sites
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Figure 3.3. Key Fish Habitat (DPI, 20007) at Redlynch Creek
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Figure 3.4. Key Fish Habitat (DPI, 2007) at Poggy Creek
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Figure 3.5. Key Fish Habitat (DPI, 2007) at Rocky Creek
Goulburn River Solar Farm
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3.6 Field survey

Preliminary mapping of the broad scale aquatic habitats within the study area was undertaken using recent aerial photography in conjunction with topographic maps prior to field surveys. Topographic maps were used to gain a broad understanding of catchment characteristics including adjacent land use, elevation, access roats and distance from source.

An aquatic survey was undertaken on 5-6th May 2022.

3.6.1 Habitat assessment

An assessment of the aquatic habitat at each of the survey sites was undertaken, and indicators of stream condition noted. The aquatic habitat characteristics were recorded using standard recording sheets (NSW AUSRIVAS, 2007) along with assessment of the suitability of the habitat for threatened species with potential to occur in the area.

Habitat features and stream condition indicators assessed include:

- Topography
- Water level (height of bank and evidence of erosion)
- Shading of the river
- Riparian vegetation (percent cover of upper, middle and lower stratum)
- Stream width (minimum, maximum., mode)
- Stream depth (minimum, maximum, mode)
- Identification of macrophytes
- Percent cover of aquatic vegetation (algae, moss, macrophytes)
- Percent cover of detritus
- Description of natural substrate (percent bedrock, boulder, cobble, clay etc)
- Per cent of total macrophytes that are submerged, emergent or floating
- Presence of drought and flood refuge areas
- Presence of pool, riffle and edge habitats
- Presence of natural or artificial barriers to fish passage upstream and downstream
- Visual assessment of disturbance related to human activities for:
    - water quality
    - instream habitat
    - riparian zone
    - catchment assessment

  Visual assessments are ranked using the following categories
    - no evidence of disturbance
    - little disturbance
    - moderate disturbance
    - high disturbance
    - extreme disturbance

Photographs were also taken upstream and downstream from the centre point of each survey site.

The results of the habitat assessment are presented in section 4.5.

3.6.2 Targeted threatened species survey requirements

Guidelines are available for sampling threatened aquatic species listed under the EPBC Act, however they are not available for threatened aquatic species listed under the FM Act. Where available, recommended sampling techniques targeting threatened species with potential to occur in the study area are summarised in Table 3-3.

Table 3-3. Summary of recommended survey techniques for target threatened species

Target threatened species	FM Act	EPBC Act	Recommended Sampling Techniques (DSEWPC, 2011)
Darling River Hardyhead *(Craterocephalus amniculus)*	EP	-	No specific guidelines are available for this species however Murray hardyhead guidelines recommend the use of scoop nets, small seines, fyke nets or un-baited traps.
Murray-Darling Basin population of Eel Tailed Catfish (*Tandanus tandanus*)	EP	-	No specific guidelines are available for this species
Southern Purple Spotted Gudgeon (*Mogurnda adspersa*)	E	-	No specific guidelines are available for this species however other gudgeon species are targeted using bait traps.

Within the Project Area, only Redlynch Creek contained remnant pools suitable for sampling (refer Table 3-4; Plates 1 and 2). The remnant pools were small and shallow (less than 0.5 metre depth) and bait traps were considered the most appropriate sampling technique. There was insufficient space and/or flows at these survey sites for the use of other recommended sampling techniques identified in Table 3-3.

Table 3-4. Fauna survey locations and sampling techniques

Survey site	Watercourse	Sample Technique[a]
1 (outside Project Area)	Redlynch Creek	3 bait traps
2	Redlynch Creek	3 bait traps

[a] Bait traps (0.5 metres long x 0.24 metres wide x 0.24 metres high) baited with chicken meal and sardines and left for 4 hours.

Plate 1. Bait trap at survey site 1, Redlynch Creek

Plate 2. Bait trap at survey site 2, Redlynch Creek

3.7 Riparian and aquatic vegetation survey and mapping

Riparian vegetation (percent cover of upper, middle and lower stratum and dominant species) and aquatic vegetation (macrophytes) were recorded using standard recording sheets (NSW AUSRIVAS, 2007). These results are provided in section 4.5.

In addition, the BDAR mapped the terrestrial vegetation within the study area and categorised it into plant community types (PCTs) using plot/transect data. The methodology used is discussed further in the BDAR. The BDAR terrestrial vegetation mapping was used to determine the type and extent of riparian vegetation within the Project Area. The area of riparian vegetation along each hydroline was calculated using the *Guidelines for controlled activities on waterfront land: Riparian corridors* (DPI, 2018; refer section 2.1.2.5 and Table 2-3 for methodology). The results are presented in section 4.7 and a discussion of riparian vegetation impacted by the project is provided in section 5.1.2.1.

3.8 Fish community status mapping

The Fish Communities and Threatened Species Distributions of NSW project (FCTSD) combined data collected over twenty years of biological surveys with standard statistical analysis and spatial distribution models, to provide mapping of the status of fish communities and threatened species distributions across NSW. The FCTSD project mapped the status of fish communities across NSW as Very Good, Good, Moderate, Poor, or Very Poor (DPI, 2016).

None of the watercourses within the Project Area were mapped, however Goulburn River was defined as ‘Fair’ to ‘Poor’ within the study area (Figure 3-6)

The fish community status mapping is useful in determining the importance of the habitat within the Project Area to threatened species that occur in the locality.

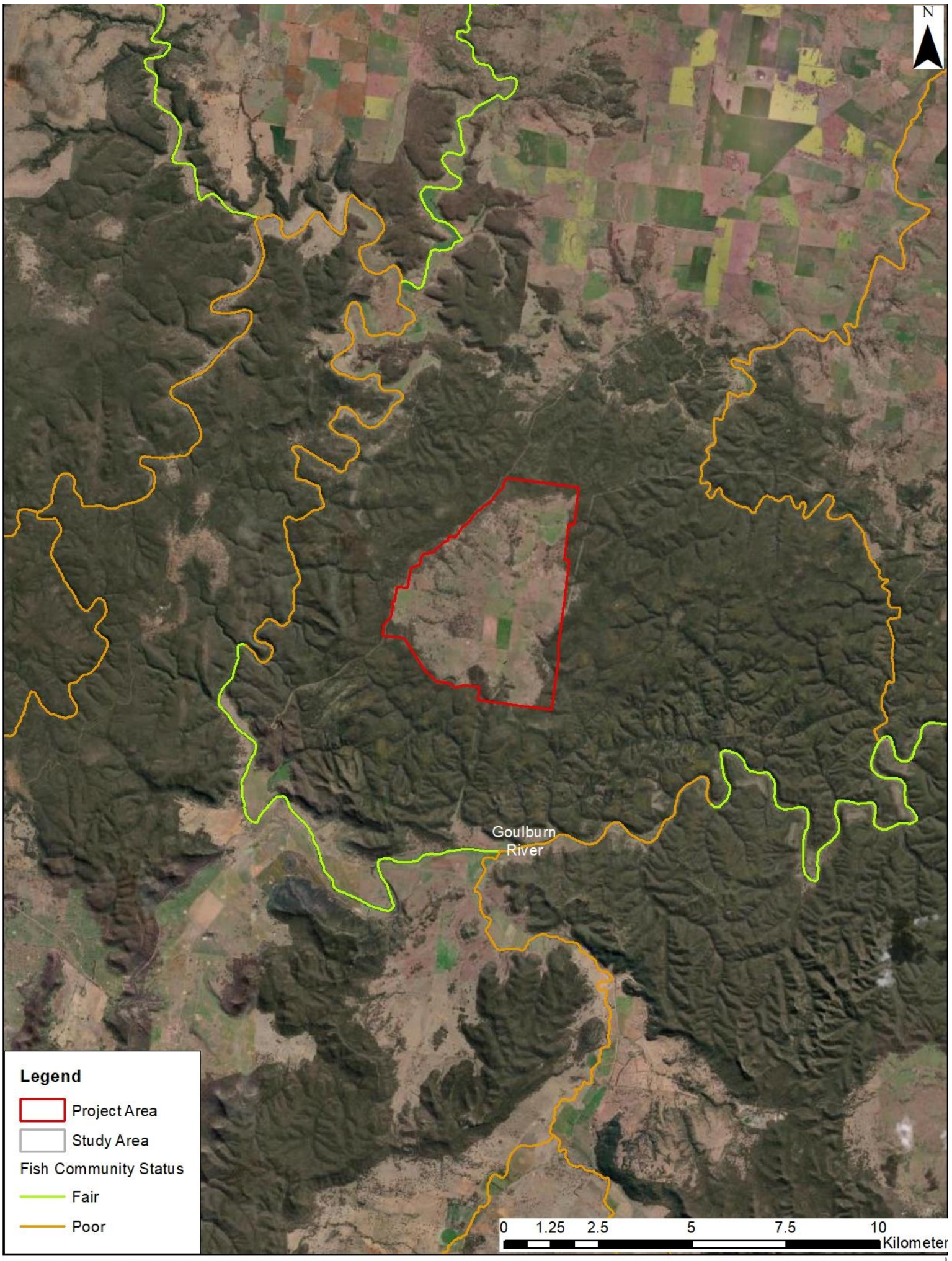

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Figure 3.6. Fish Community Status Mapping (DPI, 2016)
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3.9 Directory of important wetlands

The directory of important wetlands (DAWE, 2022) returned one important wetland: Hunter Estuary, however as this estuary is 150 km upstream of the Project Area, it will not be impacted by the project and does not require further assessment.

3.10 Risk of impact criteria

The criteria used to define the risk of impact of the project on watercourses within the study area are listed in Table 3-5. The risk of impact of the project during construction, operation and decommissioning is considered in section 5.

Table 3-5. Criteria for defining the risk of impact of the project on receiving watercourses

Risk of Impact	Criteria
Moderate	• Watercourse occurs within the Project Area, would be directly impacted by instream works or works within the riparian vegetation.
Low	• Watercourse is within the study area but outside the Project Area and provides potential habitat for threatened species and may be impacted indirectly by the project. • Watercourse is within the Project Area however construction activities would be minor, would not directly impact the watercourses and indirect impacts can be managed.
Negligible	• Watercourse is within the study area but outside the Project Area, is unlikely to provide habitat for threatened species and would not be directly impacted by construction activities. Indirect impacts can be managed. • Watercourse is within the Project Area and would be directly impacted by construction activities however the watercourse has been defined a low priority watercourse.

4. Existing environment

4.1 Weather and climatic conditions

The weather during surveys conducted between 5-6 May 2022 was fine and mild with air temperatures ranging between 4.5-22.7 degrees Celsius. Rainfall recorded 5 May 2022 was 14.2 millimetres (mm), mostly in the morning prior to the commencement of surveys (BOM, 2022a).

Most of NSW has received above average rainfall over the past 2.5 years, largely due to La Niña (BOM, 2022a). Thus, the area was not considered to be in drought at the time of survey.

4.2 Goulburn River

The watercourses within the Project Area are all tributaries of Goulburn River. Goulburn River in east New South Wales is in the Hunter/Central Rivers Catchment Management Authority and starts below Ulan at an elevation of 434m and ends at an elevation of 97.3m merging with the Hunter River near Denman. Goulburn River drops around 337m over its 221km length. It is the largest tributary of the Hunter River and accounts for 40 per cent of the Hunter River's catchment area, but contributes only 23 per cent of its flow.

4.3 Water Quality

Stream salinity is a significant management issue in the Hunter River basin. Sources of salt include rainfall and weathering products, which enter the stream via surface runoff pathways, and groundwater sources, particularly from Permian coal measures. Streams with identified groundwater interactions often have high salinities. In the Upper Goulburn River and Wollar Creek, median electrical conductivities exceed 2300 µS/cm (NSW EPA, 2013). Coal mining is thought to contribute to stream salinity, although this is difficult to confirm due to lack of long-term monitoring data and a highly variable climate.

Visual assessment of water quality was undertaken at each survey site using categories described (section 3.6.1). Watercourses with remnant pools present at the time of survey were categorised as having a low to moderate level of disturbance, attributed to catchment land use practices (i.e., farming). Visual assessments for each survey site are provided in section 4.5.

4.4 Groundwater Dependent Ecosystems

The Bureau of Meteorology's GDE Atlas (BOM, 2022b) provides the following groundwater dependent ecosystem definitions:

- Aquatic ecosystems that rely on the surface expression of groundwater – this includes surface water ecosystems which may have a groundwater component, such as rivers, wetlands and springs.
- Terrestrial ecosystems that rely on the subsurface presence of groundwater – this includes all vegetation ecosystems.
- Subterranean ecosystems – this includes cave and aquifer ecosystems.

The GDE Atlas does not map any aquatic GDEs within the study area however a portion of the study area has been defined as a low potential Terrestrial GDE (Figure 4-1).

The riparian vegetation associated with GDEs within the Project Area are discussed further in section 4.7. Further details regarding GDEs are available in the Water Resources Assessment (Umwelt, 2023) and the BDARs (Umwelt, 2023 further considers terrestrial GDEs.

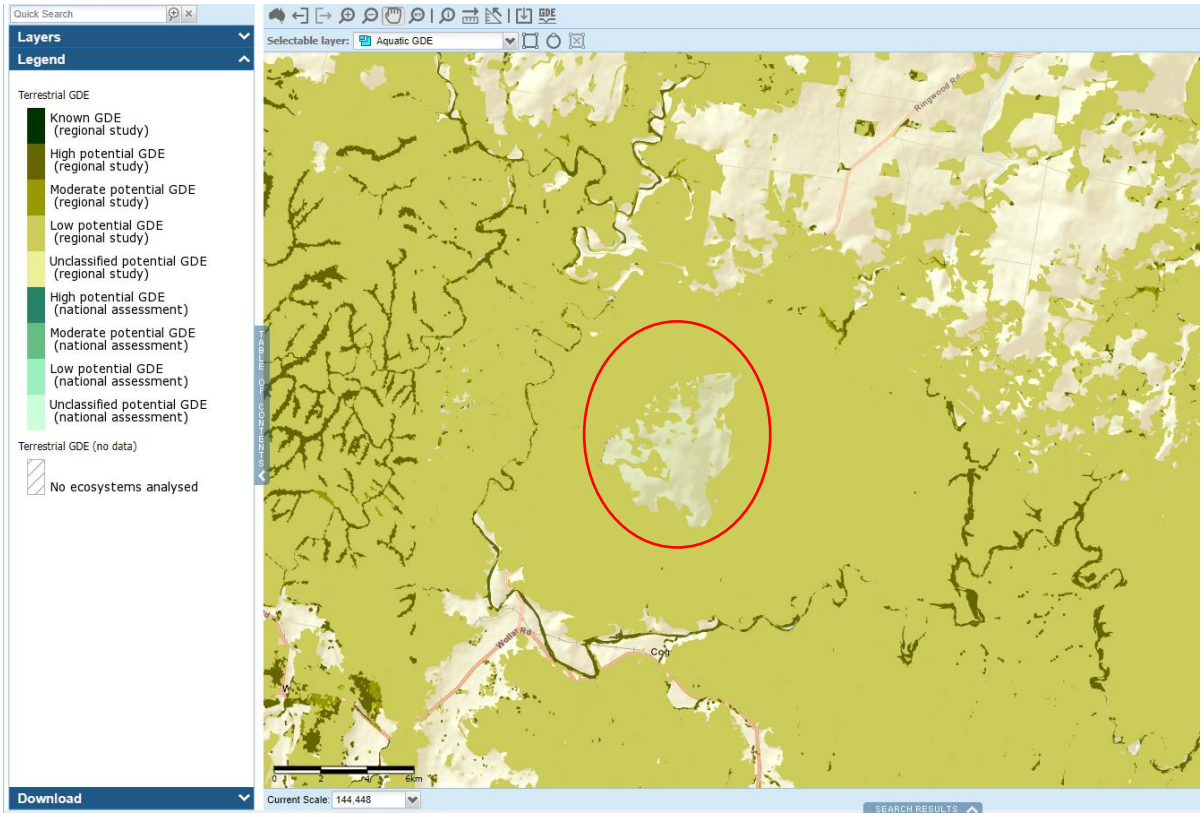

Figure 4-1. Terrestrial Groundwater Dependent Ecosystem (GDE) mapping

4.5 Aquatic habitat within the study area

Watercourses were categorised into KFH habitat types based on their sensitivity (DPI, 2013), watercourse classifications (Fairfull and Witheridge, 2003) and identified aquatic features in the field surveys. This is discussed in section 4.5.1 to section 4.5.6 and summarised in Table 4-1.

4.5.1 Redlynch Creek

Site inspections were undertaken at two survey sites along Redlynch Creek (Figure 3-2). Survey site 1 is located outside of the Project Area in a steep valley within Goulburn River National Park. At this survey site, the average bank width of Redlynch Creek was five metres. Water was flowing along a low flow channel approximately one metre wide and numerous pools were present. Riffle sections included a diversity of habitat with bedrock, boulders, cobbles, pebbles, gravel, sand and silt all represented. Some large snags were present, along with detritus, trailing bank vegetation and bank overhangs. Riparian vegetation was intact and dominant canopy species included Narrow-leaved Ironbark *Eucalyptus fibrosa* and Brown Bloodwood *Corymbia trachyphloia*, with a middle stratum dominated by shrubs including Narrow-leaved Geebung *Persoonia linearis*, *Acacia sp.* and *Dodonaea triangularis*. The lower stratum was sparse due to exposed bedrock and boulders (which had a high proportion of surface area covered by moss), however species included some native grasses (Couch Grass *Cynodon dactylon*) and native ferns along with exotic grasses and herbs. Within the watercourse itself, macrophytes included *Juncus sp.* and Buttercup *Ranunculus sp.* The land use on both sides of the bank consisted of National Park.

Visual assessment indicated that the water quality, instream habitat and riparian zone had little evidence of disturbance, despite the intensive agriculture upstream, with clear water, limited instream disturbance and an intact riparian zone (Plates 3 and 4). At this survey site, the watercourse was defined as Type 2 moderately sensitive KFH.

Plate 3. Survey site 1: upstream

Plate 4. Survey site 1: downstream

Survey site 2 is in the northeast corner of the Project Area in a broad valley and is located approximately 280 metres upstream of survey site 1 (Figure 3-2). At survey site 2, the average bank width was 4 metres. Water was flowing along a low flow channel approximately one metre wide with several pools. Substrate consisted mainly of bedrock and clay however riffle sections were absent from this survey site. Due to the absence of riparian vegetation, no snags or detritus were recorded, and the degraded nature of the bank limited the presence of trailing bank vegetation and bank overhang. Riparian vegetation was highly disturbed from agricultural practices, and few remnant trees remained (only isolated Grey Box *Eucalyptus macrocarpa* and White Box *Eucalyptus albens*). The middle stratum was absent and the lower stratum consisted entirely of exotic grasses and herbs. Within the watercourse itself, macrophytes included *Juncus sp*. and Buttercup *Ranunculus sp.* The land use on both sides of the bank consisted of cleared agricultural land.

Visual assessment indicated that the water quality was moderately disturbed, while the instream habitat and riparian zone had a high level of disturbance through the presence of pumps for water extraction, filamentous algae, vegetation clearing and bank degradation as cattle were not excluded from the edge of the watercourse (Plates 5 and 6).

Within the Project Area, Redlynch Creek had a high level of disturbance and provided limited aquatic habitat, however it was the only watercourse within the Project Area to have flowing water at the time of survey. At this survey site, the watercourse was defined as Type 3 minimally sensitive KFH.

Plate 5. Survey site 2: upstream

Plate 6. Survey site 2: downstream

4.5.2 Unnamed tributary Monaghans Creek

Survey site 3 is in the southeast corner of the Project Area in a steep valley (Figure 3-2). At this survey site, the average bank width was 8 metres with a low flow channel approximately one metre wide. No water was flowing at the time of survey. Riffle sections included a diversity of habitat with boulders, cobbles, pebbles, gravel, sand and silt all represented. Some large snags were present, along with detritus, trailing bank vegetation and bank overhangs. Riparian vegetation was intact and dominant canopy species included Narrow-leaved Ironbark *Eucalyptus fibrosa,* Grey Box *E. macrocarpa,* Spotted Gum *Corymbia maculata* and Black Pine *Callitris endlicheri* with a middle stratum dominated by a diversity of shrubs. The lower stratum was dominated by exotic grasses and herbs. No aquatic vegetation was recorded within the watercourse itself. The land use on both sides of the bank consisted of agricultural land, however due to the steepness of the valley, a wide riparian vegetation zone has been retained (Plate 7 and 8).

Visual assessment indicated that the instream habitat and riparian zone had little evidence of disturbance, despite the intensive agriculture upstream.

Due to the steepness of the surrounding topography, there are limited opportunities for water pooling and as such, there was limited aquatic habitat available. At this survey site, the watercourse is defined as Type 3 minimally sensitive KFH.

Plate 7. Survey site 3: upstream

Plate 8. Survey site 3: downstream

4.5.3 Unnamed tributary Poggy Creek

Survey site 4 is in the south of the Project Area in a broad valley (Figure 3-2). At this survey site, the banks were not well defined, however the average bank width was one metre wide. No water was flowing at the time of survey however the area was wet (approximately 10 cm deep). No riffle sections were present and despite the presence of regrowth in the canopy, large snags were absent. There was limited detritus and no bank overhangs or trailing bank vegetation. Riparian vegetation was disturbed, with sparse regrowth including Narrow-leaved Ironbark *Eucalyptus fibrosa*, Grey Box *E. macrocarpa* and Brown Bloodwood *C. trachyphloia*, a sparse middle stratum including *Acacia implexa, Pomaderris sp*. and a lower stratum consisting of exotic grasses and herbs. The watercourse was dominated by the exotic creeper *Tradescantia albiflora*.

Visual assessment indicated that the instream habitat and riparian zone had a moderate level of disturbance from the invasion by exotic species in the instream zone, and the devegetation of the riparian zone (Plates 9 and 10).

The watercourse at this survey site had a high level of disturbance and provided limited aquatic habitat. At this survey site, the watercourse was defined as Type 3 minimally sensitive KFH.

Plate 9. Survey site 4: upstream

Plate 10. Survey site 4: downstream

4.5.4 Unnamed tributaries of Rocky Creek

Site inspections were undertaken at two survey sites along Rocky Creek on the western boundary of the Project Area in a broad valley (Figure 3-2). At survey site 5, the channel had been modified through the construction of a farm dam however there was some bank definition downstream of the farm dam before the watercourse crossed Wollara Road via a pipe culvert. At this survey site, the average bank width was 4 metres. No water was flowing at the time of survey, and apart from the farm dam, no pools were present nor were there any riffle sections. The substrate consisted mainly of sand and silt, and there were no aquatic habitat features such as snags, detritus, trailing bank vegetation, bank overhangs or aquatic vegetation. Riparian vegetation had been cleared with no upper or middle stratum species present, and the lower stratum was dominated by exotic grasses and herbs. The land use on both sides of the bank consisted of farmland.

Visual assessment indicated that the water quality, instream habitat and riparian zone had a high level of disturbance, through the alteration of natural hydrology (i.e. farm dam), bank erosion and devegetation of the riparian zone, and there was limited aquatic habitat present (Plates 11 and 12). The dam may however provide habitat for protected aquatic species such as eels, turtles and crustaceans.

At this survey site, the watercourse was defined as Type 3 minimally sensitive KFH.

Plate 11. Survey site 5: upstream

Plate 12. Survey site 5: downstream

At survey site 6, the channel had also been modified through the construction of a farm dam, however there was some bank definition downstream of the farm dam before the watercourse crossed Wollara Road via a pipe culvert. At this survey site, the average bank width was 10 metres. No water was flowing at the time of survey, and apart from the farm dam, no pools were present and there were no riffle sections. The substrate consisted mainly of sand and silt, and there were no aquatic habitat features such as snags, detritus, trailing bank vegetation, bank overhangs or aquatic vegetation. Riparian vegetation had been cleared with no upper or middle stratum species present, and a lower stratum dominated by exotic grasses and herbs. The land use on both sides of the bank consisted of farmland.

Visual assessment indicated that the water quality, instream habitat and riparian zone had a high level of disturbance, through the alteration of natural hydrology (i.e. farm dam), bank erosion and devegetation of the riparian zone, and there was limited aquatic habitat present (Plates 13 and 14). The farm dam may however provide habitat for protected aquatic species such as eels, turtles and crustaceans.

At this survey site, the watercourse is defined as Type 3 minimally sensitive KFH.

Plate 13. Survey site 6: upstream dam

Plate 14. Survey site 6: downstream

4.5.5 Unnamed tributary of Councils Creek

Survey site 7 is located on an unnamed tributary of Councils Creek. The survey site is on the western boundary of the Project Area in a broad valley (Figure 3-2). The watercourse at this survey site had limited bank definition and an average bank width of one metre. No water was flowing at the time of survey, however there were some small pools (less than 20 cm deep). There were no riffle sections, trailing bank vegetation, bank overhangs or aquatic vegetation however there were snags and detritus. The substrate consisted mainly of sand and silt. Riparian vegetation was relatively intact, however the proximity of Wollara Road did impact the riparian zone. Canopy species included Narrow-leaved Ironbark *E. fibrosa,* Grey Box *E. macrocarpa* and Brown Bloodwood *C. trachyphloia*. Middle stratum consisted of a dense shrub layer and the lower stratum consisted of a mix of native and exotic grasses and herbs. The land use on both sides of the bank consisted of farmland and access roads.

Visual assessment indicated that the water quality was poor due to the proximity of the road and access roads, resulting in bare, unstabilised substrate, while the riparian zone was relatively intact with a low level of disturbance. There was limited aquatic habitat present (Plates 15 and 16). At this survey site, the watercourse is defined as Type 3 minimally sensitive KFH.

Plate 15. Survey site 7: upstream

Plate 16. Survey site 7: downstream

4.5.6 Goulburn River

Goulburn River is the only perennial watercourse within the study area, however it is outside of the Project Area (Figure 3-2). At survey site 8, this river was approximately 30 m wide and there were moderate flows. Riparian vegetation had been largely cleared for farmland, with only a few remnant trees remaining, no middle stratum species and a lower stratum consisting of exotic grasses and herbs. There were limited snags (due to the absence of riparian vegetation), no large rocks or native aquatic plants however the reach did contain sandy/gravel beds. The land use on both banks and the broader catchment consisted of rural properties and rail and road infrastructure.

Visual assessment indicated that the water quality and instream habitat had little to moderate signs of disturbance, while the riparian zone had been highly disturbed through past clearing of the riparian vegetation and the intensive agricultural land use within the catchment (Plates 17 and 18).

At this survey site, the watercourse is defined as Type 1 highly sensitive KFH.

Plate 17. Survey site 8: upstream

Plate 18. Survey site 8: downstream

4.6 Summary of aquatic habitat within the study area

Table 4-1 summarises the watercourses within the study area, including their KFH sensitivity (Type) and the watercourse Class. In summary, all watercourses within the Project Area were defined as Type 3 minimally sensitive KFH based on the absence of important aquatic habitat features and only Redlynch Creek (survey site 2) had flowing water at the time of survey despite recent rainfall events.

The lack of flowing water and only limited refuge areas observed in a year with above average rainfall indicates that these watercourses are highly ephemeral, only holding water for a short period following rain events, and draining away quickly, leaving limited aquatic fauna refuge areas.

The presence of macrophytes/aquatic vegetation is an important habitat feature in defining the type and sensitivity of KFH as it provides refuge, breeding and foraging habitat. There are three types of aquatic vegetation:

- submerged;
- floating; and
- emergent.

While some of the survey sites contained sparse cover of emergent macrophytes (i.e. *Juncus sp.*), they did not contain submerged or floating macrophytes. The presence of sparse, emergent macrophytes is not considered to be an important habitat feature for aquatic fauna.

Another important habitat feature in defining the type and sensitivity of KFH is the presence of in-stream gravel beds, rocks greater than 500 mm, snags greater than 300 mm in diameter or three metres in length. Within the Project Area, Redlynch Creek (survey site 2) contained bedrock and gravel and the unnamed tributary of Monaghans Creek (survey site 3) contained bedrock, cobbles, pebbles and gravel. No other watercourses at survey sites contained instream gravel beds or riffle sections. Only the unnamed tributary of Monaghans Creek (survey site 3) contained large snags.

Most of the survey sites contained limited bank overhang and trailing bank vegetation which are also important habitat features as they provide habitat for macroinvertebrates and therefore foraging resources for native fish species.

Watercourse Class is mainly used to determine the minimum crossing type required to maintain fish passage. Except for Redlynch Creek, all watercourses (at survey sites) within the Project Area were defined as Class 4 unlikely KFH (Table 4-1), in which case fish friendly waterway crossing designs are unwarranted. Redlynch Creek at the survey site was defined as a Class 3 minimal KFH and therefore the minimum crossing structures are a culvert or ford (in that order of preference (refer Table 2-2)).

The fish community status along the Goulburn River where it occurs within the study area, has been rated as poor to fair (DPI, 2016; Figure 3-6), which represents a fish community in low to moderate health. No other watercourses within the study area were ranked as part of the fish community status mapping project.

Table 4-1. Watercourses within the Project Area, Key Fish Habitat Type and Watercourse Class

Survey Site	Watercourse	Water present[a]?	Strahler stream order	Habitat Type[b]	Class[c]
1	Redlynch Creek (outside of Project Area)	Yes	3	Type 2 moderately sensitive KFH (contains snags greater than 300 mm in diameter, riffle sections, native aquatic plants).	Class 2 moderate KFH (clearly defined banks, semi permanent water in pools, freshwater aquatic vegetation present).
2	Redlynch Creek	Yes – only in residual pools.	3	Type 3 minimally sensitive KFH (does not contain snags, native aquatic vegetation, instream gravel beds and is ephemeral).	Class 3 Minimal KFH (defined channel, some aquatic vegetation, connected farm dam, some refuge pools present).
3	Unnamed tributary of Monaghans Creek	No	3	Type 3 minimally sensitive KFH (contains snags greater than 300 mm in diameter, but lacks aquatic vegetation, instream gravel beds and is highly ephemeral).	Class 4 Unlikely KFH (defined channel but no aquatic vegetation, steep gully so limited refuge even after rain events).
4	Unnamed tributary of Poggy Creek	No	2	Type 3 minimally sensitive KFH (does not contain snags, native aquatic vegetation, instream gravel beds and is highly ephemeral).	Class 4 Unlikely KFH (intermittent flows only after rain events, no defined channel, little or no flow post rain events and no aquatic flora present).
5	Unnamed tributary of Rocky Creek	No	3	Type 3 minimally sensitive KFH (does not contain snags, native aquatic vegetation, instream gravel beds and is highly ephemeral).	Class 4 Unlikely KFH (constructed dam along drainage line, intermittent flows only after rain events, no defined channel, little or no flow post rain events and no aquatic flora present).
6	Unnamed tributary of Rocky Creek	No	2	Type 3 minimally sensitive KFH (does not contain snags, native aquatic vegetation, instream gravel beds and is highly ephemeral).	Class 4 Unlikely KFH (constructed dam along drainage line, intermittent flows only after rain events, no defined channel, little or no flow post rain events and no aquatic flora present).
7	Unnamed tributary of Councils Creek	No	1	Type 3 minimally sensitive KFH (does not contain snags, native aquatic vegetation, instream gravel beds and is highly ephemeral).	Class 4 Unlikely KFH (intermittent flows only after rain events, no defined channel, little or no flow post rain events and no aquatic flora present).
8	Goulburn River (outside of Project Area)	Yes	7	Type 1 highly sensitive KFH (contains instream gravel beds, rocks greater than 500 mm, snags greater than 300 mm or 3 metres in length however no native aquatic vegetation within the survey site.	Class 1 major KFH (named perennial watercourse, potential habitat for threatened species (Darling River Hardyhead *C. amniculus*).

[a] within a 100 metre reach centred on the survey site; [b] Habitat Sensitivity Type: *Policy and guidelines for fish habitat conservation and management* (DPI, 2013);

[c] Classification of Watercourse for Fish Passage: *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull & Witheridge, 2003); KFH=Key Fish Habitat.

4.7 Riparian vegetation

Where a watercourse does not exhibit the features of a defined channel with bed and banks, the watercourse is not waterfront land for the purposes of the WM Act (DPI, 2018). Thus, for the purpose of this assessment, vegetation has only been defined as riparian vegetation where it is associated with a hydroline defined as moderate to high priority watercourses. The impacts of the project on non-riparian vegetation are considered in the BDAR.

In addition, while non-native riparian vegetation may provide some bank stability, the preservation of non-native riparian vegetation is not an objective in the *Guidelines for controlled activities on waterfront land* nor does its removal trigger the KTP 'Degradation of native riparian vegetation along NSW watercourses'. As such, non-native vegetation is not included in the calculation of riparian vegetation. For example, where field surveys determined that the vegetation along a hydroline consisted 100% of exotic grasses and herbs in the lower stratum, with no middle or upper stratum, this was not defined as riparian vegetation, despite being assigned a PCT in the BDAR.

As the Development Footprint has been situated largely outside of mapped hydrolines, KFH and associated riparian vegetation, no native riparian vegetation would be impacted by the project. Three isolated patches of PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley occurred on unnamed tributaries within the Development Footprint, however these tributaries lacked a defined channel and therefore these patches of PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley are not considered riparian vegetation.

4.8 Farm dams

Twenty-two farm dams occur within the Project Area however most of the farm dams have been excluded from the development footprint, resulting in only two farm dams within the development footprint. These dams likely provide habitat for protected aquatic species such as eels, turtles and crustaceans (Figure 4-2).

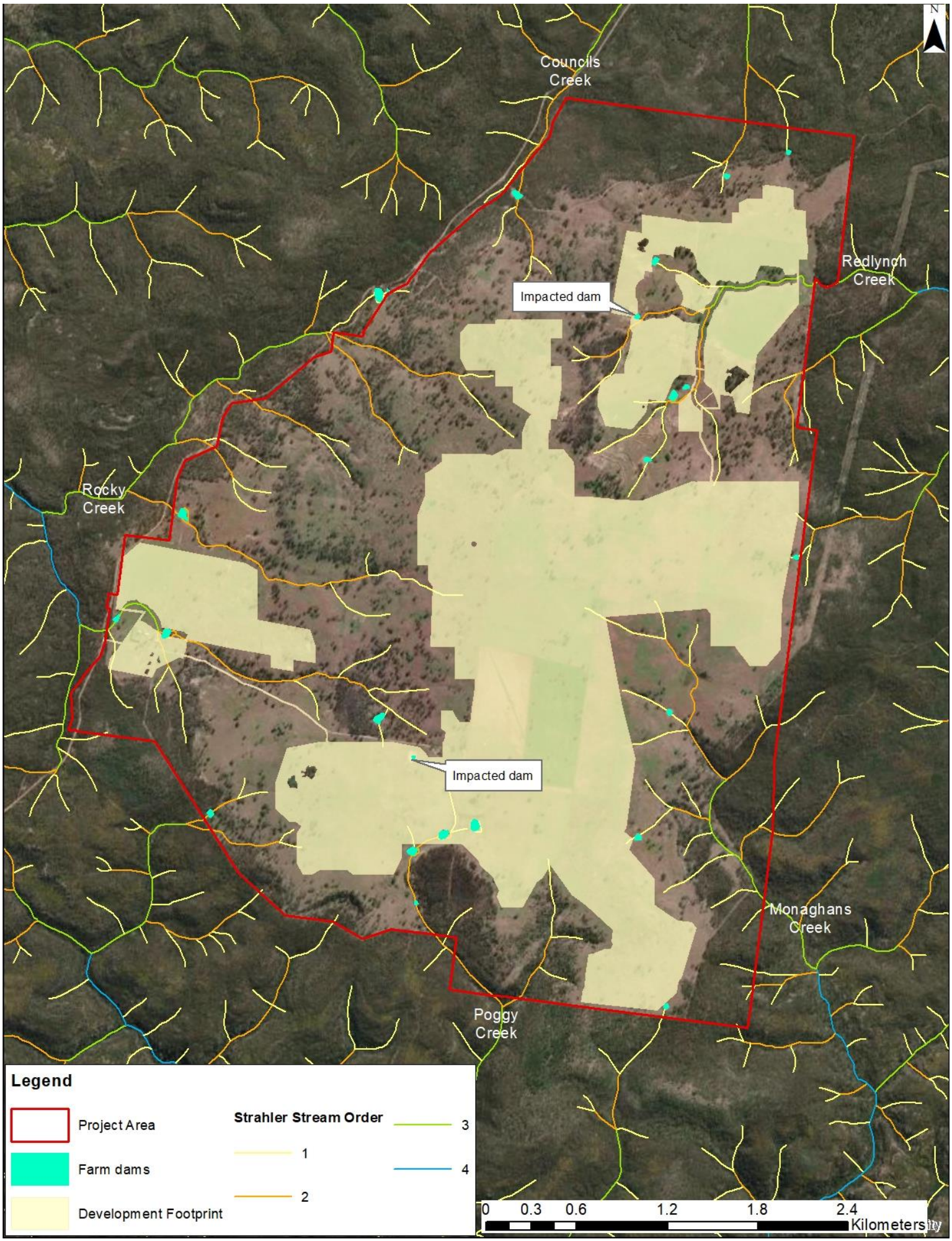

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Figure 4.2. Farm dams within the project area
Goulburn River Solar Farm
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4.9 Threatened species, populations and ecological communities

4.9.1 NSW BioNet

The BioNet search tool for past records did not contain any records of threatened aquatic species in the study area but did have records of protected species including four Platypus *Ornithorhynchus anatinus* records and six Eastern Snake-necked Turtle *Chelodina longicollis* records.

4.9.2 Atlas of Living Australia

No threatened aquatic species were recorded on the ALA (2022) however it did contain records of the following 10 protected species within the study area:

1. Flathead Gudgeon *Philypnodon grandiceps*
2. Inland Galaxias *Galaxias olidus*
3. Cox Gudgeon *Gobiomorphus coxii*
4. Firetail Gudgeon *Hypseleotris galii*
5. Western Carp Gudgeon *Hypseleotris klunzingeri*
6. Jackass Morwong *Nemadactylus macroptera*
7. Teethies *Platycephalus richardsoni*
8. Platypus *O. anatinus*
9. Macquarie River Turtle *Emydura macquarii macquarii*
10. Eastern Snake-necked Turtle *C. longicollis*.

4.9.3 Protected matters search tool

The results of the searches of PMST are provided in Table 4-2. Terrestrial threatened and migratory species and terrestrial EEC's are considered in the BDAR. Only MNES relating to the aquatic environment are considered further in this assessment.

Table 4-2. Matters of National Environmental Significance within the locality

MNES	Results of PMST Report	Relevance to the Aquatic Assessment
Listed threatened species	35	No threatened aquatic species are predicted to occur in the study area. All threatened species are terrestrial and have been assessed in the BDAR.
Listed TECs	8	No aquatic TECs are predicted to occur in the study area. All listed TECs are terrestrial and have been considered in the BDAR.
Listed Migratory species	12	No aquatic migratory species are predicted to occur in the study area. All migratory species are birds and have been assessed in the BDAR
Ramsar wetlands of international importance	1 Hunter Estuary	N/A Refer to section 3.9
Commonwealth Marine Area	None	N/A
World Heritage properties	None	N/A

MNES	Results of PMST Report	Relevance to the Aquatic Assessment
National Heritage places	None	N/A
Great Barrier Reef Marine Park	None	N/A

4.9.4 DPI website and Fisheries spatial data portal

Review of DPI threatened species list, species profiles including Primefacts and threatened species indicative distribution maps resulted in two endangered populations and one endangered species listed under the FM Act, that have an indicative distribution within the locality (i.e. Upper Hunter, Warrumbungle, Mid-Western Regional and/or Muswellbrook Local Government Areas (LGAs)) (Table 4-3;Figure 4-3).

Table 4-3 considers if the study area contains suitable distribution/habitat for these threatened species/populations to determine target species for survey.

Table 4-3. Likelihood of occurrence for threatened species/populations previously recorded in the locality

Species	Status	Description, distribution and habitat preferences	Likelihood of occurrence in the study area
Darling River Hardyhead population in the Hunter River catchment *Craterocephalus amniculus*	EP FM Act	The Darling River Hardyhead is a small-bodied native fish that occurs in the upper tributaries of the Darling River near the Queensland-New South Wales border. A small population also occurs in the Hunter River catchment. The population in the Hunter River catchment has always been relatively small. The Darling River Hardyhead population in the Hunter River catchment is listed as an endangered population in NSW. The species is most commonly found in the north-east part of the Murray-Darling Basin, especially in the MacIntyre, Namoi other border rivers. The Hunter River population is the only known occurrence of the species in an eastward flowing river. They are usually found in slow flowing, clear, shallow waters or in aquatic vegetation at the edge of such waters. The species has also been recorded from the edge of fast flowing habitats such as the runs at the head of pools. They are usually found singly or in small or large schools of up to about 50 fish. Little data has been recorded on the reproductive biology of the species, however it is closely related to the Murray hardyhead (*Craterocephalus fluviatilis*), which is considered a short lived (annual) species with an extended breeding season from spring through to autumn. The eggs will usually be deposited amongst aquatic vegetation. Darling River Hardyheads primarily eat algae and fly larvae, but have also been seen to feed on small insects. In addition to its natural rarity, the species is threatened by a number of processes including habitat degradation, thermal pollution, water extraction and predation and competition from alien fish.	Moderate The study area (Goulburn River) occurs within the indicative distribution for this species (DPI, 2016) and sections of the Goulburn River may provide suitable habitat for this species. As such, this species has been included in an assessment of significance of impact (section 5.4, Appendix A).
Eel-tailed Catfish *T. tandanus* in the Murray-Darling Basin	EP FM Act	Eel-Tailed Catfish is a medium-sized fish with a large head and a compressed rear portion of the body. It has a relatively long life span, living for at least 8 years. Individuals have been reported to grow to 900 mm in length and 6.8 kg in weight; however they are more likely to grow to 500 mm and 2 kg.	Low The study area is outside of the indicative distribution for this species (DPI, 2016), and identified indicative watercourses for this species are not linked to the Goulburn River and its tributaries.

Species	Status	Description, distribution and habitat preferences	Likelihood of occurrence in the study area
		The western population was once highly abundant and widespread throughout the Murray-Darling River System in NSW, Queensland, Victoria and South Australia. However, in NSW most riverine populations have declined significantly since the 1970s, and the species is no longer common in many areas where it was formally abundant. Eel-Tailed Catfish is now rare or absent from many rivers and creeks in Victoria as well as many of the major tributaries in NSW including the central Murray, Darling, Murrumbidgee, Lachlan, Paroo and Warrego Rivers. The Murray-Darling Basin population of Eel-Tailed Catfish is listed as an endangered population in NSW. Eel-tailed Catfish is a non-migratory, benthic (bottom dwelling) species. It is relatively sedentary and adults typically only move within a 5 km range. Individuals are more active at night compared with during the day. The species inhabits a diverse range of freshwater environments including rivers, creeks, lakes, billabongs and lagoons. It prefers clear, sluggish or still waters, but can also be found in flowing streams with turbid waters. Substrates range from mud to gravel and rock. Individuals are sexually mature at 3-5 years of age and spawn in spring/summer when water temperatures are 20-24ºC. Males construct and defend a nest up to 2 metres in diameter, made from pebbles and gravel. Eel-Tailed Catfish is predominantly an opportunistic carnivore, feeding mainly on small fish, freshwater prawns, yabbies, snails, aquatic insects and zooplankton. The species is threatened by loss of habitat through river regulation, predation and competition from alien fish, reduced success of spawning and recruitment due to alterations to flow patterns and flooding regimes, thermal pollution, chemical pollution and historic overfishing.	
Southern Purple-Spotted Gudgeon *M. adspersa*	E FM Act	Southern Purple Spotted Gudgeon is listed as an endangered species in NSW. Two populations of Southern Purple Spotted Gudgeon occur in NSW; an eastern population found in coastal catchments north of the Clarence River, and a western population found	Moderate The study area is outside of the indicative distribution for this species (DPI, 2016), however there are some downstream tributaries of the Goulburn River within the indicative distribution

Species	Status	Description, distribution and habitat preferences	Likelihood of occurrence in the study area
		throughout the Murray-Darling Basin. During the early 1980s, the Murray-Darling Basin population experienced rapid and dramatic reductions in distribution and abundance. The population is now confined to small remnant populations in the Macquarie, Gwydir and Border Rivers catchments and a self-sustaining population created from captive-bred fish in the Castlereagh Catchment. Since all remaining populations in the western region are small, isolated and disconnected from each other, there is limited gene flow between populations. There have been few recent records of the eastern population despite targeted sampling at those locations where the species has previously been found. Only two extant populations are known, one in the Richmond catchment and the other in the Hunter Valley. However, the population in Goorangoola Creek (Hunter River catchment) is outside what was previously considered the natural range of the species and it remains unknown whether the population is endemic or recently introduced. Southern Purple Spotted Gudgeon are a benthic species that can be found in a variety of habitat types such as rivers, creeks and billabongs with slow-moving or still waters or in streams with low turbidity. Cover in the form of aquatic vegetation, overhanging vegetation from riverbanks, leaf litter, rocks or snags are important for the species. Most remnant populations in NSW occur in small to medium sized streams. They feed mainly on terrestrial insects and their larvae, worms, small fish, tadpoles, and some plant matter. Eggs are deposited in clusters on solid objects such as rocks, wood or broadleafed plants. The male guards and fans the eggs until they hatch (3 - 8 days). The species is threatened by loss of habitat, changes in water levels from river regulation, predation and competition from alien fish, reduced success of spawning and recruitment due to alterations to flow patterns and flooding regimes, increased turbidity and damage of stream banks by livestock access and thermal pollution.	mapping. As such, this species has been included in an assessment of significance of impact (section 5.4, Appendix A).

4.9.5 Summary of database searches

Database searches resulted in one endangered population and one endangered species being identified as target species for further assessment (Table 4-3):

- Darling River Hardyhead (*C. Amniculus)* - Endangered population under the FM Act
- Southern Purple-Spotted Gudgeon (*M. Adspersa)* - Endangered species under the FM Act.

No threatened species listed under the EPBC Act have been previously identified in the study area, nor are the watercourses within the study area considered likely to provide habitat for any threatened species listed under the EPBC Act.

4.10 Target aquatic fauna survey results

Fauna sampling opportunities were limited to Redlynch Creek as it was the only watercourse within the Project Area containing remnant pools at the time of survey. Bait traps did not capture any aquatic fauna at either of the two survey sites (1 and 2).

No threatened species were recorded during surveys.

4.10.1 Critical habitat

The study area does not contain any water or land identified as critical habitat under the FM Act.

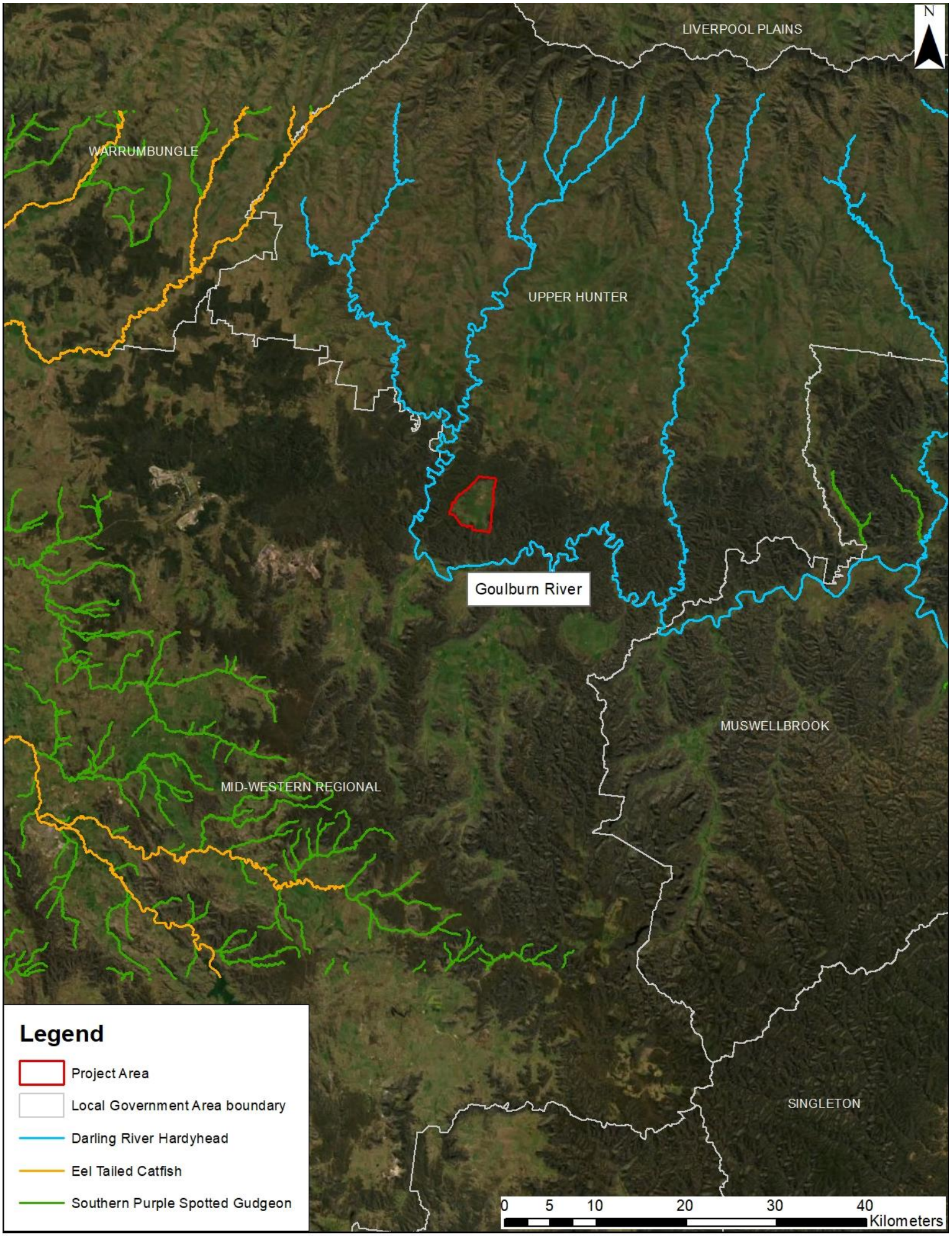

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Figure 4.3. Indicative distribution mapping (DPI, 2016) for threatened aquatic species in the locality
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5. Impact assessment

This impact assessment has been structured under seven sub-sections, and considers the potential impacts of the project on:

1. aquatic biodiversity during construction
2. aquatic biodiversity during operation
3. aquatic biodiversity during decommissioning
4. threatened species, populations and EECs protected by the FM Act
5. key threatening processes identified under the FM Act
6. matters of national environmental significance (MNES) protected by the EPBC Act
7. sensitive areas:
    a. KFH
    b. waterfront land.

5.1 Construction

Consideration of the potential impacts of the project on water quality and aquatic biodiversity is provided in sections 5.1.1 and 5.1.2. These potential impacts and the subsequent risk to receiving watercourses are detailed in Table 5-1.

5.1.1 Potential impacts on water quality

Without the implementation of appropriate erosion and sediment controls and mitigation measures throughout construction, construction activities have the potential to impact water quality in watercourses within the Project Area and receiving watercourses in the study area, through the mobilisation of sediments and other contaminants via wind or stormwater runoff.

Potential activities which can result in water quality impacts include:

- clearing of vegetation
- instream works including filling
- transportation of dust, litter and other pollutants associated with construction
- transportation of soils, exposed sediments and contaminants associated with stockpiles, construction compounds and or storage areas
- transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment
- transportation of concrete dust, concrete slurries or washout water associated with concrete works.

The Water Resources Assessment (Umwelt, 2023) for the project concluded that construction of the project, including the implementation of appropriate mitigation and management measures, is unlikely to cause changes to the water quality environment against the identified NSW Water Quality Objectives.

5.1.2 Potential impacts on aquatic biodiversity

Potential impacts on aquatic biodiversity during construction include:

1. removal of riparian corridor vegetation
2. removal of instream vegetation/large woody debris
3. obstruction to fish passage
4. alterations to hydrology
5. spread of exotic vegetation
6. poor water quality
7. removal/filling of farm dams.

5.1.2.1 Removal of riparian corridor vegetation

The riparian corridor forms a transition zone between the land and the watercourse. The protection, restoration or rehabilitation of VRZ's is important for maintaining or improving the shape, stability (or geomorphic form) and ecological functions of a watercourse (DPI, 2018).

The riparian corridor reduces the risk of erosion by reinforcing and increasing cohesion of the soil, and by providing a protective surface matting. Vegetation also uses water in the banks and increase the drainage of the soils which reduces the risk of bank failure due to heavy saturated soils. The riparian corridor and the associated layer of litter and debris also increases channel roughness, slowing the flow and reducing the capacity of the flowing water to erode and transport sediment.

Most pollutants and nutrients are attached to sediment particles and riparian vegetation plays an important role in trapping this sediment and associated nutrients and pollutants before they reach the channel. The potential impacts of excess nutrients and sediments are discussed further in section 5.1.2.4. The wider the riparian corridor buffer zone, the more effective it is at trapping sediment.

The riparian corridor also plays an important role in ecological function. Healthy, native riparian vegetation reduces the water temperature of aquatic habitats by shading. Without shading, water temperature increases, which can result in unfavourable conditions and can lead to fish kills.

During the design phase of the project, the Development Footprint boundary was adjusted to exclude the majority of mapped hydrolines, KFH and the associated riparian vegetation. As such, no riparian vegetation would be impacted by the proposal. Three small patches of paddock trees (PCT 483 Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region, upper Hunter Valley, which cover a total area of approximately 0.18 ha) are associated with mapped hydrolines within the Development Footprint, however as these hydrolines do not have defined bed and banks, they are not defined as waterfront land by NRAR and the associated vegetation is not defined as riparian vegetation.

The KTP 'degradation of native riparian vegetation along NSW watercourses' (listed under the FM Act; refer section 5.4.2) is not triggered by the proposal.

5.1.2.2 Removal of instream vegetation/large woody debris

Large woody debris and macrophytes within the stream provides shelter, feeding and spawning habitat for many native birds, fish and invertebrates. Instream or aquatic vegetation is also effective at water purification by further removing nutrients.

Only the unnamed tributary on Monaghans Creek contained large woody debris within the Project Area, and this creek would not be directly impacted by the project. Hence, the KTP 'removal of large woody debris' listed under the FM Act is not triggered by the project.

None of the watercourses within the Project Area contained native macrophytes considered likely to provide aquatic habitat.

5.1.2.3 Obstruction of fish passage

All watercourses crossed by the Project Area have been defined as ephemeral, are close to the source and have been defined as Type 3 minimally sensitive KFH and Class 4 unlikely KFH except for Redlynch Creek has been defined as Type 3 minimally sensitive KFH but Class 3 minimal KFH.

Three access roads up to 10 metres wide are proposed across Redlynch Creek (

Figure 3-3) and one across a tributary of Rocky Creek (Figure 3-5). If filling is required for the construction of access roads across watercourses mapped as KFH, then fish passage would be maintained in accordance with DPI guidelines (Fairfull and Witheridge, 2003, refer

section 2.1.2.2 and Table 2.2). The final position of the crossing point(s) can be subject to change, to select a lower impact crossing position.

No other impacts on fish passage are likely during construction works.

5.1.2.4 Alterations to hydrology

The filling of creeks and or installation of culverts may result in impacts to water flows to receiving watercourses. The 'installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams' is a KTP under the FM Act and would be triggered by the proposal. This is considered further in section 5.4.2.

Negative impacts to hydrology can be mitigated through the installation of instream structures that are in accordance with the DPI guidelines (i.e. a high flow culvert design).

5.1.2.5 Spread of exotic vegetation

The Project Area currently has an extensive cover of exotic grasses and herbs, many of which are serious environmental weeds. There is potential for these exotic species to spread to downstream riparian zones during construction disturbance without appropriate erosion and sediment control measures and weed management (which would be included in the Erosion and Sediment Control Plan and Weed and Pest Management Plan respectively).

From an aquatic ecology perspective, excessive use of herbicide is not recommended for exotic species control.

5.1.2.6 Poor water quality

Indirect impacts relating to reduced water quality from construction activities can impact aquatic biodiversity in downstream watercourses in the following ways:

- shading of aquatic vegetation due to high turbidity, smothering aquatic vegetation and resulting in dieback
- mortality of filter feeding aquatic fauna, including invertebrates, by blocking filter apparatus preventing oxygen flow
- fish kills due to clogging fish gills
- fish kills resulting from high turbidity, making it difficult for fish to see and catch prey
- fish kills resulting from increased nutrients and subsequent algal blooms and oxygen depleted water
- low recruitment in fish species where eggs laid on the bottom of rivers are buried by sedimentation
- potential increase in abundance of pest species able to tolerate poorer water quality which can subsequently outcompete native species for resources
- reduction in native fish species presence through altered habitat resulting from sedimentation in remnant pools
- toxicity and mortality in freshwater organisms, particularly microorganisms, invertebrates and vegetation resulting from pollutants such as petroleum, diesel, hydraulic fluids, oils and herbicide that may be spilled into ephemeral waterways and become mobilised following rainfall events. The effects of toxicity and mortality can move up the food chain and indirectly impact higher order species such as fish, birds and mammals.

Potential direct and indirect impacts to water quality from construction is relevant to all watercourses within the study area. The above impacts on aquatic biodiversity due to impacts to water quality are worst case scenarios. The Water Resources Assessment (Umwelt, 2023) for the project concluded that construction of the project is unlikely to cause changes to the water quality environment against the identified NSW Water Quality Objectives. Measures to minimise the impacts on water quality are provided in section 6.

5.1.2.7 Farm dams

Direct impacts on farm dams from construction include filling/dewatering, loss of habitat and mortality. A dewatering protocol would be prepared as part of the Construction Environmental Management Plan (CEMP) for the two farm dams that require dewatering and filling, to minimise direct impacts on aquatic fauna.

Indirect impacts on farm dams from construction include a reduction in water quality following rainfall. This would be mitigated with appropriate erosion and sediment control.

Table 5-1. Potential construction impacts on water quality and aquatic biodiversity and associated risk to receiving watercourses

Watercourse	Construction activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Redlynch Creek	Redlynch Creek is within the Development Footprint for the installation of Project infrastructure.	Potential direct impacts from construction activities include: • construction impacts on the bed and banks of mapped KFH within this watercourse for three proposed access roads. Potential indirect impacts on water quality from construction activities at this site include: • mobilisation of sediments and other contaminants to downstream watercourses • transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment.	Receiving watercourses include downstream areas of Redlynch Creek, which flows into Goulburn River. There is a low risk to Redlynch Creek within the Project Area in addition to potential indirect impacts to good quality downstream areas of this watercourse. Risk to receiving watercourses is low as: • the farm dam proposed for filling within the catchment of this tributary is outside of the area mapped as KFH (DPI, 2007) • the majority of the Redlynch Creek catchment is outside of the Development Footprint • within the development footprint, Redlynch Ck mapped as KFH (DPI, 2007) is ephemeral, does not hold water most of the time and lacks important aquatic habitat features • any indirect impacts can be mitigated, through appropriate erosion and sediment control measures • threatened aquatic species are considered unlikely to occur in this watercourse.
Unnamed tributary of Monaghans Creek	The unnamed tributary of Monaghans Creek is outside the Development Footprint.	Potential indirect impacts on water quality from construction activities at this site are unlikely as the majority of Monaghans Creek catchment is outside of the Development Footprint.	The aquatic biodiversity within and downstream of the unnamed tributary of Monaghans Creek has a low risk of being indirectly impacted from poor water quality as: • the majority of Monaghans Creek catchment is outside of the Development Footprint • the watercourse is ephemeral and does not hold water most of the time • any indirect impacts can be mitigated, through appropriate erosion and sediment control measures • threatened aquatic species are considered unlikely to occur in this watercourse.

Watercourse	Construction activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Unnamed tributary of Poggy Creek	An unnamed tributary of Poggy Creek occurs within the Development Footprint for the installation of Project infrastructure.	Potential direct impacts from construction activities include: • construction impacts within an area mapped as KFH within this watercourse. Potential indirect impacts on water quality from construction activities at this site include: • mobilisation of sediments and other contaminants to downstream watercourses • transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment.	Risk to receiving watercourses is low as: • the farm dam proposed for filling within the catchment of this tributary is outside of the area mapped as KFH (DPI, 2007) • the majority of the Poggy Creek catchment is outside of the Development Footprint • the watercourse mapped as KFH (DPI, 2007) is ephemeral, does not hold water most of the time and lacks important aquatic habitat features • any indirect impacts can be mitigated, through appropriate erosion and sediment control measures • threatened aquatic species are considered unlikely to occur in this watercourse.
Unnamed tributaries of Rocky Creek	Unnamed tributaries of Rocky Creek occur within the Development Footprint for the installation of Project infrastructure.	Potential direct impacts from construction activities include: • construction impacts on the bed and banks mapped as KFH within this watercourse for one proposed access roads. Potential indirect impacts on water quality from construction activities at this site include: • mobilisation of sediments and other contaminants to downstream watercourses • transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment.	Risk to receiving watercourses is low as: • most of the Rocky Creek catchment is outside of the Development Footprint • the watercourse is ephemeral and does not hold water most of the time • any indirect impacts can be mitigated, through appropriate erosion and sediment control measures • threatened aquatic species are considered unlikely to occur in this watercourse.

Watercourse	Construction activities	Potential impacts on water quality and aquatic biodiversity	Risk to receiving watercourses and aquatic biodiversity
Unnamed tributary of Councils Creek	The unnamed tributary of Council Creek is outside the Development Footprint.	• Potential indirect impacts on water quality from construction activities at this site are unlikely as the Councils Creek catchment is outside of the Development Footprint.	The aquatic biodiversity downstream in Councils Creek has a low risk of being indirectly impacted from poor water quality as: • Councils Creek catchment is outside of the Development Footprint • the watercourse is ephemeral and does not hold water most of the time • any indirect impacts can be mitigated, through appropriate erosion and sediment control measures • threatened aquatic species are considered unlikely to occur in this watercourse.
Goulburn River	There will be no direct impacts on Goulburn River however construction works would occur within the catchment of this perennial watercourse.	Potential indirect impacts on water quality from construction activities at this site include: • mobilisation of sediments and other contaminants to downstream watercourses • transportation of pollutants from accidental spills or leaks of fuels and/or oils from the maintenance or refuelling of construction plant equipment.	There is a low cumulative risk of indirect impact to this watercourse from the project as despite there being potential habitat for the threatened aquatic species Darling River Hardyhead and Southern Spotted Purple Gudgeon, any indirect impacts can be managed through appropriate erosion and sediment control and avoidance of pollutants.

Summary of risk of impacts on watercourses

All watercourses within the study area have a low risk of impact from the project. Mitigation measures have been provided in Chapter 7 to further minimise impacts.

5.2 Operation

During the operational phase of the project, the installation of solar panels, battery and other infrastructure would be complete and cleared areas would be stabilised. Areas with high risk of soil erodibility would be stabilised and therefore there would be little or no risk of soil erosion and subsequent transport of sediment into nearby watercourses.

Risks to aquatic ecosystems during the operation would be mainly associated with maintenance activities/vehicles and accidental spills or leaks that could potentially mobilise contaminants.

5.2.1 Potential impacts on water quality

For the operational phase, the risks are related to potential impacts to water quality through the mobilisation of sediments and other contaminants via wind or stormwater runoff from:

- transportation of dust, litter, exotic vegetation seed, and other pollutants associated with operations
- transportation of pollutants from accidental spills or leaks from maintenance vehicles
- transportation of herbicides used to control exotic species.

The Water Resources Assessment (Umwelt, 2023) for the project concluded that operation of the project is unlikely to cause changes to the water quality environment.

5.2.2 Impacts to aquatic biodiversity

For the operational phase, the risks to aquatic biodiversity are related to:

- Barriers to fish-passage due to blocked watercourses. This applies to watercourses identified as KFH where access roads are proposed (i.e., Redlynch Creek and unnamed tributary of Rocky Creek).
- Changes in water quality resulting in:
    - shading of aquatic vegetation due to high turbidity, smothering aquatic vegetation and causing dieback
    - mortality of filter feeding aquatic fauna, including invertebrates, by blocking filter apparatus preventing oxygen flow
    - fish kills due to clogging fish gills
    - fish kills resulting from high turbidity, making it difficult for fish to see and catch prey
    - fish kills caused from increased nutrients and subsequent algal blooms and oxygen depleted water
    - low recruitment in fish species where eggs laid on the bottom of rivers are buried by sedimentation
    - potential increase in abundance of pest species able to tolerate poorer water quality which can subsequently outcompete native species for resources
    - reduction in native fish species presence through altered habitat caused by sedimentation in remnant pools
    - toxicity and mortality in freshwater organisms, particularly microorganisms, invertebrates and vegetation caused from pollutants such as petroleum, diesel, hydraulic fluids, oils and herbicides that may be spilled into ephemeral waterways and become mobilised following rainfall events. The effects of toxicity and mortality can move up the food chain and indirectly impact higher order species such as fish, birds and mammals.

However, given that there are unlikely to be additional impacts from operations on water quality, the additional risk of impact on aquatic biodiversity from the operation of the project is negligible.

In summary, potential operational impacts on the aquatic biodiversity are considered negligible for the following reasons:

- The proposed instream modifications in KFH would be rehabilitated to ensure the bank morphology is returned to pre-construction condition, and the substrate is stabilised with vegetation.
- Maintenance vehicles would be maintained, therefore the risk of spills would be unlikely.
- Herbicide, if required, would be used within recommended guidelines and not used on waterfront land.

5.3 Decommissioning

At the end of the useful life of the asset, decommissioning would involve the mobilisation of a workforce and additional temporary facilities, and the subsequent removal of equipment and infrastructure. At this time, it is expected that significant movements of light vehicles and trucks for transporting waste would occur. The decommissioning phase would be expected to last less than eight months.

During decommissioning, works would include:

- removal of solar arrays, including the foundation posts, and sorting and packaging of all materials for removal from the site and recycling and/or reuse
- removal of all site amenities and equipment, and recycling and/or reuse of materials wherever practicable
- removal and recycling of posts and cabling,
- removal of fencing including small concrete footings.

The risks associated with decommissioning are related to potential impacts to water quality through the mobilisation of sediments and other contaminants via wind or stormwater runoff from:

- transportation of dust, litter, exotic vegetation seed, and other pollutants associated with vehicle movement
- transportation of pollutants from accidental spills or leaks from vehicles.

The subsequent risks to aquatic biodiversity are discussed in section 5.2.2.

However, given that there are unlikely to be additional impacts during decommissioning on water quality, the additional risk of impact on aquatic biodiversity during decommissioning of the project is negligible.

In summary, potential decommissioning impacts on the aquatic biodiversity are considered negligible for the following reasons:

- any access roads over existing watercourses would be stabilised to prevent excess erosion and sedimentation
- maintenance vehicles would be maintained, therefore the risk of spills would be unlikely.

5.4 Threatened species, populations and aquatic ecological communities assessed under the FM Act

Relevant database searches identified one threatened species (Southern Purple Spotted Gudgeon) and one endangered population (Darling River Hardyhead) listed under the FM Act that have a moderate likelihood of occurrence in the study area (Goulburn River), however these species are unlikely to occur within watercourses within the Project Area. No other threatened species or aquatic ecological communities were identified within the study area.

In summary, the assessment of significance of impact under the FM Act (Appendix A) concluded that the project was unlikely to have an adverse effect on the life cycle of Darling River Hardyhead or Southern Purple Spotted Gudgeon such that a viable local population of these species/populations is likely to be placed at risk of extinction. This was based on the lack of important habitat features for these species within watercourses in the Project Area and the relatively minor nature of works. Potential indirect impacts on water quality associated with the mobilization of sediments is relevant to all watercourses within the study area however this can be managed using standard erosion and sediment control measures during the construction, operation, and decommissioning phases of the project. Thus, the level of impact to the aquatic environment and threatened aquatic species is considered minor.

In relation to the habitat of threatened species/populations, only Goulburn River contained potential habitat for these two threatened entities. The project does not require any direct impacts to Goulburn River and potential indirect impacts can be mitigated through appropriate erosion and sediment control. Thus, the habitat of these threatened species/populations will not be removed or significantly modified, nor will the habitat become fragmented or isolated from other areas of habitat because of the project.

In terms of the importance of the habitat to be potentially modified, Goulburn River was mapped as within the indicative distribution for the Darling River Hardyhead (but not the Southern Purple Spotted Gudgeon), however it is noted that portions of the Goulburn River within the study area have been highly modified through land use practices in the catchment, with intensive farming practices including extensive clearing of riparian vegetation to the bank, reducing the presence of aquatic vegetation, detritus, trailing bank vegetation and snags, which are important habitat features for this species. Thus, the existing habitat in the Goulburn River is likely to be of low importance to the long-term survival of these threatened species/populations.

The project is not inconsistent with any priority action statements for the assessed threatened species and population as most recovery actions listed are not directly relevant to the project, except for habitat rehabilitation, which would be undertaken as part of the Biodiversity Management Plan for the project.

5.4.1 Impacts on critical habitat

The study area does not contain any water or land identified as critical habitat under the FM Act.

5.4.2 Key threatening processes

Eight KTPs are listed under the FM Act however only three are of relevance to the project:

1. degradation of native riparian vegetation along New South Wales water courses
2. installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams
3. removal of large woody debris from New South Wales rivers and streams.

'Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams' is triggered by the project where infrastructure

crosses watercourses mapped as KFH, require filling. In these cases, installation of culverts designed in accordance with relevant DPI guidelines (refer section 2.1.2.2 and section 4.6)) are required to maintain fish passage. The installation of appropriately designed culverts is unlikely to significantly contribute to this KTP.

'Degradation of native riparian vegetation along New South Wales water courses' is not triggered by the project as riparian vegetation has been avoided in the design phase.

'Removal of large woody debris from New South Wales rivers and streams' is not triggered by the project as no watercourses within the Development Footprint contain large woody debris.

5.5 Matters of National Significance assessed under the Commonwealth EPBC Act

No MNES, including threatened and/or migratory aquatic species listed under the EPBC Act have been previously recorded in the study area and none are considered likely to occur within the Project Area. As such, an Assessment of Significance of Impact under the EPBC Act was not required for the project.

5.6 Sensitive areas

5.6.1 Key fish habitat

Policy and Guidelines for Fish Habitat Conservation and Management (DPI, 2013) states that *"to ensure "no net loss" of aquatic habitats, NSW DPI requires that proponents should, as a first priority, aim to avoid impacts upon KFH. Where avoidance is impossible or impractical, proponents should then aim to minimise impacts. Any remaining impacts should then be offset with compensatory works"*.

KFH within the study area was defined based on existing KFH mapping by DPI (2007), watercourses sensitivity type (DPI, 2013) and watercourse class (Fairfull and Witheridge, 2003) which were defined following site inspection. Only instream habitat (top of bank to top of bank) is defined as KFH. This excludes riparian vegetation.

All watercourses within the Project Area were defined as having minimally sensitive KFH due to their highly ephemeral nature and the absence of fish habitat features. Regardless, the Development Footprint covers mapped KFH (DPI, 2007) along the following watercourses:

- Redlynch Creek (Figure 3-3)
- unnamed tributary of Poggys Creek (Figure 3-4)
- unnamed tributary of Rocky Creek (Figure 3-5).

The project does not require extensive earthworks or fill and instream works in watercourses mapped as KFH can mostly be avoided. Where filling is required for access roads across KFH watercourses, culverts would be installed in accordance with relevant guidelines (refer section 2.1.2.2 and section 4.6) to maintain fish passage during flooding, and bed and banks would be stabilised using vegetation in accordance with the Biodiversity Management Plan. As such, KFH would not be permanently lost or disrupted and no aquatic biodiversity offset is required.

5.6.2 Waterfront land

Waterfront land includes the bed and bank of watercourses and all land within 40 metres of the highest bank (DPI, 2012). However, watercourses lacking defined bed and banks are not typically associated with waterfront land. Within the Development Footprint, Redlynch Creek and the unnamed tributary of Rocky Creek had defined bed and banks and therefore have waterfront land associated with them. Impacts to waterfront land would occur through the construction of infrastructure and access roads. Construction works are to avoid waterfront land and where this is not possible (i.e for access roads), the bed and banks of watercourses are to be stabilised with vegetation following completion of works.

5.7 Cumulative impact assessment

For an EIS, cumulative impacts can be defined as the successive, incremental, and combined effect of multiple impacts, which may in themselves be minor but could become significant when considered together.

The investigation area for the cumulative aquatic biodiversity impact assessment includes watercourses within the Goulburn River catchment. Of the 21 major projects considered in chapter 19 of the EIS, five occur within the Goulburn River catchment (Table 5-2). The potential cumulative impacts of the project combined with these other five major projects are considered further in Table 5-3. Major projects outside of this investigation area were considered unlikely to contribute to cumulative impacts on watercourses within the study area and were therefore not considered further.

Table 5-2. Major Projects within the investigation area

Project	Proximity	Associated watercourses	Further consideration?
Beryl Solar Farm	56 km	Cudgegong River which is part of the Macquarie catchment within the Murray–Darling basin.	No
Ulan Coal Complex, Moolarben Coal Complex and Wilpinjong Mine	28 km	Goulburn River, > 50 km upstream of the study area	Yes
Kyoto Wind Farm	62 km	Kingdon Ponds, which flows into the Hunter River downstream of Goulburn River.	No
Liverpool Range Wind Farm	55 km	Turee Creek, flows into Talbragar River which is part of the Macquarie catchment within the Murray–Darling basin	No
Stubbo Solar Farm	48 km	Cudgegong River which is part of the Macquarie catchment within the Murray–Darling basin.	No
Birriwa Solar and Battery Project	60 km	Talbragar River which is part of the Macquarie catchment within the Murray–Darling basin.	No
Valley of the Winds Wind Farm	57 km	Coolaburragundy River flows into Talbragar River which is part of the Macquarie catchment within the Murray–Darling basin.	No
Barneys Reef Wind Farm	50 km	Slapdash Creek, flows into Waldra Creek then the Cudgegong River which is part of the Macquarie catchment within the Murray–Darling basin.	No
Tallawang Solar Farm	50 km	Boomley Creek, flows into Talbragar River which is part of the Macquarie catchment within the Murray–Darling basin.	No
Spicers Creek Wind Farm	80 m	Spicers Creek, which flows into Talbragar River which is part of the Macquarie catchment within the Murray–Darling basin.	No
Wollar Solar farm	22 km	Goulburn River, approximately 15 km upstream of the study area.	Yes
Dunedoo Solar Farm	70 km	Talbragar River which is part of the Macquarie catchment within the Murray–Darling basin.	No

Project	Proximity	Associated watercourses	Further consideration?
Central West Orana Transmission Project	25 km	Wollar Creek flows into Goulburn River upstream of the study area.	Yes
Merriwa Solar Farm	30 km	Bow River flows into the Goulburn River approximately 25 km downstream of the study area.	Yes
Bowmans Creek Wind Farm	96 km	Bowmans Creek flows into the Hunter River.	No
Hills of Gold Wind Farm	101 km	Barnard River flows into the Manning River.	No
Bellambi Heights Renewables Project	54 km	Cudgegong River which is part of the Macquarie catchment within the Murray–Darling basin.	No
Ulan Solar Farm	38 km	Sportsmans Hollow Creek, located at the source of the Goulburn River (i.e. approximately 70 km upstream of the study area).	Yes
Sandy Creek Solar Farm	83 km	Sandy Creek, flows into Talbragar River which is part of the Macquarie catchment within the Murray–Darling basin.	No
Cobbora Solar Farm	82 km	Spring Creek, flows into Talbragar River which is part of the Macquarie catchment within the Murray–Darling basin.	No
Bowdens Silver Project	45 km	Lawsons Creek flows into Cudgegong River which is part of the Macquarie catchment within the Murray–Darling basin.	No

Table 5-3. Summary of potential cumulative impacts

Major Project	Potential impacts on aquatic biodiversity during construction[2]	Construction mitigation measures	Potential impact during operation	Operation mitigation measures	Construction and operation residual impact
Ulan Coal Complex, Moolarben Coal Complex and Wilpinjong Mine	N/A This project is in the operation stage.	N/A	The relevant environment issues identified for the mining operations and associated infrastructure were: • Loss of threatened native flora and fauna. • Surface and groundwater management, including impacts on private water bores and impacts on the Goulburn and Talbragar rivers.	Features of their water management system include: • Controls to prevent the discharge of pollutants. • Controls that minimise the amount of clean water that enters the mine's system. • Minimising work areas and rehabilitating land as soon as possible. • Separating water of differing qualities. • Recycling and reuse of water wherever possible. • Avoiding underground water storage and handling water once. Biodiversity management programs include: • Separating water of differing qualities • The creation of post-mining rehabilitation areas to provide a stable final landform	Provided the biodiversity management programs are implemented, maintained and monitored, the cumulative impacts of the project on the Goulburn River, would be negligible.

Major Project	Potential impacts on aquatic biodiversity during construction[2]	Construction mitigation measures	Potential impact during operation	Operation mitigation measures	Construction and operation residual impact
				with acceptable land use capability. A number of areas are set aside for conservation of endangered ecological communities and their supporting ecosystems • Local provenance native seed is collected from rehabilitated bushland to support the revegetation programs • Regeneration works are conducted to enhance the quality and quantity of native vegetation in conservation areas • Feral animal control and weed management • Ecological and Rehabilitation monitoring.	
Wollar Solar Farm	Construction for this project commenced in July 2022 and is expected to take up to 18 months. The project includes: • Upgrading Barigan Road to ensure safe	N/A	The EIS for the Wollar Solar Farm stated that during operation, there was minimal potential for any impacts to surface water quality to occur. Suitable drainage features would be constructed along internal	Relevant mitigation measures included: • Design waterway crossings and services crossing in accordance with relevant publications. • All fuels, chemicals,	Provided controls are implemented, maintained and monitored, the cumulative impacts of the project the Goulburn River, would be negligible.

Major Project	Potential impacts on aquatic biodiversity during construction[2]	Construction mitigation measures	Potential impact during operation	Operation mitigation measures	Construction and operation residual impact
	movement of construction traffic. • Building an access road to allow deliveries onto the site. • Preparing the site for construction and establishing a site compound. • Building internal access roads to be used construction and for maintenance once operational. • Building a new substation on-site. • Preparing foundations for panels. • Installing panels. • Installing underground cabling to transport power to the substation. • Connecting to the local electricity network via an existing overhead power line. Chapter 19 of the EIS assumed no overlap in the construction phase.		roads to minimise the risk of polluted water leaving the site or entering the waterways.	and liquids would be stored at least 40m from any waterways or drainage lines, not on sloping land and would be stored in an impervious bunded area. • The refuelling of plant and maintenance would be undertaken in impervious bunded areas on hardstand areas only. • All potential pollutants stored on-site would be stored in accordance with HAZMAT requirements and bunded. • Roads and other maintenance access roads would incorporate appropriate water quality treatment measures such as vegetated swales to minimise the opportunity of dirty water leaving the site or entering the waterways.	
Central West	This is a proposed project	N/A	Details on potential	Details on potential	Provided controls

Major Project	Potential impacts on aquatic biodiversity during construction[2]	Construction mitigation measures	Potential impact during operation	Operation mitigation measures	Construction and operation residual impact
Orana Transmission Project	and details on proposed construction are not yet available. Chapter 19 of the EIS has assumed no overlap with the project in the construction phase.		operational impacts are not available.	operation mitigation measures are not available, however it is anticipated that the following would be undertaken as a minimum: • Design waterway crossings and services crossing in accordance with relevant publications. • Refueling outside of waterfront land. • Environmental monitoring after construction.	are implemented, maintained and monitored, the cumulative impacts of the project the Goulburn River, would be negligible.
Merriwa Solar Farm	This is a proposed project and details on proposed construction are not yet available. The proposed Merriwa Solar Farm is the closest major project to the study area. It is within the catchment of the Bow River, which confluences with the Goulburn River approximately 25 km downstream of the study area. Chapter 19 of the EIS indicated a possible overlap	Details on potential construction mitigation measures are not available, however it is anticipated that the following would be undertaken as a minimum: • Erosion and sediment control measures in accordance with the Blue Book. • Stockpile management.	Details on potential operational impacts are not available.	Details on potential operation mitigation measures are not available, however it is anticipated that the following would be undertaken as a minimum: • Design waterway crossings and services crossings in accordance with relevant publications. • Refueling outside of waterfront land. • Environmental	Provided controls are implemented, maintained and monitored, the cumulative impacts of the project the Goulburn River, would be negligible.

Major Project	Potential impacts on aquatic biodiversity during construction[2]	Construction mitigation measures	Potential impact during operation	Operation mitigation measures	Construction and operation residual impact
	in construction and potential cumulative impacts on biodiversity due to the site proximity and similarities. Construction works have the potential to reduce water quality in Goulburn River through the mobilisation of sediments, litter and other contaminants via wind or stormwater runoff which could subsequently impact aquatic biodiversity. Increased turbidity results in shading and potential dieback of aquatic vegetation, fish kills through clogging gills or making prey hard to find and/or reduced recruitment by smothering fish eggs. Excess nutrients attached to sediments can result in algal blooms and oxygen depletion, leading to fish kills. Transport of contaminants resulting from spill such as petroleum, diesel, hydraulic fluids and oils that may become mobilised following rainfall and cause toxicity and mortality in freshwater organisms, which can move up the food chain.	• Compounds and stockpile sites located outside of riparian habitat and waterfront land. • Monitoring and maintenance of erosion and sediment control devices.		monitoring after construction.	

Major Project	Potential impacts on aquatic biodiversity during construction[2]	Construction mitigation measures	Potential impact during operation	Operation mitigation measures	Construction and operation residual impact
Ulan Solar Farm	This is a proposed project and details on proposed construction are not yet available. The proposed Ulan Solar Farm is within the catchment of the Sportsmans Hollow Creek, which confluences with the Goulburn River approximately 70 km upstream of the study area. Construction works have the potential to reduce water quality in Goulburn River through the mobilisation of sediments, litter and other contaminants via wind or stormwater runoff which could subsequently impact aquatic biodiversity. Increased turbidity results in shading and potential dieback of aquatic vegetation, fish kills through clogging gills or making prey hard to find and/or reduced recruitment by smothering fish eggs. Excess nutrients attached to sediments can result in algal blooms and oxygen depletion, leading to fish kills. Transport of contaminants resulting from	Details on potential construction mitigation measures are not available, however it is anticipated that the following would be undertaken as a minimum: • Erosion and sediment control measures in accordance with the Blue Book. • Stockpile management. • Compounds and stockpile sites located outside of riparian habitat and waterfront land. • Monitoring and maintenance of erosion and sediment control devices.	Details on potential operational impacts are not available.	Details on potential operation mitigation measures are not available, however it is anticipated that the following would be undertaken as a minimum: • Design waterway crossings and services crossing in accordance with relevant publications. • Refueling outside of waterfront land. • Environmental monitoring after construction.	Provided controls are implemented, maintained and monitored, the cumulative impacts of the project on the Goulburn River, would be negligible.

Major Project	Potential impacts on aquatic biodiversity during construction[2]	Construction mitigation measures	Potential impact during operation	Operation mitigation measures	Construction and operation residual impact
	spill such as petroleum, diesel, hydraulic fluids and oils that may become mobilised following rainfall and cause toxicity and mortality in freshwater organisms, which can move up the food chain.				

This assessment concludes that the cumulative impacts from the four major works projects occurring within the Goulburn River catchment are unlikely to be significant, provided the biodiversity management programs for each project are implemented, maintained and monitored.

6. Mitigation and management measures

The mitigation measures to minimise impacts to aquatic biodiversity from the project during detailed design / pre-construction, construction and operation are outlined in Table 6-1.

Table 6-1. Summary of mitigation and management measures

Impact type	Mitigation management measure	Project phase
Riparian vegetation	Detailed design and construction planning avoided direct impacts on native riparian vegetation (section 5.1.2.1).	Detailed design/ Pre-construction
Waterfront land	Sections of Redlynch Creek and the unnamed tributary of Rocky Creek containing bed and banks, are to be electronically mapped in order to identify Waterfront land. Waterfront land is measured as 40 m from the top of bank and any waterfront land disturbed is to be revegetated following completion of works.	Detailed design/ Pre-construction
Key Fish habitat	Detailed design and construction planning would seek to identify refinements that further avoid or minimise impacts on key fish habitat (KFH) (section 5.6.1).	Detailed design/ pre-construction
Fish passage	Fish passage would be maintained at watercourses identified as KFH within the Development Footprint. Minimum requirements for fish passage are discussed in section 5.1.2.3. It is proposed that access roads are designed to prevent blocking of fish passage where access roads cross watercourses (i.e., Redlynch Creek and Rocky Creek), such as installing culverts or dry fords.	Detailed design/ pre-construction / construction
Fauna	Pre-clearance surveys would be carried out prior to construction by a suitability qualified ecologist including native aquatic fauna salvage in accordance with a farm dam dewatering policy (refer section 5.1.2.7). All salvaged aquatic fauna would be relocated to similar habitat nearby.	Pre-construction/ Construction
Instream impacts	Appropriate erosion and sediment control would be installed in accordance with the Erosion and Sediment Control Plan, around ground disturbance works conducted on waterfront land or within watercourses mapped as KFH	Construction
Riparian vegetation	Exclusion areas would be established and maintained around riparian vegetation to be retained on waterfront land (40 metres from top of bank for watercourses with defined bed and banks (parts of Redlynch Creek and Rocky Creek) (refer 5.6.2).	Construction
Riparian vegetation	Activities within vegetated riparian zones would be managed to minimise impacts to aquatic environments as far as practicable. Riparian areas subject to disturbance would be progressively stabilised and rehabilitated in accordance with the Biodiversity Management Plan. The spread of exotic species would be minimized through implementation of the Weed and Pest Management Plan.	Construction
Instream impacts	Instream works in areas mapped as KFH (i.e. Redlynch Creek, unnamed tributary of Poggy Creek and unnamed tributary of Rocky Creek) would be undertaken in dry conditions as far as practicable and appropriate erosion and sediment control would be installed and maintained. Watercourses impacted by instream works would have the bed and bank morphology reinstated, and disturbed areas would be stabilized using vegetation to minimize erosion in accordance with the Biodiversity Management Plan.	Construction/ Decommissioning

Impact type	Mitigation management measure	Project phase
Unexpected finds	A species unexpected finds protocol would be implemented if threatened species, not assessed in the aquatic assessment, are identified in the Development Footprint. This would include stop work orders in the immediate area and notifying DPIE.	Construction
Instream impacts	Refueling would be conducted outside of waterfront land (refer section 5.6.2), with appropriate measures in place to avoid impacts to waterways, aquatic habitats, and groundwater. This includes spill kits always kept with maintenance vehicles and or machinery within 100 metres of a watercourse.	Construction, operation and decommissioning
Instream impacts	If herbicide is used to control exotic species within the Project Area, its use would be kept to a minimum and it would be applied in accordance with relevant application guidelines.	Construction and Operation

7. Conclusion

The aquatic ecological assessment for the construction and operation of the Goulburn River Solar Farm and Battery Energy Storage System near Merriwa has been prepared based on a review of available aerial photography, topography, databases, literature, policies and guidelines, as well as results of field investigation. The key findings of report are as follows:

Existing aquatic environment

- The Project Area includes 90 mapped hydrolines, of which three are third order watercourses based on Strahler stream order (Strahler, 1952), and five are mapped as KFH by DPI (2007). Six watercourses within the Project Area were subject to field survey and habitat assessment.
- Aquatic habitat assessment in the field found that all watercourses within the Project Area were highly ephemeral, with only Redlynch Creek containing shallow remnant pools following rainfall.
- First and second order drainage lines were dry and most riparian zones were significantly modified by agricultural land practices.
- Targeted threatened fauna surveys were undertaken using bait traps in remnant pools on Redlynch Creek however no aquatic fauna was recorded.
- Watercourses within the Project Area were defined as Type 3 minimally sensitive KFH.

Impact assessment

Three watercourses (or sections of) mapped as KFH occur within the Development Footprint:

- Redlynch Creek
- an unnamed tributary of Poggy Creek
- an unnamed tributary of Rocky Creek.

In addition, two farm dams occur within the Development Footprint.

Direct impacts from the project on aquatic biodiversity could include potential blockage of fish passage (during floods) where filling is required for access roads across KFH watercourses, potential modification to riparian habitat through the spread of exotic flora, potential mortality to protected aquatic fauna during farm dam dewatering and filling and potential impacts on water quality through disturbance of soil on waterfront land. Potential indirect impacts to aquatic biodiversity relate to the mobilisation of poor-quality stormwater runoff from construction activities including vegetation removal, earthworks, establishment and use of construction compounds, trenching and access roads and pollution downstream and potential mortality to aquatic flora and fauna.

Following assessment, all watercourses within the study area were considered to have a low or negligible risk of potential impact from the project during construction, operation and decommissioning due to the highly ephemeral nature of the watercourses, the lack of KFH features and or the minor nature of works proposed within the catchment of these watercourses.

Potential risks can be managed in ephemeral watercourses by:

- undertaking construction when watercourses are dry (where practicable) as aquatic fauna species would not be present
- implementing appropriate erosion and sediment control measures
- installing fish friendly crossings (in accordance with relevant guidelines) where access roads are proposed across watercourses mapped as KFH
- avoiding all construction activities, including tree removal and re-fuelling of vehicles and other machinery, on waterfront land (i.e., land 40 metres from the top of bank, where watercourses have a defined bed and banks)

- re-instating watercourse bed, banks and riparian vegetation where these are disturbed in areas mapped as KFH.

Potential indirect risks to the perennial watercourse (Goulburn River) can be managed through the implementation of appropriate erosion and sediment control measures on upstream watercourses during construction.

Threatened species, populations and EECs

Desktop studies identified one endangered population (Darling River Hardyhead) and one threatened species (Southern Purple Spotted Gudgeon) had a moderate likelihood of occurrence in watercourses within the study area (Goulburn River), however watercourses within the Project Area are considered unlikely to provide habitat for these species. Potential indirect impacts on these species through impacts on water quality in the Goulburn River were considered.

Assessment under the FM Act concluded that the project was unlikely to have an adverse effect on the life cycle of these species such that a viable local population is likely to be placed at risk of extinction. This was based on the absence of direct impacts to habitat for these species. Potential indirect impacts on water quality associated with the mobilization of sediments can be managed using standard practices during the operation, construction and decommissioning phases of the project and the level of impact to the aquatic environment is therefore considered minor.

One KTP is triggered by the project:

- installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams.

Where the filling of watercourses mapped as KFH is required for access roads, culverts would be designed in accordance with relevant guidelines (Fairfull and Witheridge, 2003) and would not significantly impact natural flow regimes.

Impacts to key fish habitat

KFH within the study area was determined based on existing KFH mapping by DPI (2007), watercourses sensitivity type (DPI, 2013) and watercourse class (Fairfull and Witheridge, 2003) which were defined following site inspection.

All watercourses within the Project Area were defined as having minimally sensitive KFH due to their highly ephemeral nature and the absence of fish habitat features. Regardless, the Development Footprint covers mapped KFH along the following watercourses:

- Redlynch Creek
- unnamed tributary of Poggys Creek
- unnamed tributary of Rocky Creek.

Proposed access roads/infrastructure cross Redlynch Creek in three locations and Rocky Creek in one location. Where access roads cross a watercourse defined as KFH, appropriate fish passage would be maintained through the installation of a high flow design culvert. As such, fish passage would be maintained and KFH would not be permanently lost or disrupted so no aquatic biodiversity offset would be required.

Waterfront land includes the bed and bank of watercourses and all land within 40 metres of the highest bank (DPI, 2012). However, watercourses lacking defined bed and banks are not typically associated with waterfront land. Within the Development Footprint, Redlynch Creek and an unnamed tributary of Rocky Creek have defined bed and banks and as such, these watercourses have associated waterfront land. Where possible, construction works would not be undertaken on waterfront land. Any disturbance to waterfront land would be remediated as detailed in the Biodiversity Management Plan.

No aquatic groundwater dependent ecosystems (GDEs) were identified in the study area.

Mitigation and management measures

The project has been designed to avoid and minimise potential impacts to watercourses and aquatic biodiversity as far as practicable. Any impacts to aquatic biodiversity would be managed through the implementation of appropriate mitigation and management detailed in this assessment.

Conclusion

The aquatic biodiversity impact assessment concludes that the impacts of the project would not significantly compromise the functionality, long-term connectivity or viability of habitats, or ecological processes within watercourses in the study area nor would it directly impact threatened species/populations with potential to occur in the study area. Most of the potential impacts are associated with indirect impacts on water quality and would therefore be temporary and managed through the adoption of appropriate erosion and sediment control measures.

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Appendix A. Assessment of significance (FM Act)

Section 5.5 of the EP&A Act requires that a determining authority examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the project and that assessment of significance is undertaken to assess the likelihood of significant impact upon threatened species, populations or ecological communities listed under the FM Act. The test for determining whether the project is likely to affect threatened species, populations or ecological communities or their habitats is in section 221ZV of the FM Act.

Two aquatic species were identified as likely or possible to occur within the study area (Appendix A) and are assessed against an assessment of significance:

1. Darling River Hardyhead *C. amniculus* Endangered population
2. Southern Purple-Spotted Gudgeon *M. adspersa* Endangered species.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species, populations or ecological communities:

Impact on local population of a species

> *(a) 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,*

Southern Purple Spotted Gudgeon

Southern Purple Spotted Gudgeon is listed as an endangered species in NSW. Southern Purple Spotted Gudgeon have a rounded head with a small mouth and a rounded tail. They have two dorsal fins; the first being shorter and lower than the second. They are generally dark brown in colour along the back, fading to pale brown or cream on the belly. A number of distinguishing markings occur along the body, such as white and red spots and a blue wash along the flanks, all of which brighten during breeding, and yellow bars on the margins of the dorsal and anal fins. The three red-maroon bars on the cheek differentiate the species from other similarly shaped freshwater gudgeon species within NSW even at very small sizes (such as Coxs, Striped and Flathead Gudgeons). Southern Purple Spotted Gudgeon grow to around 15 cm in length.

Two populations of Southern Purple Spotted Gudgeon occur in NSW; an eastern population found in coastal catchments north of the Clarence River, and a western population found throughout Murray-Darling Basin. During the early 1980s, the Murray-Darling Basin population experienced rapid and dramatic reductions in distribution and abundance. The population is now confined to small remnant populations in the Macquarie, Gwydir and Border Rivers catchments and a self-sustaining population created from captive-bred fish in the Castlereagh Catchment. Since all remaining populations in the western region are small, isolated and disconnected from each other, there is limited gene flow between populations. There have been few recent records of the eastern population despite targeted sampling at those locations where the species has previously been found. Only two extant populations are known, one in the Richmond catchment and the other in the Hunter Valley. However, the population in Goorangoola Creek (Hunter River catchment) is outside what was previously considered the natural range of the species and it remains unknown whether the population is endemic or recently introduced.

Southern Purple Spotted Gudgeon are a benthic species that can be found in a variety of habitat types such as rivers, creeks and billabongs with slow-moving or still waters or in streams with low turbidity. Cover in the form of aquatic vegetation, overhanging vegetation from riverbanks, leaf litter, rocks or snags are important for the species. Most remnant populations in NSW occur in small to medium sized streams. They feed mainly on terrestrial insects and their larvae, worms, small fish, tadpoles, and some plant matter. Eggs are

deposited in clusters on solid objects such as rocks, wood or broad-leafed plants. The male guards and fans the eggs until they hatch (3 - 8 days).

The species is threatened by:

- Predation by introduced fish such as Eastern Gambusia (*Gambusia holbrooki*) and Redfin Perch (*Perca fluviatilis*).
- Habitat disturbance by common carp (*Cyprinus carpio*).
- Loss of favourable habitat, particularly aquatic plants.
- Fluctuations in water levels and flow as a result of river regulation have a significant impact on the inundation frequency for wetland habitats including habitats important for Southern Purple Spotted Gudgeon reproduction and recruitment.
- Thermal pollution.
- Increased turbidity and damage of stream banks by livestock access.
- Decreased water quality due to agricultural runoff and siltation.
- Local extinctions may not be naturally recolonised because of the species' inability to disperse the long distances required.
- Populations are generally small and isolated from each other, and therefore vulnerable to localised extinctions from severe events.

The study area is outside of the indicative distribution mapping for Southern Purple Spotted Gudgeon (DPI, 2016), however indicative distributions do include some downstream tributaries of the Goulburn River (Figure 4-3) and as such, this species was included in further assessment as a conservative approach.

Watercourses within the Project Area do not contain suitable habitat for Southern Purple Spotted Gudgeon, hence no direct impacts on suitable habitat for this species are likely. The Goulburn River and its tributaries, including downstream sections of Redlynch Creek, provide suitable habitat for Southern Purple Spotted Gudgeon through the presence of aquatic vegetation, overhanging vegetation from riverbanks, leaf litter, rocks or snags. These watercourses are outside of the Project Area and therefore would not be directly impacted by the project however indirect impacts include alterations to water quality because of the project. These indirect impacts can however be managed through appropriate erosion and sediment control measures and spill kits kept in vehicles/machinery used during construction, and the ongoing maintenance of vehicles used during the operation of the project. As such, the project is unlikely to have an adverse effect on the life cycle of the Southern Purple Spotted Gudgeon such that a viable local population of the species is likely to be placed at risk of extinction.

Impacts on an endangered population

> *(b) in the case of an endangered population, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

Darling River Hardyhead
The Darling River Hardyhead population in the Hunter River catchment is listed as an endangered population in NSW.

The Darling River Hardyhead is a small species of fish growing to a maximum of 80mm fork length, but is generally around 42mm. It has compressed sides and a small protrusible mouth and thin lips to help capture and grip food. It has a forked tail, two small, short-based dorsal fins, and pectoral fins that are positioned high on the body. The second dorsal fin is situated directly above the anal fin. The Darling River Hardyhead has large, silvery eyes. The scales are small and rarely overlap, and there are usually no scales on top of the head. The species is normally dusky gold coloured on its back with a dark silvery

stripe which runs along the length of the body. The underside of the Darling River Hardyhead is lighter in colour, often with a silvery sheen.

The Darling River Hardyhead occurs in the upper tributaries of the Darling River near the Queensland-New South Wales border. A small population also occurs in the Hunter River catchment. The Hunter River population is the only known occurrence of the species in an eastward flowing river and this population has always been relatively small.

They are usually found in slow flowing, clear, shallow waters or in aquatic vegetation at the edge of such waters. The species has also been recorded from the edge of fast flowing habitats such as the runs at the head of pools.

They are usually found singly or in small or large schools of up to about 50 fish. Little data has been recorded on the reproductive biology of the species, however it is closely related to the Murray hardyhead (*Craterocephalus fluviatilis*), which is considered a short lived (annual) species with an extended breeding season from spring through to autumn. The eggs will usually be deposited amongst aquatic vegetation.

Darling River Hardyheads primarily eat algae and fly larvae, but have also been seen to feed on small insects.

The species is threatened by:

- The habitat of the Darling River Hardyhead has been degraded through soil erosion, land clearing and livestock damage to riverbanks.
- Thermal pollution (changes in water temperature) from large impoundments such as Glenbawn Dam, Lake Lidell and Lake St Clair is likely to harm populations downstream.
- The presence of competing species, including alien Goldfish (Carassius auratus), eastern gambusia (*Gambusa holbrooki*) and common carp (*Cyprinus carpio*) may be causing significant declines of the Darling River Hardyhead in the Hunter River catchment. It is also likely that gambusia feed on the eggs and larvae of the Darling River Hardyhead.
- Water extraction from smaller tributary streams during droughts may put additional pressure on remnant populations.

Within the study area, the Goulburn River is within the indicative distribution mapping for the Darling River Hardyhead (DPI, 2016), however watercourses within the Project Area are not (Figure 4-3).

Watercourses within the Project Area do not contain suitable habitat for Darling River Hardyhead, hence no direct impacts on suitable habitat for this species are likely. The Goulburn River and its tributaries, including downstream sections of Redlynch Creek, provide suitable habitat for Darling River Hardyhead through the presence of slow flowing, clear, shallow waters, aquatic vegetation, along with runs and pools in faster flowing habitats. These watercourses are outside of the Project Area and therefore would not be directly impacted by the project however indirect impacts include alterations to water quality because of the project. These indirect impacts can however be managed through appropriate erosion and sediment control measures and spill kits kept in vehicles/machinery used during construction, and the ongoing maintenance of vehicles used during the operation of the project. As such, the project is unlikely to have an adverse effect on the life cycle of the Darling River Hardyhead such that a viable local population of the species is likely to be placed at risk of extinction.

Impact on Endangered Ecological Community

> *(c) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity—*

(i) 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

(ii) 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,

N/A

Habitat of a threatened species, population, ecological community

(d) in relation to the habitat of a threatened species, population or ecological community—

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

(ii) 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

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the threatened species, population or ecological community in the locality,

Two watercourses within the study area were identified as having potential habitat for threatened species/populations:

1. downstream areas of Redlynch Creek
2. Goulburn River

the project does not require any direct impacts to the downstream areas of Redlynch Creek or the Goulburn River and potential indirect impacts can be mitigated through appropriate erosion and sediment control. Thus, the habitat will not be removed or significantly modified, nor will the habitat become fragmented or isolated from other areas of habitat because of the project.

In terms of the importance of the habitat to be potentially modified, Redlynch Creek has not been identified within the indicative distribution for either Darling River Hardyhead or Southern Purple Spotted Gudgeon and is therefore considered to be of low importance to the long-term survival of these threatened species/populations, as they have not been recorded in these areas previously.

The Goulburn River was mapped as within the indicative distribution for the Darling River Hardyhead (but not the Southern Purple Spotted Gudgeon), however it is noted that the Goulburn River (within the study area) has been highly modified through land use practices in the catchment, with intensive farming practices, including extensive clearing of riparian vegetation to the bank, reducing the presence of aquatic vegetation, detritus, trailing bank vegetation and snags, which are important habitat features for this species. Thus, the existing habitat in the Goulburn River is likely to be of low importance to the long-term survival of these threatened species/populations.

Critical Habitat

(e) whether the proposed development or activity is likely to have an adverse effect on any critical habitat (either directly or indirectly),

N/A

Priorities Action Statement

(f) whether the proposed development or activity is consistent with a Priorities Action Statements.

All of the threatened species considered above have priority actions statements associated with their listing. The species action statements generally include:

- Advice to consent and determining authorities
- Collate and review existing information
- Community and stakeholder liaison, awareness and education
- Compliance / enforcement
- Enhance, modify or implement NRM planning processes to minimize adverse impacts on threatened species
- Habitat rehabilitation
- Pest eradication and control
- Research / monitoring
- Stocking / translocation
- Survey / mapping

the project is not inconsistent with any priorities action statement for the assessed threatened species/populations. Most recovery actions listed are not directly relevant to the project and relate to actions required by DPI to ensure the protection of these species. Habitat rehabilitation would be detailed in the Biodiversity Management Plan.

Priority actions statements for each species are detailed below:

Darling River Hardyhead

- Advice to consent and determining authorities
    - Provide information on the distribution of the Darling River Hardyhead to local councils and determining authorities to ensure appropriate consideration during development assessment processes (High priority).
- Collate and review existing information
    - Compile existing information on Darling River Hardyhead and identify knowledge gaps for the purpose of targeting future research activities (High priority).
    - Collate data on the historical distribution of Darling River Hardyhead including anecdotal and indigenous knowledge (Low priority).
- Community and stakeholder liaison, awareness and education
    - Encourage community reporting of Darling River Hardyhead sightings via the NSW DPI Threatened and Pest Species Sightings Program online form (Medium priority).
    - Implement education initiatives to improve awareness of the status of the Darling River Hardyhead and ways to minimise impacts on the species by preparing and distributing appropriate advisory material (Medium priority).
    - Install signs and/or interpretive displays at appropriate locations to assist with identification and awareness of Darling River Hardyhead (Low priority).
    - Foster long-term, two-way knowledge transfer and capacity building to enhance the role of indigenous ecological knowledge in the recovery of Darling River Hardyhead (Low priority).
- Compliance / enforcement
    - Maximise compliance activities at identified important sites (Low priority).
- Enhance, modify or implement NRM planning processes to minimize adverse impacts on threatened species

  - Negotiate with relevant authorities to encourage the identification, assessment, and modification of natural resource management plans and policies to minimise impacts on Darling River Hardyhead habitats and water quality (High priority).
  - Implement relevant State policies and programs (e.g. the NSW Diffuse Source Water Pollution Strategy) in an effort to reduce water pollution (particularly chemical pollution from agricultural pesticides) impacts on Darling River Hardyhead habitats in NSW (High priority).
- Habitat rehabilitation
  - Undertake work to identify, restore and protect known and potential Darling River Hardyhead habitats and address key threats such as habitat degradation and water quality decline from expanding development (High priority).
  - Undertake priority rehabilitation, restoration and enhancement work (e.g. rehabilitating riparian vegetation, cold water pollution reduction measures, reinstating large woody debris, removal of barriers to fish passage, removal of willows from riverbanks, sediment and erosion control measures) at key sites known to support Darling River Hardyhead populations (High priority).
  - Actively seek funds through grant schemes or other sources to implement riparian vegetation and water quality improvement projects in priority areas (Medium priority).
- Pest eradication and control
  - Investigate and implement integrated management of introduced species in and adjacent to identified Darling River Hardyhead habitats and take action to prevent the spread of introduced species into these habitats (Medium priority).
- Research / monitoring
  - Conduct research on the biology and ecology of Darling River Hardyhead, particularly the species' ecological role, environmental tolerances, factors influencing population dynamics, age and growth, life cycle and diet (High priority).
  - Undertake research to identify, prioritise and improve understanding of the threatening processes and causes of decline of Darling River Hardyhead (High priority).
  - Monitor populations of Darling River Hardyhead over time to assess trends in abundance and distribution and to identify emerging threatening processes (Medium priority).
  - Actively encourage community involvement in aspects of Darling River Hardyhead recovery including for example, research and monitoring programs (Medium priority).
  - Actively seek grants or investor partnerships to fund research and monitoring programs for Darling River Hardyhead (Medium priority).
  - Obtain and analyse genetic material from remnant populations of Darling River Hardyhead to identify genetic units to inform conservation breeding or translocation (Medium priority).
- Stocking / translocation
  - Develop an emergency response policy to guide the collection and captive husbandry of Darling River Hardyhead. The policy should address the circumstances in which wild individuals may be collected, held and re-released,

and identify holding facilities, potential funding sources and legal requirements (Medium priority).

- Identify potential candidate sites for possible future translocation of Darling River Hardyhead (Medium priority).
- Undertake emergency rescues of Darling River Hardyhead in response to droughts, oil spills/ pollution, detection of biosecurity threats (e.g. disease or pests), or to avoid imminent impacts in accordance with the emergency response policy (Medium priority).
- Maintain and monitor translocated populations (Medium priority).
- Implement the NSW Freshwater Fish Stocking Fishery Management Strategy to prevent significant impacts from stocking on Darling River Hardyhead populations (Medium priority).
- Review and assess the potential of artificial refuge areas for the protection of Darling River Hardyhead (Low priority).

- Survey / mapping
  - Conduct targeted surveys to determine the current distribution and abundance of Darling River Hardyhead (High priority).
  - Collect data on the presence/absence of Darling River Hardyhead during incidental surveys (High priority).

Southern Purple Spotted Gudgeon

- Advice to consent and determining authorities
  - Provide information on the distribution of Southern Purple Spotted Gudgeon to local councils and determining authorities to ensure appropriate consideration during development assessment processes (High priority).
- Collate and review existing information
  - Compile existing information on Southern Purple Spotted Gudgeon and identify knowledge gaps for the purpose of targeting future research activities (Medium priority).
  - Collate data on the historical distribution of Southern Purple Spotted Gudgeon including anecdotal and indigenous knowledge (Low priority).
- Community and stakeholder liaison, awareness and education
  - Encourage community reporting of Southern Purple Spotted Gudgeon via the NSW DPI Threatened and Pest Species Sightings Program online form (Medium priority).
  - Implement education initiatives to improve awareness of the status of Southern Purple Spotted Gudgeon and ways to minimise impacts on the species by preparing and distributing appropriate advisory material (Medium priority).
  - Install signs and/or interpretive displays at appropriate locations to assist with identification and awareness of Southern Purple Spotted Gudgeon (Low priority).
  - Foster long-term, two-way knowledge transfer and capacity building to enhance the role of indigenous ecological knowledge in the recovery of Southern Purple Spotted Gudgeon (Low priority).
- Compliance / enforcement
  - Maximise compliance with the ban on collecting Southern Purple Spotted Gudgeon by communicating with aquarium enthusiasts using a number of

communication mediums (e.g. aquarium industry journals, newsletters, conferences) (High priority).

- Maximise compliance activities at identified important sites (Medium priority).

- Enhance, modify or implement NRM planning processes to minimize adverse impacts on threatened species
  - Incorporate new research information into catchment management, river health and wetlands programs where appropriate (High priority).
  - Negotiate with relevant authorities to encourage the identification, assessment, and modification of natural resource management plans and policies to minimise impacts on Southern Purple Spotted Gudgeon habitats and water quality (High priority).
  - Implement relevant State policies and programs (e.g. the NSW Diffuse Source Water Pollution Strategy) in an effort to reduce water pollution (particularly chemical pollution from agricultural pesticides) impacts on Southern Purple Spotted Gudgeon habitats in NSW (Medium priority).
- Habitat rehabilitation
  - Undertake work to identify, restore and protect known and potential Southern Purple Spotted Gudgeon habitats and address key threats such as habitat degradation and water quality decline from expanding development (High priority).
  - Allocate and manage environmental water flows in regulated rivers to restore natural seasonal flow patterns, and to reduce the impact of cold water downstream of dams (High priority).
  - Actively seek funds through grant schemes or other sources to implement riparian vegetation and water quality improvement projects in priority areas (High priority).
  - Undertake priority rehabilitation, restoration and enhancement work (e.g. rehabilitating riparian vegetation, cold water pollution reduction measures, reinstating large woody debris, removal of barriers to fish passage, removal of willows from riverbanks, sediment and erosion control measures) at key sites known to support Southern Purple Spotted Gudgeon populations (High priority).
- Pest eradication and control
  - Investigate and implement integrated management of introduced species in and adjacent to identified Southern Purple Spotted Gudgeon habitats and take action to prevent the spread of introduced species into these habitats (Medium priority).
- Research / monitoring
  - Conduct research on the biology and ecology of Southern Purple Spotted Gudgeon, particularly the species' ecological role, environmental tolerances, factors influencing population dynamics, age and growth, life cycle and diet (High priority).
  - Undertake research to identify, prioritise and improve understanding of the threatening processes and causes of decline of Southern Purple Spotted Gudgeon (High priority).
  - Obtain and analyse genetic material from remnant populations of Southern Purple Spotted Gudgeon to identify genetic units to inform conservation breeding or translocation (High priority).

    - Actively encourage community involvement in aspects of Southern Purple Spotted Gudgeon research and monitoring programs (Medium priority).
    - Monitor populations of Southern Purple Spotted Gudgeon over time to assess trends in abundance and distribution and to identify emerging threatening processes (Medium priority).
    - Actively seek grants or investor partnerships to fund research and monitoring programs for Southern Purple Spotted Gudgeon (Medium priority).
- Survey / mapping
    - Conduct targeted surveys to determine the current distribution and abundance of Southern Purple Spotted Gudgeon (High priority).
    - Collect data on the presence/absence of Southern Purple Spotted Gudgeon during incidental surveys (High priority).
- Stocking / translocation
    - Conduct targeted sampling at stocked sites to assess the status of stocked populations including growth and recruitment rates (Medium priority).
    - Conduct research to evaluate the effectiveness of translocation of adult fish compared to stocking of juveniles to inform future conservation actions (Low priority).
    - Identify potential candidate sites for possible future translocation of Southern Purple Spotted Gudgeon (Low priority).
    - Maintain and monitor translocated populations (Low priority).

Key threatening Process

(g) whether the proposed development constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The following KTPs are listed under the FM Act:

- Degradation of native riparian vegetation along New South Wales water courses
- Hook and line fishing in areas important for the survival of threatened fish species
- Human-caused climate change
- Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams
- Introduction of fish to waters within a river catchment outside their natural range
- Introduction of non-indigenous fish and marine vegetation to the coastal waters of New South Wales
- Removal of large woody debris from New South Wales rivers and streams
- The current shark meshing program in New South Wales waters

Of these eight KTPs, only three are of relevance to the project:

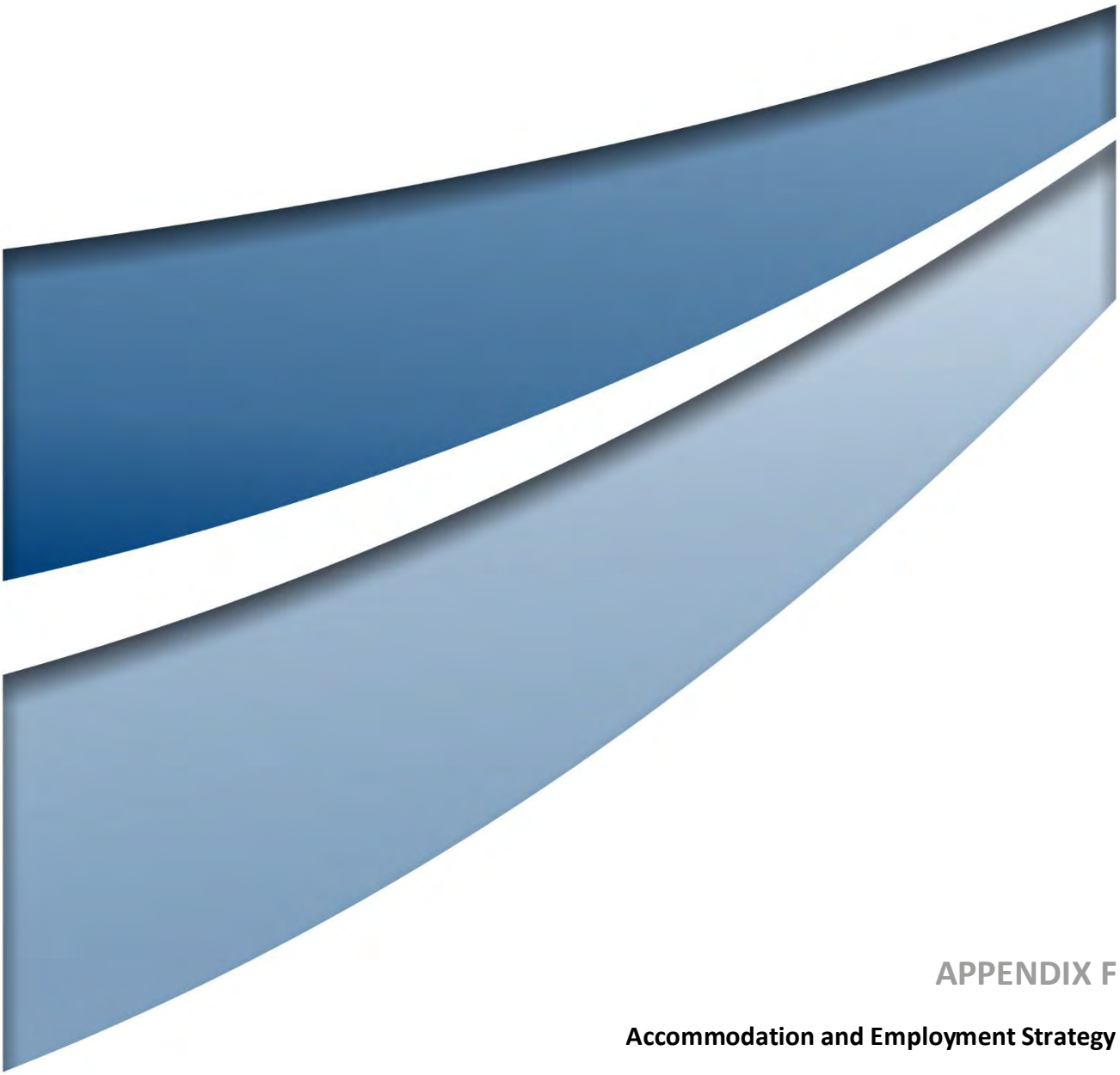
1. Degradation of native riparian vegetation along New South Wales water courses
2. Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams
3. Removal of large woody debris from New South Wales rivers and streams

Under the proposal, ‘installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams’ is triggered by the project though the installation of culvert to maintain fish passage across watercourses identified as KFH. Culverts would be designed in accordance with relevant guidelines, to

maintain fish passage and to minimise impacts to natural flow regimes. The installation of culverts however is not considered to significantly contribute to this KTP.

'Degradation of native riparian vegetation along New South Wales water courses' is not triggered by the project as removal of riparian vegetation has been avoided during the design phase.

'Removal of large woody debris from New South Wales rivers and streams' is not triggered by the project as no watercourses within the area of impact contain large woody debris.



APPENDIX F

Accommodation and Employment Strategy

umwelt
Environmental & Social Consultants

lightsource bp

ACCOMMODATION AND EMPLOYMENT STRATEGY

Goulburn River Solar Farm

FINAL

December 2023

lightsource bp

ACCOMMODATION AND EMPLOYMENT STRATEGY

Goulburn River Solar Farm

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Lightsource bp

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Report No. 23485/R13
Date: December 2023

umwelt
Environmental & Social Consultants

APPROVED COMPANY ISO 9001
QHS Certification Services

This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Acknowledgement of Country

Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
V1	Dr Kate Raynor	23/11/23	Dr Kate Raynor	27/11/23
Final	Dr Kate Raynor	05/12/23	Dr Kate Raynor	05/12/23

Executive Summary

The purpose of this Accommodation and Employment Strategy (AES) is to provide an overview of the baseline economic, social, and housing context surrounding the Goulburn River Solar Farm project (the Project) located near Merriwa in NSW. This AES outlines Lightsource Development Services Australia Pty Ltd's (Lightsource bp) proposed approach to managing, enhancing and mitigating key employment and accommodation impacts of the Project.

The strategy has been informed by interviews with key stakeholders and a desktop analysis of accommodation and employment data for the Upper Hunter, Muswellbrook, and Mid-Western Regional Local Governments Areas (LGAs). The key geographical areas considered in the AES are Mudgee, Wollar, Gulgong, Kandos, Merriwa, Scone, Muswellbrook and Denman Suburbs and Localities (SALs) (the social locality).

Project Overview

The Project is a large-scale solar farm, located approximately 28 kilometres (km) southwest of the township of Merriwa, and approximately 200 km to the northwest of the closest capital city of Sydney. The Project sits within the Upper Hunter Shire Local Government Area (LGA), in the state of New South Wales (NSW). The proposed Project Area is on partially cleared freehold land with two private owners and is surrounded by the Goulburn River National Park. The Project will involve the construction, operation, maintenance and decommissioning of approximately 550-megawatt peak (MWp) of solar photovoltaic (PV) generation as well as a battery energy storage system.

Construction is proposed to commence by mid-2024, with a construction phase of approximately 24 months. A peak on-site workforce of 350 direct construction jobs is anticipated, with an average of around 250 direct jobs throughout the construction period. Lightsource bp anticipates an ongoing workforce of up to 10 operational staff, with an operational period of 40 years.

Project Accommodation and Employment Context

This AES has identified considerable housing, accommodation, employment and procurement constraints in the social locality, linked to the Project's remote location and the presence of multiple concurrent and proximal projects. The AES has also identified existing regional strengths, including regional expertise in mining and construction sectors and access to land, with the capacity to host worker villages for in-coming workers.

Availability of short-term and rental accommodation

There is a shortage of short-term accommodation (hotels, motels, and Airbnb properties) in the Upper Hunter, Mid-Western Regional and Muswellbrook LGAs. Considerate use of this existing short-term accommodation will be necessary to minimise disruption to the local tourism and short-term accommodation market. Analysis has concluded that **around 14 workers have the potential to be housed in existing proximal short-term accommodation** while **approximately 40 additional new short-term accommodation rooms may be established** by existing accommodation providers in the social locality in response to anticipated future demand.

The region surrounding the Project is characterised by low rental vacancy rates and low rental stock. Analysis has concluded that approximately three homes (one in Scone and two in Muswellbrook) may be available to the Project without placing unsustainable pressure on the existing rental market.

Availability of a custom-built temporary workforce accommodation facility (TWA Facility)

Given limited access to existing short-term and rental accommodation in the social locality, Lightsource bp has entered into a memorandum of understanding with a local developer currently planning to build an accommodation facility of up to 500 rooms within the town of Merriwa. Lightsource bp has an option in place to rent up to 300 rooms during the construction period of the Project, with potential to increase the number of rooms if required. The commencement of this facility is being coordinated between the two parties to align with the ramp up of workforce numbers onsite at the Project.

Availability of local workers and supply chain opportunities

The social locality surrounding the Project is characterised by employment and business strengths in agriculture, forestry and fishing, and mining and manufacturing sectors with some capacity to adapt to support the Project. However, a low unemployment rate across the social locality will make it difficult to achieve a large workforce sourced wholly from within the locality. This challenge is exacerbated by the close proximity of the project to multiple other renewable energy projects (some of which have overlapping construction timelines with the Project) and multiple coal mines in the region, which all compete for the local workforce.

Interviews and a desktop analysis indicate that sourcing approximately 10% (approximately 35 workers) of the Project peak construction workforce from the local community appears feasible, however for a more detailed analysis of local employment assumptions refer to **Section 5.2.1**. This AES uses this conservative estimate to ensure that accommodation sufficiency is assessed based on a 'worst case scenario.' The AES also includes recommendations to increase local employment and procurement wherever possible. This estimate is different to the original assumptions supplied in the Economic Impact Assessment (Ethos Urban, 2023) as that was developed earlier in the assessment phase.

Accommodation and Employment Recommendations

This AES has identified several opportunities to address the need for accommodation for construction workers and maximise opportunities for local employment and procurement associated with the Project.

Key Accommodation Recommendations

- Accommodate the majority of the incoming non-resident workforce in a custom-built workforce accommodation facility in Merriwa.
- Prioritise sustainable use of local accommodation a maximum of 75 minutes-drive or 100 km from the development (i.e., Merriwa, Cassilis, Sandy Hollow, Denman, and possibly Scone and Muswellbrook) while maintaining pooled transport options to site.
- Reduce or avoid upward pressure on housing prices, rental costs and demand that may result from development activities by limiting the amount of rental and short-term accommodation consumed by non-resident workforces.

Key Employment Recommendations

- Transparently communicate employment and procurement opportunities to the local community and provide updates on whether objectives are achieved.
- Implement strategies to target a minimum of approximately 35 people (10% of peak workforce) sourced locally, including working alongside organisations such as Programmed or Blackrock Industries to offer traineeships and apprenticeships for local people.
- Pro-actively generate opportunities for employment of under-represented communities, including First Nations people, women, and unemployed people.

Proactive management and monitoring of outcomes will be achieved through post-approval management strategies and mechanisms that operationalise this AES.

Abbreviations

Abbreviation	Description
ABS	Australian Bureau of Statistics
AES	Accommodation and Employment Strategy
APM	Advanced Personnel Management
BESS	Battery Energy Storage System
CWO REZ	Central-West Orana Renewable Energy Zone
DCJ	Department of Communities and Justice
DIDO	Drive-in Drive-out
DPE	Department of Planning and Environment
FIFO	Fly-in Fly-out
FTE	Full Time Equivalent
IER	Index of Economic Resources
IRSAD	Index of Relative Socio-Economic Advantage and Disadvantage
IRSD	Index of Relative Socio-Economic Disadvantage
km	kilometre
kV	kilovolt
LGA	Local Government Area
MOU	Memorandum of Understanding
MW	megawatt
MWh	megawatt hour
NSW	New South Wales
REZ	Renewable Energy Zone
SAL	Suburb and Locality
SALM	Small Area Labour Markets
SEIFA	Socio-Economic Indexes for Areas
The Project	Goulburn River Solar Farm project
TWA	Temporary Workers' Accommodation

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1.0 Introduction

1.1 Purpose of the Accommodation and Employment Framework

Lightsource Development Services Australia Pty Ltd (Lightsource bp; LSbp) is seeking to develop the Goulburn River Solar Farm (the Project) 28 kilometres (km) southwest of the township of Merriwa, in the Upper Hunter Shire. The Project is being assessed under the NSW *Environmental Planning and Assessment Act 1979 (*EP & A Act). Further information regarding the Project is provided in **Section 1.2**.

Umwelt prepared the Environmental Impact Statement (EIS) including a Social Impact Assessment (SIA) for the Project. The Project was placed on public exhibition in June and July of 2023. During the exhibition period, 69 submissions were received. This Accommodation and Employment Strategy (AES) is a direct response to the findings and recommendations identified in the SIA and the questions raised through formal submissions while on exhibition about the limited accommodation in the region and consideration of feasible local employment levels.

The AES has been developed to meet the following objectives:

- Ensure there is sufficient accommodation for the required workforce, taking into consideration the cumulative impacts associated with other developments in the region within the same timeframe.
- Reduce the strain on the local accommodation and housing sector during the influx of workforces.
- Maximise the capacity for Lightsource bp to generate local benefits through local procurement and employment outcomes.
- If relevant, support the criteria and goals of LSbp's Industry and Aboriginal Participation Plan (IAPP) developed for the Project[1].
- Identify options for the effective and appropriate accommodation of workforce associated with the Project.
- Respond to the community, council and agency concerns in relation to temporary workforce accommodation and local employment opportunities.
- Detail the consultation and analysis undertaken to-date to support consideration of accommodation and employment and procurement opportunities associated with the Project.

[1] The IAPP is based on a framework introduced by the NSW Government to support and create better long-term outcomes for First Nations people, businesses, and communities. It includes targets to develop direct and indirect opportunities in the Project's supply chain, provide funding for local initiatives and support educational and training opportunities and forms part of LSbp's bid for a Long-Term Energy Service Agreement.

1.2 Overview of the Project

Lightsource bp propose the development of the Goulburn River Solar Farm. The Project sits within the Upper Hunter Shire Local Government Area (LGA), in the state of New South Wales (NSW). Other regional population centres nearby include Muswellbrook (75 km east of the Project), Scone (76 km northeast of the Project), and Mudgee (60 km southwest of the Project).

The proposed Project Area is on partially cleared freehold land with two private owners and is surrounded by the Goulburn River National Park. The Project will involve the construction, operation, maintenance and decommissioning of the solar farm and battery energy storage system (BESS), with construction proposed over 24 months and operations for 40 years.

The Project, as exhibited in the EIS, will involve the construction, operation, maintenance, and decommissioning of approximately 550 megawatt peak (MWp) of solar photovoltaic (PV) generation as well as a BESS with 280 MWp / 570 megawatt hour (MWh) capacity. The Project also comprised supporting infrastructure including a substation and connection to an existing 500 kilovolt (kV) transmission line and road upgrades to parts of Wollara Road and Ringwood Road, including two culverts at Bow River and Killoe Creek.

1.2.1 Proposed Amendments

Following public exhibition of the EIS, LSbp have continued to consult with landholders and stakeholders. Ongoing consultation and consideration of the submissions received has resulted in a number of proposed changes to the Project.

A summary of the key proposed amendments to the EIS Project are provided in **Table 1.1** below. Amendment No. 6 is addressed by this AES.

Table 1.1 Summary of Key Proposed Project Amendments

No.	Description
1	Transport route amendments and upgrade of the intersection of the Golden Highway and Ringwood Road.
2	Upgrades to additional parts of Wollara Road and Ringwood Road.
3	Increased BESS capacity and option of a decentralised BESS.
4	Minor modifications to the Development Footprint and internal layout including: • removal of travelling stock route (TSR) 4481 from within the Project Area • relocation and/or removal of solar arrays within the Development Footprint to avoid Regent Honeyeater Habitat, scattered trees and Box Gum Woodland • increased width of selected internal access roads to accommodate subterranean power cables.
5	Construction of an additional transmission tower adjacent the BESS/substation.
6	Additional assessment and revised approach for workforce accommodation.

1.3 Workforce and Accommodation Overview

Subject to development approval, construction would commence by mid-2024, with a construction phase of approximately 24 months. Lightsource bp anticipates a peak on-site workforce of 350 fulltime equivalent (FTE) direct construction jobs, with an average of approximately 250 FTE direct jobs throughout the construction period (see **Figure 1.1**). Lightsource bp anticipates an ongoing workforce of up to 10 staff during operations.

Apart from direct employment opportunities associated with the development itself, the employment benefits are expected to extend through local supply chains to include vehicle and equipment servicing, fencing contractors, uniform suppliers, cafés, pubs, catering and cleaning companies, tradespersons, tool and equipment suppliers and other supporting businesses.

While Lightsource bp aims to drive local employment opportunities where possible for local job seekers and contractors, it is difficult to anticipate how many jobs will be sourced locally. Analysis indicates approximately 10% of the peak workforce (35 people) may be local to the area. (See **Section 5.2.2**).

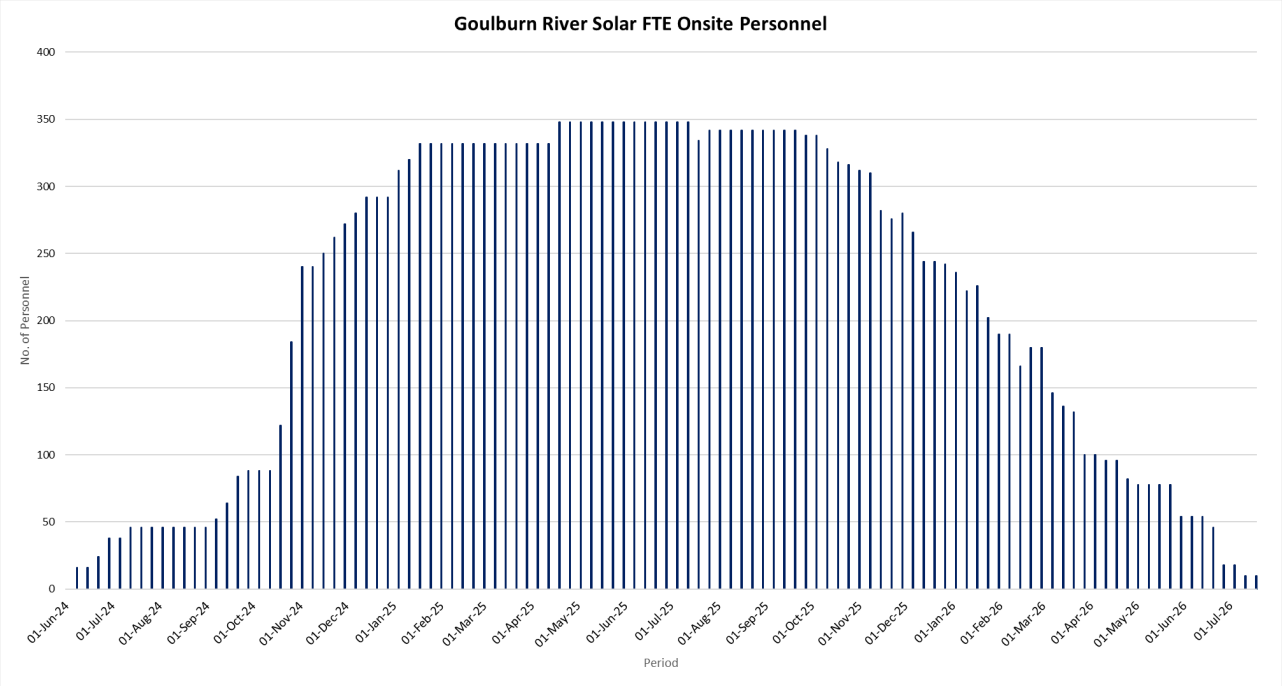

Figure 1.1 Goulburn River Solar Farm FTE Onsite Personnel

Source: (Lightsource bp, 2023).

1.4 Study Limitations

This study has been developed based on preliminary workforce forecasts provided by Lightsource bp and a review of existing publicly available data on short-term accommodation availability. It reflects estimates based on these data inputs, complemented by feedback from Project stakeholders including local councils, community groups and local businesses. The exact numbers of workers may differ based on changing construction timelines and/or changed access to short-term accommodation and rental accommodation. Construction timelines and workforce estimates will be finalised once civil and electrical contractors have been appointed and a detailed design process undertaken.

2.0 Regional Profile

The following section provides an overview of the socio-local context relevant to the development.

2.1 Defining the Social Locality

Statistical areas defined by the Australian Bureau of Statistics (ABS), as well as the land tenure composition of properties in or nearby the Project Area, have been used to determine the social locality (or 'area of social influence') as represented in **Figure 2.1**. The primary communities of interest that comprise the social locality for the purpose of this assessment are outlined in **Table 2.1** and **Figure 2.2**.

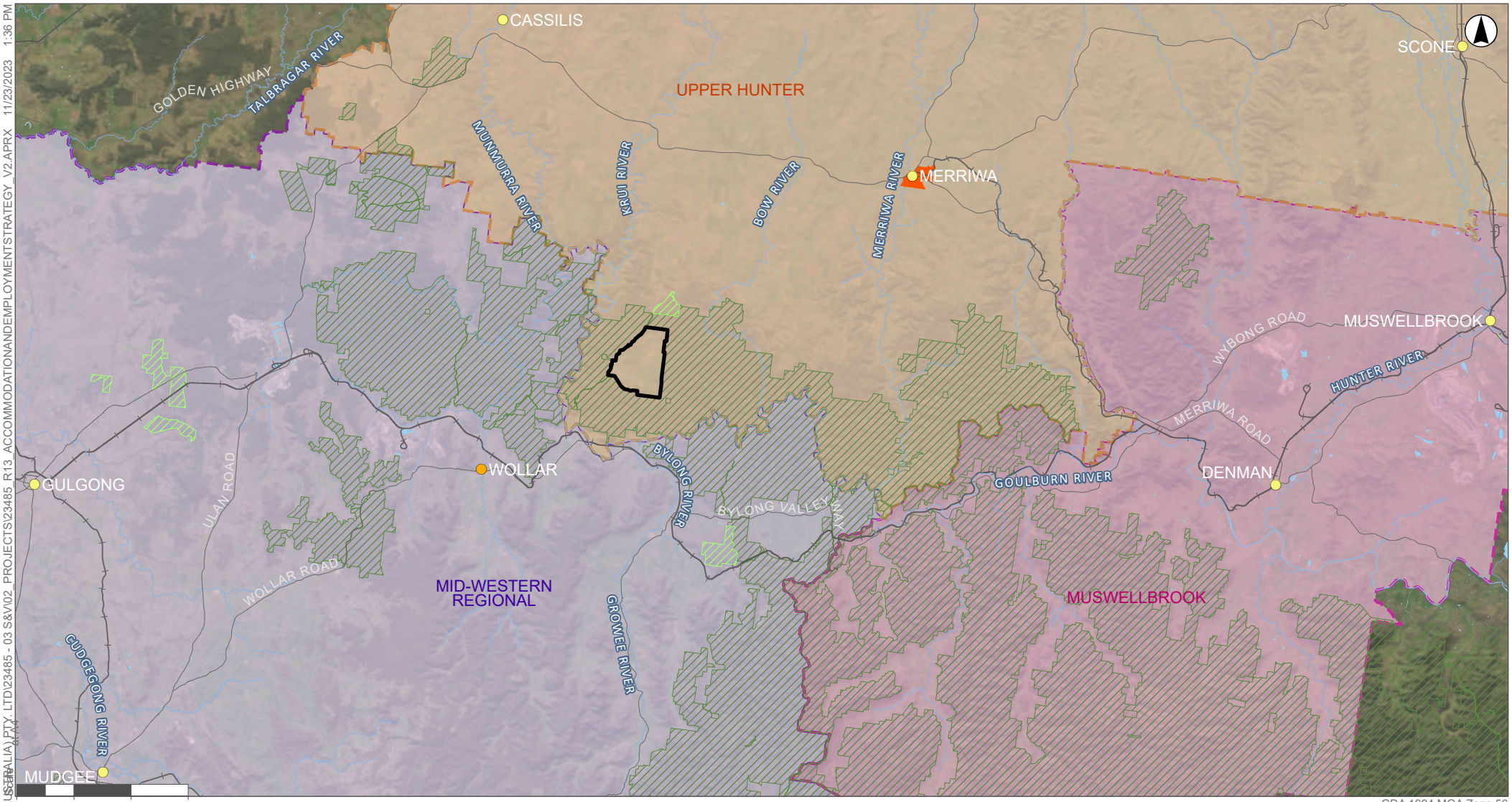

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FIGURE 2.4
Social Locality

Image Source: ESRI Basemap (2023) **Data source:** NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023); Lightsource BP (2023)

Table 2.1 Key Settlements

Settlement Type	Township (Population)	Reason for Inclusion
Host Local Government Area	Upper Hunter Shire LGA (14,229)	As a host LGA for the Project, Upper Hunter Shire LGA is likely to experience the highest accommodation and employment impacts and opportunities.
Neighbouring Government Areas	Mid-Western Regional LGA (25,713) Muswellbrook LGA (16,357)	As neighbouring LGAs for the Project, Mid-Western Regional and Muswellbrook LGAs are likely to experience employment impacts and opportunities. Muswellbrook LGA may experience some accommodation impacts and opportunities. Note: It is not proposed that any workers are accommodated in the Mid-Western LGA. Mid-Western Regional and Muswellbrook LGAs have a larger population and labour force, with strong regional expertise in mining industries and the potential to support renewable energy projects.
Geographically adjacent (within 30 min drive)	Merriwa SAL (1,825)) Wollar SAL (50)	These settlements are included due to their physical proximity to the Project and possibility of providing services or accommodation to support the Project. Note: following consultation with Mid-Western Council, it is not proposed for any workers to be accommodated in the Mid-Western LGA (see **Section 4.2**).
Proximal (within 60-minute drive) and primary order settlements (population over 10,000 people)	Mudgee SAL (11,457)	
Proximal (within 60-minute drive) and secondary order settlements (population between 1,000 and 10,000 people)	Denman SAL (1,821) Gulgong SAL (2,680) Kandos SAL (1,263) Scone SAL (5,824)	
Neighbouring (between 60 to 120-minute drive) and primary order settlements (population over 10,000 people)	Muswellbrook SAL (12,272)	These settlements are included due to the size of their populations, which means these localities are likely to serve as higher-order townships with a greater density of businesses, services, and infrastructure. They may be potential residential locations for project workforces.

Source: Umwelt, 2023.

Figure 2.2 Regional Geographical Scales

Source: (Umwelt, 2023).

2.2 Regional Demographic Context

Table 2.3 provides an overview of the key demographic characteristics of the LGAs under consideration in this study. **Table 2.4** provides an overview of the key townships. The tables in the following section are colour coded according to **Table 2.2** to demonstrate difference between the localities and the NSW average.

Table 2.2 Table Colour Scheme Meaning

Colour	Meaning
	Figure lower than the NSW average or median*
	Figure higher than the NSW average or median*

**Not applicable for population, and IEO, IRSD, IRSAD, or IER scores.*

Table 2.3 Regional Overview

	Upper Hunter Shire LGA	Mid-Western Regional LGA	Muswellbrook LGA	NSW
Population	14,229	25,713	16,357	8,072,163
Key Townships	Merriwa, Scone	Mudgee, Wollar, Gulgong, Kandos	Denman, Muswellbrook	-
Median Age (Years)	42	42	37	39
Percentage of population older than 65 years	21.2%	27.3%	15.6%	17.7%
Percentage of population younger than 15 years	18.6%	19.5%	27%	18.2%
Population growth 2011 to 2021	+475 +3.45%	+3395 +15.21%	+77 +0.47%	+ 1,154,505 +16.68%
Projected population growth 2021 to 2041	-475 -3.33%	+1842 +7.16%	+982 +5.98%	+ 861,477 10.67% increase
Proportion of population with a Bachelor degree or higher	6%	13.3%	4%	27.8%
Proportion of population with vocational qualifications	23.1%	24.5%	23%	15.1%
Index of Education and Occupation (IEO)[2]	3rd decile	4th decile	1st decile	-
Index of Relative Socio-Economic Disadvantage (IRSD)[3]	5th decile	5th decile	3rd decile	-
Index of Economic Resources (IER)[4]	7th decile	7th decile	4th decile	-

[2] The Index of Education and Occupation (IEO) is designed to reflect the educational and occupational level of communities. The education variables in this index show either the level of qualification achieved or whether further education is being undertaken. A low score indicates relatively lower education and occupation status of people in the area in general. For example, an area could have a low score if there are: many people without qualifications, or many people in low skilled occupations or many people unemployed, AND few people with a high level of qualifications or in highly skilled occupations.

[3] The Index of Relative Socio-economic Disadvantage (IRSD is a general socio-economic index that summarises a range of information about the economic and social conditions of people and households within an area. Unlike the other indexes, this index includes only measures of relative disadvantage. A low score indicates relatively greater disadvantage in general. For example, an area could have a low score if there are: many households with low income, many households with no qualifications, many people in low skill occupations.

[4] The Index of Economic Resources (IER) focuses on the financial aspects of relative socio-economic advantage and disadvantage, by summarising variables related to income and wealth. This index excludes education and occupation variables because they are not direct measures of economic resources. A low score indicates a relative lack of access to economic resources in general. For example, an area may have a low score if there are: many households with low income, or many households paying low rent, AND; few households with high income, or few owned homes.

Implications:

- The **Upper Hunter Shire and Mid-Western Regional LGAs have a population with a higher median age and larger proportion of people over the age of 65**. This indicates that the population is aging. This has implications for labour force participation and access to employees and underlines the need for specific health and social service infrastructure provision in the region. Comparatively, **Muswellbrook LGA has a median age below the NSW average and a lower proportion of people aged below 65 years**.
- IRSD scores indicate that the **LGAs of Upper Hunter Shire and Mid-Western Regional have average levels of low-income, low-qualification and low-skilled households**. Muswellbrook LGA is an exception, exhibiting substantially higher rates of disadvantage than other LGAs in the region. This has implications for access to skilled labour forces and presents opportunities for targeted training and education programs.
- IER scores indicate that **Mid-Western Regional and Upper Hunter Shire LGAs have relatively high levels of economic resources**, with higher proportions of households earning high incomes and owning their own homes. Comparatively, **Muswellbrook LGA has substantially higher proportions of households with few economic resources** and higher levels of vulnerability to economic shocks.
- **The population of all LGAs have grown at rates below the NSW average between 2011 and 2021**, with Muswellbrook LGA experiencing the lowest growth. This is followed by Upper Hunter Shire LGA. Compared to the other LGAs, Mid-Western Regional experienced the highest rate of growth.
- **Between 2021 and 2041, the populations of Mid-Western Regional and Muswellbrook LGAs are predicted to increase**. However, this growth rate is not expected to be substantial and will be below NSW's growth rate. Opposingly, **the population of Upper Hunter Shire is expected to decline**. A slow population growth rate, or a decline, can increase business willingness to re-locate or invest in other regions.
- **All LGAs have lower levels of university degree qualifications compared to the NSW average, but rather have a higher proportion with certificate qualifications**. This represents a substantial proportion of the population with a trade qualification, suggesting higher levels of alignment with workforce requirements for construction phases of development.

Source: ABS Community Profiles, 2021 (ABS, 2021) (ABS, 2021) (ABS, 2021), & Socio-Economic Indexes for Areas (SEIFA), 2021.

Table 2.4 Key Townships Overview

	Upper Hunter Shire LGA		Mid-Western Regional LGA		Muswellbrook LGA				NSW
Town	Merriwa	Scone	Mudgee	Gulgong	Wollar	Kandos	Muswellbrook	Denman	
Population	1,825	6,035	11,457	2,680	52	1,263	12,272	1,821	8,072,163
Median Age	45	39	41	35	35	54	35	43	37
Population Change (2011–2021)	+35 +1.95%	+346 +6.3%	+1,064 +10.14%	+299 +12.55%	-208 -80%	- 21 -1.63%	+481 +4.08%	+19 +1%	+ 1,154,505 +16.68%
IRSD	2nd decile	3rd decile	4th decile	2nd decile	2nd decile	1st decile	2nd decile	3rd decile	
IER	2nd decile	4th decile	5th decile	2nd decile	3rd decile	1st decile	2nd decile	4th decile	
IEO	2nd decile	2nd decile	1st decile	1st decile	2nd decile	1st decile	1st decile	1st decile	

Implications:

- Most townships have experienced minimal population growth between 2011 and 2021. Gulgong and Mudgee have experienced the highest increase, but this growth rate is still below the NSW average. The townships of Wollar and Kandos have both experienced a population decline.
- All townships have low SEIFA metrics, indicating higher rates of disadvantage.

Source: ABS Community Profiles, 2021 (ABS, 2021) (ABS, 2021) (ABS, 2021).

2.3 Regional Housing Context

Housing and accommodation shortages are acknowledged in policy documents across the social locality. For example, the Muswellbrook Local Strategic Planning Statement (2020) identifies a lack of housing diversity as a key challenge for the LGA and includes a planning priority to '*provide opportunities for growth in housing, including a greater mix of housing types to cater for the needs of different residents*.' Similarly, the Mid-Western Regional Local Strategic Planning Statement (2022) states that the Shire is seeking to focus on delivering affordable and adaptable housing options through effective land use planning and ensure that there is sufficient housing stock and varied residential housing options to account for growth. Mid-Western Regional Council has provided documentation to all renewable energy proponents highlighting a current lack of accommodation in the LGA and indicating their preference for TWA facilities to avoid unsustainable pressure on existing short-term accommodation. The Upper Hunter Shire LGA Local Strategic Planning Statement (2020) also recognises the need for greater housing affordability and diversity, and, as such, is aiming to encourage a range of housing types and densities, facilitate rural residential development, and support affordable and social housing.

Table 2.5 provides an overview of key housing characteristics across the LGAs, while **Table 2.6** shows the key townships within the social locality for the Project. The tables highlight that rental and housing prices are lower than NSW averages and that the proportion of low-income households in housing stress is also lower than NSW averages. However, household median incomes are also lower than NSW, and rental vacancy rates are lower than the average in Upper Hunter Shire and Muswellbrook LGAs.

Table 2.5 Regional Housing Overview

	Upper Hunter Shire LGA	Mid-Western Regional LGA	Muswellbrook LGA	NSW
Housing Market Indicators				
Weekly median household income	$1,429	$1,486	$1,628	$1,829
Proportion of low-income households in housing stress	47.8%	48.4%	43.9%	52.8%
Median house price	$540,000	$690,000	$480,000	$895,000
Median weekly rent (June 2023)	$410	$480	$420	$600
% rental price increase 2018 and 2023	46.4%	45.4%	27.2%	25%
Rental vacancy rate	0.32%	1.29%	0.56%	1.23%

Implications:

- All LGAs have a **lower weekly household income** than the State median. However, this is offset by a lower cost of living in the study area regarding median house price and median rent.
- **Rental prices have increased substantially between 2018 and 2023 in the LGAs of Upper Hunter Shire and Mid-Western Regional**. Rental prices have also increased in Muswellbrook LGA, but this growth is more consistent with the NSW average.

Sources: (DCJ Statistics, 2022; Real Estate Investor, 2023; Real Estate Investor, 2023; Real Estate Investor, 2023).

Table 2.6 Key Townships Housing Overview

	Upper Hunter Shire LGA		Mid-Western Regional LGA			Muswellbrook LGA			NSW
Town	**Merriwa**	**Scone**	**Mudgee**	**Gulgong**	**Wollar**	**Kandos**	**Muswellbrook**	**Denman**	
Median weekly household income	$1,208	$1,507	$1,678	$1,371	$1,875	$677	$1,628	$1,427	$1,829
Proportion of low-income households in housing stress	37.9%	39.5%	42.8%	51.2%	N/A	70.1%	40.4%	42.2%	52.8%
Median house price	$371,250	$568,000	$703,500	$559,250	N/A	$360,000	$465,000	$420,000	$895,000
House price increase between 2018 and 2023	$121,250 (35%)	$200,000 (36%)	$308,500 (78%)	$264,250 (89.5%)	N/A	$170,000 (89.5%)	$165,000 (35.4%)	$120,000 (28.5%)	$230,000 (36.1%)
Median weekly rental price	$350	$500	$540	$460	N/A	$350	$450	$450	$600
Rental vacancy rates	0.67%	0.52%	2.61%	0.48%	NA	0.78%	0.68%	0.45%	1.23%
Rental price increase 2018 and 2023 (%)	$100+ (40%)	$170+ (51.5%)	$165+ (44%)	$140+ (43.7%)	N/A	$120+ (52.1%)	$110+ (32.3%)	$90+ (25%)	$120+ (25%)

Implications:

- **Median weekly incomes are below the NSW median**.
- All townships with available data have reported **a significantly high increase in median house prices between 2018 and 2023**. The highest increases were reported in the townships of Kandos, Gulgong and Mudgee.
- Apart from the township of Mudgee, **rental vacancy rates remain very low.** The lowest rental vacancy was evident in Denman (0.45%) and the highest was evident in Mudgee (2.61%). Low rental vacancy rates indicate that there are limited rental properties available for incoming workforces.

Sources: (ABS, 2021; ABS, 2021; ABS, 2021; Real Estate Investor, 2023; Real Estate Investor, 2023; Real Estate Investor, 2023).

2.4 Community Facilities and Services

The workforce associated with the Project is most likely to access services and facilities in Merriwa (the town likely to host the largest number of workers), followed by Mudgee (the closet primary order town) and Muswellbrook (a larger town within 75 minutes of the Project and a larger town along the transport route from Newcastle).

Upper Hunter Shire is a base for 13 primary and secondary schools and a TAFE Campus. Key services include an airport, two hospitals and associated allied specialist and health services. Upper Hunter Shire also has a variety of entertainment and cultural facilities. Merriwa hosts a multi-purpose service medical centre and a surgery employing two general practitioners (GP).

Mid-Western Regional LGA provides a series of higher-order services, including 11 primary and secondary schools and a TAFE. Services and population in the Mid-Western Regional LGA are concentrated in the town of Mudgee. Mudgee provides multiple allied specialist and health services, an airport and is connected to Sydney via daily train and bus services.

The Muswellbrook LGA also hosts a number of key services. This includes eight primary and secondary schools, public transport to Sydney, a TAFE campus and one hospital. Services are concentrated in the town of Muswellbrook.

Analysis conducted for EnergyCo on the Central West Orana Renewable Energy Zone, and echoed in the 2022 to 2025 Western Primary Health Network Needs Assessment (Primary Health Network Western NSW, 2022), has identified substantial gaps in health services in the region, with marked shortages in GPs, specialist medical practitioners and hospital beds, particularly in the Upper Hunter LGA (EnergyCo, 2022).

Table 2.7 provides a further overview of the facilities and services currently available in the social locality, services identified through local government webpages and community support directories.

Table 2.7 Community Facilities and Services

	Upper Hunter Shire LGA	Mid-Western Regional LGA	Muswellbrook LGA
Health services, including surgeries, hospitals and multi-purpose centres	• Scott Memorial Hospital • Murrurundi Hospital • Merriwa Multi-Purpose Service • Merriwa Surgery.	• Mudgee Health service • Gulgong Multi-Purpose Service • Kandos Medical Health Practice • Mudgee Medical Centre.	• Muswellbrook Hospital • Ungooroo Outreach Clinic • Hunter Medical Practice • Muswellbrook Doctors • Brook Medical Centre.
Educational options	• 13 primary and secondary schools across the LGA • TAFE campus.	• 11 primary and secondary schools • TAFE campus • Country University Centre (Under Construction).	• 8 primary schools and secondary schools • TAFE Campus.

	Upper Hunter Shire LGA	Mid-Western Regional LGA	Muswellbrook LGA
Key Transport Infrastructure	• Scone Memorial Airport • Aberdeen is the last stop on the CityLink and gets direct train services from Newcastle daily, buses running between Scone, Aberdeen, Muswellbrook and Denman.	• Mudgee Airport • Daily train and bus services from Sydney.	• Daily train services to Sydney, Armidale, and Newcastle.
Employment Service	• Joblink Plus, APM, Workskill.	• Sureway Employment and Training, Skillset, APM, Verto.	• APM, Harvey Recruitment, Joblink Plus.
Cultural and Entertainment Facilities	• 2 art galleries, 5 museums, 5 library branches, 3 swimming pools	• 2 art galleries, 5 museums, 4 library branches, swimming pool	• 2 art galleries, 1 swimming pool, 1 golf club, 1 cinema and 2 library branches.
Housing Services	• Upper Hunter Homeless Support & Upper Hunter Community Services are both located outside of the LGA in Muswellbrook.	• Mudgee Department of Communities & Justice (DCJ) Office • Housing Plus.	• Upper Hunter Homeless Support • Upper Hunter Community Services.
Police Stations	• Scone • Merriwa • Murrundi • Moonan Flt • Cassilis.	• Dunedoo • Kandos • Mudgee • Gulgong • Rylestone.	• Muswellbrook • Denman.

Source: (Mid-Western Regional Council, 2023; Upper Hunter Shire Council, 2023; Muswellbrook Shire Council, 2023).

2.5 Regional Economic Context

The Upper Hunter Regional Plan 2041 outlines the goals and actions for the Upper Hunter Region to achieve a sustainable future (NSW Department of Planning and Environment, 2022). The plan applies to 10 local government areas including the Upper Hunter and Muswellbrook Shires. The Plan establishes the following objectives with relevance to the AES:

- Diversify the Hunter's mining, energy and industrial capacity.
- Ensure economic self-determination for Aboriginal communities.
- Create a 15-minute region made up of mixed, multi-modal, inclusive and vibrant local community.
- Plan for "Nimble neighbourhoods", diverse housing and sequenced development.
- Plan for business and services at the heart of healthy, prosperous and innovative communities.

- Build an inter-connected and globally focused Hunter. The economy is expected to further diversify and cater to demand for renewable energy.
- Increased infrastructure assets and skilled workforce to support more renewable energy generation.

The Upper Hunter is recognised as undergoing a transition with major transformation occurring in power generation and emerging technologies. The existing high voltage transmission lines and transport infrastructure mean the Hunter plays an important role in powering NSW.

Table 2.8 provides an overview of the key trends and characteristics of both regional economies and highlights relevant LGA-level insights. Data reveals that employment in Mid-Western Regional and Muswellbrook LGAs is predominately focused on the mining sector, with significant regional strengths in this sector. In contrast, Upper Hunter Shire LGA is highly reliant on agriculture, forestry and fishing. Across all LGAs, there is a large proportion of workforce employed as technicians and trades workers, suggesting higher likelihood that locals will have appropriate skill sets to support construction of the Project.

Table 2.8 Regional Economy Overview

	Upper Hunter Shire LGA	Mid-Western Regional LGA	Muswellbrook LGA	NSW
Unemployment rate	4.9%	4%	5.1%	4.9%
Top 5 industries of employment	Agriculture, Forestry and Fishing: (22.9%) Health Care and Social Assistance: (10.6%) Education and Training-: (9.8%) Manufacturing: (8.3%) Retail Trade: (8.0%)	Mining: (15%) Health Care and Social Assistance: (11.1%) Retail Trade: (9.2%) Construction: 8.3% Education and Training/ Accommodation and Food Service: (7.9%)	Mining: (21.5%) Health Care and Social Assistance: (9.0%) Retail Trade: (9.0%) Agriculture, Forestry and Fishing: (7.1%) Accommodation and Food Services: (6.8%)	Hospitals (except psychiatric hospitals) - 4.2% Supermarket and Grocery Stores – 2.5% Other Social assistance Services – 2.45 Computer System design and related Services – 2.3% Aged Care Residential Services – 2.2%
Top 5 occupation types	Technicians and trades workers: 1152 (17%) Labourers: 1136 (16.7%) Managers: 1037 (15.3%) Machinery operators and drivers: 892 (13.1%) Professionals: 825 (12.2%)	Technicians and trades workers: 1998 (17.5%) Professionals: 1607 (14.1%) Managers: 1591 (13.9%) Machinery operators and drivers: 1473 (12.9%) Labourers: 1298 (11.4%)	Technicians and trades workers:(19.4%) Machinery operators and drivers: (18%) Labourers: (13.8%) Community and personal service workers: (10.3%) Professional: (10.1%)	Professionals: 952,131 (25.8%) Managers: 536,820 (14.6%) Clerical and administrative workers: 480,612 (13.0%) Technicians and trades workers: 436,589 (11.9%) Community and personal service workers: 390,779 (10.6%)
Labour force participation rate	60.5%	57.8%	60.1%	58.7%

Sources: (ABS, 2021; ABS, 2021; ABS, 2021; Department of Jobs and Skills Asutralia, 2023)

2.6 Cumulative Impacts

Cumulative impacts may occur if construction periods of nearby major projects overlap with the construction period of the current development and consequently may present significant challenges in relation to access to housing, accommodation, and social infrastructure. In contrast, overlapping projects create opportunities to build a pipeline of projects that encourage skilled workers (and their families) to move/relocate to the area, either permanently or in the medium-term, given project continuity.

Table 2.10 outlines the State Significant Developments (SSDs) in the Central-West Orana Renewable Energy Zone and whether their construction timeframes are likely to overlap with the Project's construction timeframe. Note that timeframes for construction have been identified through a review of publicly available information on the DPE's Major Projects Portal (Department of Planning and Environment, 2023). It is possible, and indeed likely, that many of these timeframes will be delayed, and unlikely that they will commence ahead of the proposed dates.

When assessing likelihood of cumulative impact, the assessment considers distance between projects, anticipated size of project workforces, distances to larger-order townships likely to provide the majority of accommodation, employment and service contributions and anticipated construction timelines. Cumulative impact is anticipated even for projects up to 100 km from each other given the scarcity of larger townships in the social locality to meet higher-order health, retail, accommodation, supply chain and service needs of projects and workforces. The impacts are colour coded according to **Table 2.9**.

Table 2.9 Cumulative Impact Colour Scheme Meaning

Colour	Meaning
	No/unlikely cumulative impact
	Possible cumulative impact
	Likely cumulative impact
	Highly likely cumulative impact

Table 2.10 Cumulative Impact of Proximal Developments

State Significant Development	LGA	Description	Indicative Construction Timeline (where available)	Location and Distance from the Project	Approximate Workforce Numbers	Cumulative Impact
Request for SEARs yet to be submitted						
Piambong Wind Farm	Mid-Western Regional LGA	550 MW wind farm.	Construction to commence in 2026 (tentative)	Piambong (100 km)	400 jobs during construction and 15 jobs during operation.	Construction timeframes may overlap later in the Project's construction phase. Cumulative impact on housing and accommodation is **unlikely** given distance between projects and differences in development phases.
SEARS						
Beryl Battery Energy Storage System SSD-61460977	Mid-Western Regional LGA	Development of a 100 MW / 200 MWh battery energy storage facility with associated infrastructure.	Construction to commence in 2025 (tentative)	Holleys Lane, Gulgong (80 km)	40 FTE during construction.	Construction timeframes may overlap later in the Project's construction phase. Cumulative impact on housing and accommodation is **possible** given distance between projects and differences in development phases.
Prepare EIS						
Sandy Creek Solar Farm SSD-41287735	Warrumbungle Shire LGA & Dubbo Regional LGA	Development of a 700 MW solar farm and relevant infrastructure.	Construction to commence in late 2025 or early 2026	Dapper Rd, Dunedoo (100 km) Located within CWO REZ	270 workers during construction, but this could increase to a peak of 350 over a 28-month period.	Construction timeframes may overlap later in the Project's construction phase. Cumulative impact on housing and employment is **possible** given distance between projects and differences in development phases.

State Significant Development	LGA	Description	Indicative Construction Timeline (where available)	Location and Distance from the Project	Approximate Workforce Numbers	Cumulative Impact
Cobbora Solar Farm SSD-29491142	Warrumbungle Shire LGA & Dubbo LGA	Development of a 700 MW solar farm with energy storage and relevant infrastructure.	2025–2028 (tentative)	Spring Ridge Road, Cobbora (100 km) Located within CWO REZ	Peak construction workforce of 700.	Construction timeframes may overlap throughout the Project's construction phase. Cumulative impact on housing, employment and access to services is **possible** given distance between projects and differences in development phases.
Barneys Reef Wind Farm SSD-24106966	Mid-Western Regional LGA	350 MW wind farm, up to 63 wind turbines.	2025–2027	Castlereagh Highway, 16 km north of Gulgong (50 km) Located within CWO REZ	340 jobs during the construction phase and approximately 10 jobs during the operational phase.	Construction timeframes may overlap later in the Project's construction phase. Cumulative impact on housing, employment and access to services is **likely** given proximity of projects.
Orana Wind Farm SSD-58260958	Warrumbungle Shire LGA & Mid-Western Regional LGA	Construction and operation of a wind farm with up to 92 wind turbines, battery storage and associated infrastructure.	2025–2027	Dunedoo (124 km) Located within CWO REZ	580 construction workers and 12 FTE operational staff.	Construction timeframes may overlap later in the Project's construction phase. Cumulative impact on housing, employment and access to services is **possible** given distance between projects and differences in development phases.
Merriwa Solar Farm SSD-30913035	Upper Hunter Shire LGA	Development of a 550 MW solar farm and a BESS.	Construction to be completed in 2027	Merriwa (30 km)	500 jobs during construction.	Construction timeframes may overlap later in the Project's construction phase. Cumulative impact on housing, employment and access to services is **likely** given proximity between projects. However, indicative timing suggests that Goulburn River Solar Farm peak construction will likely be completed before Merriwa Solar Farm commences, reducing the scale of impact.

State Significant Development	LGA	Description	Indicative Construction Timeline (where available)	Location and Distance from the Project	Approximate Workforce Numbers	Cumulative Impact
Dapper Solar Farm SSD-52217961	Warrumbungle Shire LGA	Development of a 300 MW solar farm and associated infrastructure.	2025–2026	Sandy Creek, Cobbora (110 km) Located within CWO REZ	250 FTE during construction, with 350 during peak construction.	Construction timeframes may overlap later in the Project's construction phase. Cumulative impact on housing, employment and access to services is **possible** given distance between projects and differences in development phases.
Exhibition						
Bellambi Heights Solar Farm SSD-33344237	Mid-Western Regional LGA	Originally a 200 MW Solar Farm (one stage), 200 MW Battery (built in 2x 100 MW stages), connecting to existing 330 kV transmission line. Revised in 2023 to remove the solar farm and only retain the BESS.	2025–2026	Castlereagh Highway and Puggoon Road, Beryl (54 km)	Employment generation would include approximately 70–100 people for battery per stage.	Construction timeframes may overlap later in the Project's construction phase. Cumulative impact on housing, employment and access to services is **likely** given proximity between projects and overlapping development phases.
CWO REZ Transmission Infrastructure SSI-48323210	-	Development of new twin double circuit 500 kV transmission lines between Wollar and the proposed substations at Merotherie and Elong Elong, and connections from these lines to renewable energy generation and storage projects in the CWO REZ.	2024–2027	25 km	Peak workforce of 650, with a construction period of 36 months.	Construction timeframes may overlap throughout the Project's construction phase. Cumulative impact on employment and access to services is **highly likely** given proximity between projects and differences in development phases. Impacts to housing are mitigated by plans for a temporary workforce accommodation camp.

State Significant Development	LGA	Description	Indicative Construction Timeline (where available)	Location and Distance from the Project	Approximate Workforce Numbers	Cumulative Impact
Response to Submissions						
Wellington South Battery Energy Storage Facility SSD-27014706	Dubbo Regional LGA	Development of a 500 MW and 1000 MWH BESS.	2024	Goolma Rd, Wuuluman (140 km)	100 construction workers and 2 workers during operation.	Construction timeframes may overlap earlier in the Project's construction phase. Cumulative impact on housing, employment and access to services is **unlikely** given distance between projects.
Spicers Creek Wind Farm SSD-41134610	Warrumbungle Shire LGA & Dubbo Regional LGA	Development of up to 117 wind turbines.	2025–2028	Sweeneys Lane, Elong Elong (80 km) Located within CWO REZ	Up to 300 construction jobs.	Construction timeframes may overlap throughout the Project's construction phase. Cumulative impact on housing, employment and access to services is **possible** given distance between projects.
Dubbo Gas Energy Storage System (Dubbo Firming Power Station) SSD-28088034	Dubbo Regional LGA	60 MW gas fired power station, hydrogen generation plant and 2.5 km and 500 m gas pipelines.	2024–2025	Yarrandale Rd, Dubbo (185 km)	Not Available.	Construction timeframes may overlap earlier in the Project's construction phase. Cumulative impact on housing, employment and access to services is **unlikely** given distance between projects.
Moolarben OC3 Extension Project SSD-33083358	Mid-Western Regional LGA	Extension of open cut mining at OC3 to the south.	Construction to be completed in 2025	Ulan Rd, Ulan (48 km)	Not Available.	Construction timeframes may overlap earlier in the Project's construction phase. Cumulative impact on housing, employment and access to services is **likely** given distance between projects.

State Significant Development	LGA	Description	Indicative Construction Timeline (where available)	Location and Distance from the Project	Approximate Workforce Numbers	Cumulative Impact
Orana BESS SSD-45242780	Dubbo Regional LGA	Development of a 400 MW / 1600 MWh battery energy storage system and associated infrastructure and connection works.	2024	Goolma Road, Montefiores (140 km)	100–150 jobs during construction.	Construction timeframes may overlap earlier in the Project's construction phase. Cumulative impact on housing, employment and access to services is **unlikely** given distance between projects.
Valley of the Winds Wind Farm SSD-10461	Warrumbungle Shire LGA	800 MW wind farm, up to 175 wind turbines.	2025–2027	Coolah (57 km) Located within CWO REZ	400 peak construction workforce.	Construction timeframes may overlap later in the Project's construction phase. Cumulative impact on housing, employment and access to services is **likely** given distance between projects and overlapping construction time frames.
Tallawang Solar Farm SSD-23700028	Mid-Western Regional Council	Development of a 500 MW solar farm with 200 MW battery energy storage system and associated infrastructure.	2025–2027	Puggoon Rd (50 km) Located within CWO REZ	380 full time equivalent (FTE) jobs during construction (with a peak of 420), and 10 FTE jobs during operation.	Construction timeframes may overlap later in the Project's construction phase. Cumulative impact on housing, employment and access to services is **likely** given distance between projects and overlapping construction timeframes.
Birriwa Solar Farm SSD-29508870	Mid-Western Regional LGA	600 MW solar farm with 1000 MW BESS.	2025–2027	Barneys Reef Rd, Birriwa (60 km) Located within CWO REZ	Peak construction workforce of 800. 20 full time equivalent jobs throughout operations, 28-month construction period.	Construction timeframes may overlap throughout in the Project's construction phase. Cumulative impact on housing, employment and access to services is **likely** given distance between projects and overlapping timeframes.

State Significant Development	LGA	Description	Indicative Construction Timeline (where available)	Location and Distance from the Project	Approximate Workforce Numbers	Cumulative Impact
Assessment						
Bowmans Creek Wind Farm SSD-10315	Muswellbrook LGA, Singleton LGA & Upper Hunter Shire LGA	Construction and operation of a wind farm with up to 60 wind turbines and associated infrastructure.	Commencing 2024 (tentative)	Bowmans Creek (96 km)	150 peak construction workforce.	Construction timeframes may overlap earlier in the Project's construction phase. Cumulative impact on housing, employment and access to services is **possible** given distance between projects and differences in development phases.
Hills of Gold Wind Farm SSD-9679	Tamworth Regional LGA, Upper Hunter Shire LGA & Liverpool Plains LGA	Up to 65 wind turbines with a maximum capacity of 420 MW.	2024–2026	Morrisons Gap Rd, Hanging Rock (101 km)	Up to 272 jobs during construction and up to 34 operational jobs.	Construction timeframes may overlap earlier in the Project's construction phase. Cumulative impact on housing, employment and access to services is **unlikely** given distance between projects.
Determination						
Dubbo Quarry Continuation Project SSD-10417	Dubbo Regional LGA	Expansion of existing hard rock quarry into two new areas.	N/A	Sheraton Rd, Dubbo (180 km)	12 equivalent FTE, with a peak of 14.	Cumulative impact **unlikely** due to location and low workforce numbers.
Maryvale Solar Farm SSD-8777	Dubbo Regional LGA	Development of a 125 MW solar farm and relevant infrastructure	2024	Maryvale Rd, Maryvale (150 km)	Approximately 100 workers during construction.	Cumulative impact **unlikely** due to distance and construction timing.
Dubbo Project (formerly known as the Dubbo Zirconia Mine) SSD-5251	Dubbo Regional LGA	Mining of ore to produce Zirconia and Niobium products.	2022–2024	Toongi Rd, Toongi (190 km)		Cumulative impact **unlikely** due to distance and construction timing.

State Significant Development	LGA	Description	Indicative Construction Timeline (where available)	Location and Distance from the Project	Approximate Workforce Numbers	Cumulative Impact
Apsley Battery Energy Storage System SSD-35160796	Dubbo Regional LGA	Development of a 120 MW / 240 MWh battery energy storage facility with associated infrastructure.	2024	Mitchell Highway, Apsley (150 km)	50 jobs during peak construction, with 5 FTE staff during operation with the potential for up to 50 casual positions.	Cumulative impact **unlikely** due to distance, construction timing and low workforce numbers.
Wellington North Solar Farm SSD-8895	Dubbo Regional LGA	Development of a 300 MW solar farm and associated infrastructure.	2022–2024	Goolma Rd, Wellington (100 km)	250 peak construction workforce.	Cumulative impact **unlikely** due to distance and construction timing.
Wollar Solar Farm SSD-9254	Mid-Western Regional LGA	290 MW solar farm.	2024	Mudgee (22 km)	Construction workforce of up to 300 over a two-year period.	Construction timeframes may overlap throughout the Project's construction phase. Cumulative impact on housing, employment and access to services is **highly likely** given proximity between projects.
Uungula Wind Farm SSD-6687	Dubbo Regional LGA	Development of up to 97 wind turbines with energy storage and relevant infrastructure.	2024–2025	Uungula (120 km)	250 direct and 400 indirect full time equivalent positions over the construction period. Once operational, there would be 12 direct and 35 indirect jobs. Construction expected to take approx. 30 months.	Cumulative impact unlikely due to distance between projects.

State Significant Development	LGA	Description	Indicative Construction Timeline (where available)	Location and Distance from the Project	Approximate Workforce Numbers	Cumulative Impact
Dunedoo Solar Farm SSD-8847	Warrumbungle Shire LGA	Development of a 55 MW solar farm with energy storage.	2024	Allweather Road, Dunedoo (70 km)	100–125 Peak workforce, with a 10–12 month construction period. Up to three FTE staff during operation.	Construction timeframes may overlap earlier in the Project's construction phase. Cumulative impact on housing, employment and access to services is **possible (though limited)** given small workforce.
Stubbo Solar Farm SSD-10452	Mid-Western Regional LGA	400 MW solar farm with energy storage.	2025–2026	Blue Springs Rd, Stubbo (48 km) Located within CWO REZ	Employment generation would include approximately 400 people during construction over 2 years.	Construction timeframes may overlap throughout the Project's construction phase. Cumulative impact on housing, employment and access to services is **likely** given distance between projects.
Bowdens Silver Mine SSD-5765	Mid-Western Regional LGA	Development of an open cut silver mine and associated infrastructure.	2024–2026	Maloneys Rd, Lue (100 km)	Construction workforce up to 246 on-site workers and 74 off-site, and between 192–228 workers over 15 years of operations. Peak workforce of 320. Construction timeframe of 18 months.	Construction timeframes may overlap throughout the Project's construction phase. Cumulative impact on housing, employment and access to services is **possible (though limited)** given distance between projects.

State Significant Development	LGA	Description	Indicative Construction Timeline (where available)	Location and Distance from the Project	Approximate Workforce Numbers	Cumulative Impact
Liverpool Range Wind Farm SSD-6696	Warrumbungle Shire LGA, Upper Hunter Shire LGA & Mid-Western Regional LGA	Up to 1,000 MW wind farm with up to 267 wind turbines.	2025–2027	Coolah (55 km) Located within CWO REZ	Up to 800 construction workers and 47 roles during operations. 550 peak workforce, approx. 24–36 months for construction.	Construction timeframes may overlap throughout the Project's construction phase. Cumulative impact on housing, employment and access to services is **likely** given distance between projects.
Operational						
Suntop Solar Farm SSD-8696	Dubbo Regional LGA	Development of a 170 MW solar farm.	N/A	Suntop Rd, Suntop (161 km)	N/A.	No, project is operational.
Dubbo Hospital Redevelopment Stage 1/2 SSD-5250	Dubbo Regional LGA	Dubbo Base Hospital Redevelopment Stage 1 and 2.	N/A	Myall Street, Dubbo (180 km)	Not Available.	No, construction is complete.
Dubbo Base Hospital Redevelopment Stage 3/4 SSD-7720	Dubbo Regional LGA	Construction and operation of Dubbo Base Hospital Redevelopment Stage 3 and 4.	N/A	Myall Street, Dubbo (180 km)	Not Available.	No, construction is complete.
Beryl Solar Farm SSD-8183	Mid-Western Regional LGA	109 MW solar farm	N/A	Beryl (50 km)	N/A.	No, project is operational.
Kyoto Wind Farm MP06_0055	Muswellbrook Shire LGA & Upper Hunter Shire LGA	A 200 MWh wind farm.	N/A	Middlebrook and Mountainview Stations, Scone (62 km)	N/A.	No, project is operational.

State Significant Development	LGA	Description	Indicative Construction Timeline (where available)	Location and Distance from the Project	Approximate Workforce Numbers	Cumulative Impact
Bodangora Wind Farm MP10_0157	Dubbo Regional LGA	A 113 MW operational wind farm.	N/A	Gillinghall Rd, Bondangora (130 km)	N/A.	No, project is operational.
Ulan Coal Complex, Moolarben Coal Complex and Wilpinjong Mine	Mid-Western Regional LGA	Open cut and underground mine, operational with approval until 2033.	N/A	29 km	Production of up to 20 MT if run-of-mine coal per annum, with a peak workforce of 931.	Cumulative impacts **possible** given distance between projects and existence of an operational workforce.
Cobbora Coal Mine MP10_0001	Warrumbungle Shire LGA, Mid-Western Regional LGA & Wellington LGA	Operational Coal Mine.	N/A	Cobbora (140 km)	N/A.	No, project is operational.
Wellington Solar Farm SSD-8573	Dubbo Regional LGA	A 174 MW solar farm and associated infrastructure.	N/A	Goolma Rd, Wellington (100 km)	N/A.	No, project is operational.

Source: (Department of Planning and Environment, 2023).

2.6.1 Impact of Local Events

As the Hunter Valley is a popular tourism destination, there may also be competition for accommodation during peak tourism periods or during key events or festivals, when local accommodation may experience high occupancy rates.

These periods include the Christmas and Easter holiday periods, school holiday periods, the autumn harvest period of March to May (which coincides with the Hunter Valley Harvest Festival), as well as during popular local events such as the Festival of the Fleeces in Merriwa in June, the Merriwa Springtime Show in September, and wider events such as the Hunter Valley Wine and Beer Festival around June. The Hunter Valley region is also a popular location for music festivals and concerts through the year. Although individual events may be located in specific towns distant to the Project, visitors to the region for these events may choose to travel through and visit other towns in the Project's host or neighbouring LGAs, and patronise local accommodation providers.

LSbp could help mitigate accommodation impacts by actively avoiding occupying rooms in local accommodation providers during peak periods.

3.0 Key Stakeholder Engagement

To support the preparation of the AES, targeted engagement has been undertaken between 5 October and 2 November 2023 with the following stakeholder groups. This engagement has been in addition to other community and government agency consultation undertaken to inform and support the preparation of the Response to Submissions and Amendment Report.

Table 3.1 Stakeholder Engagement to Inform the AES

Stakeholder Name	Location	Engagement Mechanism	Key Themes/Findings	Timing in 2023
Accommodation Providers				
Local developer (name redacted)	Upper Hunter Shire LGA	MS Teams Meeting	• The project aims to build a 500-room workers camp in Merriwa using recycled shipping containers, which will accommodate the staff of renewable energy projects in the area. The camp will offer various facilities and benefits for the workers and the local community, and will have potential long-term uses for tourism, aged care, housing, or relocation.	9 October 2023
The Golden Fleece Motor Inn	Upper Hunter Shire LGA	In person discussion	• The hotel owner is willing to host the project workers, but has limited availability due to high demand from various customers. The hotel has 17 rooms and a high occupancy rate of 95%, and faces challenges in expanding and staffing.	11 October 2023
The Royal Hotel Cassilis	Upper Hunter Shire LGA	In person meeting	• The pub owner is keen to cater for the project, as it will boost their business. They offer dinner and lunch on selected days, and have 15 rooms available for accommodation. They are planning to expand and could provide more rooms and cabins if they have a formal agreement with LSbp.	12 October 2023
Merriwa RSL	Upper Hunter Shire LGA	In person meeting	• The RSL is exploring the option of adding up to 25 modular units in its backyard to accommodate the project workers. They are in talks with a modular dwelling company.	12 October 2023
RM Property	Upper Hunter Shire LGA	In person meeting	• The rental manager has a high occupancy rate of 98% for their rentals and Airbnb's in the area, which vary depending on the season and the demand. They suggest that the project should use a hybrid approach of different accommodation options to share the economic benefit with the local community.	13 October 2023

Stakeholder Name	Location	Engagement Mechanism	Key Themes/Findings	Timing in 2023
Merriwa Motor Inn	Upper Hunter Shire LGA	In person discussion	• The Motor Inn has 14 rooms available for the project workers at a discounted rate.	13 October 2023
The Property Shop Mudgee	Mid-Western Regional LGA	Phone call	• The owner highlighted the challenge of finding accommodation for the project workers in Mudgee and surrounds, due to the low availability of housing stock and the negative community perception of previous solar farm workers. Also noted the lesson learnt from mining companies who made a deal with local council to build cabins and guarantee their occupancy, however, the shared community memory of mining affects the town's tourism and property market.	5 October 2023
Sandy Hollow Tourist Park	Upper Hunter Shire LGA	In person discussion	• The tourist park can currently offer 25 rooms (including cabins, hotel rooms, and a house), but have plans to expand their capacity up to 40 rooms for the project workers with additional cabins.	13 October 2023
Ellamara Giants Creek	Upper Hunter Shire LGA	In person discussion	• Expressed capacity to book out up to 17 beds (requires room sharing with king singles) with the capacity to build up to 12 more rooms.	13 October 2023
Grapevine Motel – Denman	Muswellbrook Shire LGA	In person meeting	• Would consider booking out 10–12 rooms at a time to the project, however, currently has 98% occupancy rate. Explained that they would not book out entire venue to solar farm workers, as they want to continue relationship with regulars.	13 October 2023
Brightlands Living	Muswellbrook Shire LGA	MS Teams Meeting	• Discussed existing development in planning in Muswellbrook, including 450 lots of long-term housing with the capacity to house the Project workforce.	17 October 2023
Employment Providers				
Blackrock Industries	Muswellbrook Shire LGA	In person meeting	• Discussed opportunities to place local workers, apprentices, and prisoner-program participants on the project. Also discussed the opportunity to partner with Brightlands Living in their accommodation.	12 October 2023

Stakeholder Name	Location	Engagement Mechanism	Key Themes/Findings	Timing in 2023
			• Blackrock Industries described how participants from their successful prisoner program found work in the local mining industry, and how these learnings could be transferred to this Project. Blackrock Industries also described their ability to engage local people into the Project's construction workforce, including opportunities for trainee and apprenticeships for people who identify as Indigenous. Blackrock Industries assumes they would be able to provide at least 30 local workers for the construction of the Project, being a mix of prisoner program participants, labouring roles, and some trainees.	
Programmed	Muswellbrook Shire LGA	Phone call	• Would be interested in working with LSbp to help provide local (Merriwa, Muswellbrook and Singleton) skilled labour, but also a campaign targeting Year 12 students, labouring roles and farming workers who could do flexible shifts. • Programmed indicated their interest in working with LSbp, as they would be able to provide skilled local workers from Merriwa, Muswellbrook, and Singleton to work on the Project. They indicated they could implement a campaign targeting various cohorts such as students in year 12, labouring roles, and farm workers with the flexibility to do other part-time work. Considering the competitive industries in the region, and what Programmed have been able to provide for other Projects in the area, Programmed indicated there is a key opportunity for the Project in terms of employing local workforce, should LSbp provide traineeships and/or apprenticeships for local people.	19 October 2023
Local Government				
Upper Hunter Shire Council	Upper Hunter Shire LGA	In person meeting	• Discussed social impacts of population growth in Merriwa. Raised concerns about the proposed design of the accommodation campsite.	12 October 2023
		MS Teams Meeting	• Discussed the proposed accommodation campsite, and where it was up to in the development process. • Discussed the Project's response to the incoming workforce impact to medical services in the area. Explained the conversation with the local health provider, and LSbp shared their Telehealth offering to all incoming workforce. LSbp provided an update on the AES process.	8 November 2023

Stakeholder Name	Location	Engagement Mechanism	Key Themes/Findings	Timing in 2023
Muswellbrook Shire Council	Muswellbrook Shire LGA	In person meeting	• Expressed desire to see renewable energy proponents support transition programs to help those working in mining to move to renewable energy, acknowledging there aren't many operational roles. Expressed preference for long-term housing and options that encouraged people to remain in the community, not Drive-in-Drive-Out (DIDO).	12 October 2023
Mid-Western Regional Council	Mid-Western Regional LGA	MS Teams Meeting	• Expressed satisfaction with the Project AES plan to avoid use of temporary accommodation in Mid-Western Region.	19 October 2023
Industry / Community Groups				
Merriwa Chamber of Commerce	Upper Hunter Shire LGA	In person meeting	• The Chamber of Commerce invited LSbp to attend a meeting to present the project and the accommodation plans to the local businesses. They expressed a positive attitude towards the project and its economic benefits, and suggested that LSbp should collaborate with TAFE and schools to promote the industry to young people.	13 October 2023
Merriwa – Cassilis Alliance	Upper Hunter Shire LGA	Phone call	• Advertising to all the smaller business owners and Airbnb hosts is important, as they may be looking at building additional accommodation. Great opportunities for local people.	5 October 2023
Gulgong Chamber of Commerce	Mid-Western Regional LGA	Phone call	• Lack of available accommodation in Gulgong currently.	5 October 2023
Health Provider				
Merriwa Surgery	Upper Hunter Shire LGA	In person discussion	• Indicated there were sufficient health services in Merriwa at present, especially if workers were encouraged to seek non-urgent care in their home communities while being triaged through the Multi-Purpose Centre for emergency care.	13 October 2023

Source: Umwelt, 2023.

4.0 Accommodation Framework

4.1 Accommodation Framework Scope

This Accommodation Framework aims to provide evidence-based recommendations to manage the social opportunities and impacts associated with housing the temporary construction workforces required for the Project.

4.2 Accommodation Profile – Review of Options

In developing the framework and profile, the following accommodation types have been considered:

- **Existing short-term accommodation** – this includes self-catering houses and units (typically listed on short stay services such as Airbnb and HomeAway), motels, hotels and camping/caravan parks (most suitable would-be cabin style facilities), with the availability of properties influenced by a strong visitor economy.
- **Emerging short-term accommodation** – this includes new short-term accommodation (as defined above) that is likely to become available in time for Project construction timelines. This new housing has been identified through stakeholder engagement with local accommodation providers currently planning to expand their offerings in response to anticipated future demand.
- **Longer term accommodation** – this includes rental properties available in the social locality. The availability of these properties is influenced by the supply and future development of housing options in the target area.
- **Custom-built temporary accommodation** – this includes purpose-built worker's sites designed to meet the needs of a single project or multiple proximal projects.

4.2.1 Existing Short-term Accommodation

This section considers levels of availability of this accommodation type, based on the following assumptions and limitations:

- Short-term accommodation stock:
    - For the purposes of this study, an 'entire place' on Airbnb has been counted as two beds, despite there likely being opportunity to fit more than one person in a home and multiple workers sharing a rental being a common practice in the industry. Similarly, each room listed in short-term accommodation has been counted as space for one person, despite some rooms including more than one bed. These are conservative estimates and reflect a 'worst case scenario' in relation to accommodation availability.
    - For the purposes of this analysis, all short-term accommodation has been considered as 'able to be occupied' by incoming work forces. However, it is likely that certain accommodation types, e.g., cottages or luxury retreats are unlikely to be utilised by the incoming workforce. This assumption is therefore less conservative.

- Short-term accommodation occupancy:
    - Data derived from AirDNA (2023) identified that across the three LGAs the average occupancy rate ranged between 51% and 61.6% (see **Figure 4.1**). The highest occupancy rate was recorded in Muswellbrook LGA (61.6%). Although this data is based on Airbnb occupancy only, it is assumed that this is indicative of occupancy and demand trends for short-term accommodation in general.
    - Between January 2022 and April 2023, occupancy rates in Upper Hunter Shire and Mid-Western Regional LGAs Airbnb peaked in April 2022 at 66.7% and 71.9%. Occupancy rates peaked in May 2022 for Muswellbrook LGA, which recorded an occupancy rate of 79.9%.
    - This framework uses a conservative estimate of 80% occupancy rates across Airbnb and hotel and motel accommodation, thus assuming that 20% of total stock is available to incoming workforces.
    - This framework acknowledges the cumulative impact of multiple construction projects competing for access to remaining short-term accommodation. It therefore aims to access 20% of the available short-term accommodation. This approach also accounts for the presence of accommodation in the room count that is not 'appropriate' for the workforce.
    - Following discussions with Mid-Western Regional Council, it has been determined that short-term accommodation providers within Mid-Western Regional LGA will not be considered as available to the Project. Subsequently, while data is presented for Mid-Western Regional LGA in **Table 4.1** and **Table 4.2**, they are not considered in the final room availability figures.

Table 4.1 below provides an overview of short-term accommodation availability across the Upper Hunter, Mid-Western Regional, and Muswellbrook LGAs, while **Table 4.2** provides an overview of Airbnb availability for the same LGAs.

As mentioned, assessment of room occupancy rates is based on a conservative estimate of 80% occupancy rates across Airbnb and hotel and motel accommodation, and final availability is based on the assumption that 20% of available stock is available to the incoming Project workforce.

Table 4.1 Short Term Accommodation Availability

LGA	Town	No. of short-term accommodation providers	Total no. of short-term accommodation rooms	Number of rooms available at 80% occupancy rate	Number of rooms available to the Project (20% of rooms available)
Upper Hunter Shire LGA	Merriwa	3	36	7	1
	Scone	10	46	9	2
Mid-Western Regional LGA[5]	Mudgee	94	1,033	361	0
	Gulgong	5	53	18	0
	Wollar	0	0	0	0
	Kandos	1	4	0	0
Muswellbrook LGA	Muswellbrook	2	124	25	5
	Denman	0	0	0	0
Total		**115**	**1,296**	**451**	**8**

Source: (Accommodation Tourism Data Warehouse, 2023).

[5] Following discussions with Mid-Western Regional Council, it has been determined that short-term accommodation providers within Mid-Western Regional LGA will not be considered as available to the Project.

Table 4.2 Airbnb Rooms Available as of May 2023

LGA	Number of Listings	Number of rooms	Number of Rooms available at 80% Occupancy Rate	Number of Rooms available to the Project (20%)
Muswellbrook LGA	24	48	10	2
Upper Hunter Shire LGA	46	92	18	4
Mid-Western Regional LGA[6]	621	1,242	0	0
Total	**691**	**1,382**	**42**	**6**

Source: (AirDNA, 2023).

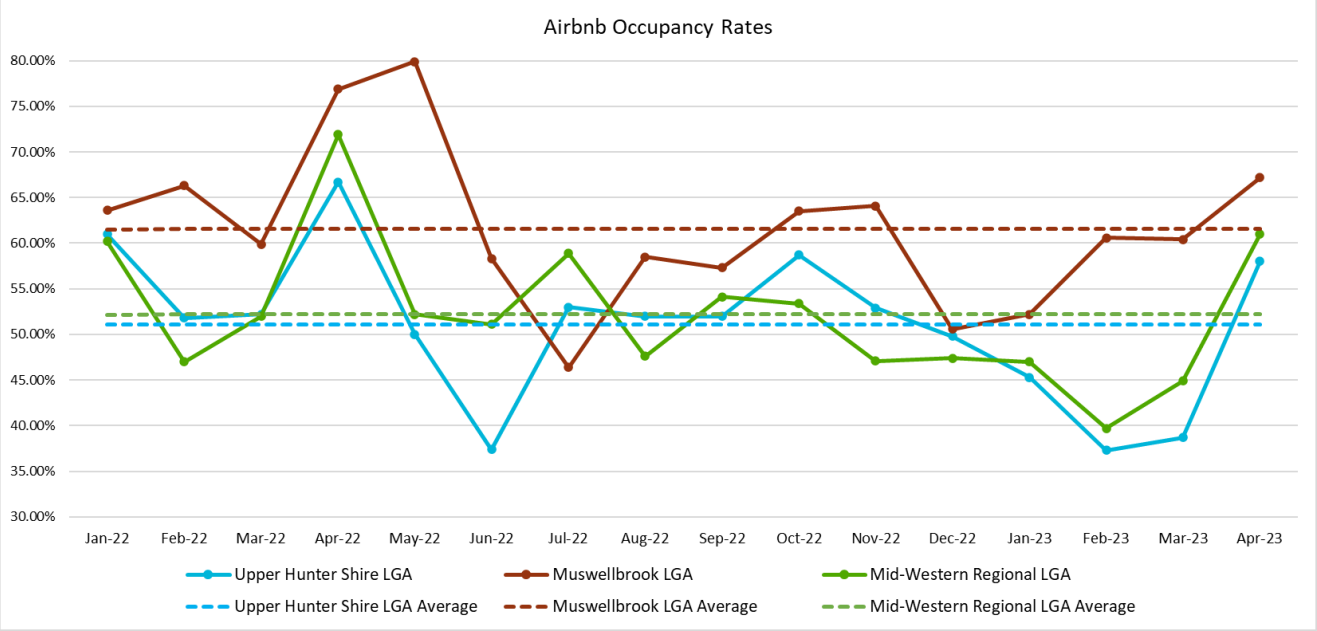

Figure 4.1 Airbnb Occupancy Rates

Source: (AirDNA, 2023).

Based on the above analysis and assumptions made, the accommodation framework anticipates that approximately 14 workers may be housed in existing proximal short-term accommodation without causing significant impact to the existing tourism sector and other short-term accommodation users within the social locality.

4.2.2 Emerging short-term accommodation

Based on engagement conducted for this AES (summarised in **Section 3.0**), there is evidence that many existing accommodation and service providers in the region are considering expanding or establishing accommodation offerings to meet anticipated future demand, as outlined in **Table 4.3** below.

[6] Following discussions with Mid-Western Regional Council, it has been determined that short-term accommodation providers within Mid-Western Regional LGA will not be considered as available to the Project.

Table 4.3 Accommodation Providers With Potential Future Expansion

Options	Current Number of Beds	Potential Expansion	Benefits
The Golden Fleece Motor Inn	25	Up to 10 beds	Within 30 min drive of the project. Walking distance to services in Merriwa town.
The Royal Hotel Cassilis	15	Between 15 to 25 beds	Within 30 min drive of the project. Have indicated willingness to expand to 25 beds.
Merriwa RSL	0	Potentially 25 beds	Within 30 min drive of the project. Walking distance to services in Merriwa town.
RM Property	2	Approximately 15 beds	Within 1 hour drive of the Project.
Merriwa Motor Inn	14	14 beds	Within 30 min drive of the project. Walking distance to services in Merriwa town.
Sandy Hollow Tourist Park	25	Up to 40 beds	Within 30–45 min drive of the project. Existing food and transport facilities for workers.
Ellamara Giants Creek	0	Approximately 15 beds	Within 45 min drive from the Project. Self-contained facilities.
Brightlands Living – Muswellbrook	0	450 beds (proposed), however, distance from the Project is likely to be prohibitive	Within 90 min drive from the Project.

Source: Umwelt, 2023.

It is likely a proportion of these providers will follow through with plans to expand their accommodation offerings, especially if Lightsource bp commits to renting a proportion of beds during the Project's construction period. This AES conservatively considers **up to 40 additional beds are likely to become available to the Project** through local expansion projects.

4.2.3 Longer Term Rental Accommodation

The information presented in this section regarding rental availability is based on desktop reviews undertaken in September 2023. There is currently low rental availability in the key townships surrounding the Project area (refer to **Table 4.4**).

Table 4.4 Rental Accommodation Availability as of September 2023

Township	Rental Population	Vacancy Rate	Rental Stock Available	Stock Available to the Project (up to 5%)
Merriwa	24.1%	0.67%	7	0
Scone	27.5%	0.52%	14	1
Mudgee	30.7%	2.29%	124	0

Township	Rental Population	Vacancy Rate	Rental Stock Available	Stock Available to the Project (up to 5%)
Gulgong	23.3%	0.56%	7	0
Wollar	23.8%	N/A	0	0
Kandos	23.5%	1.43%	11	0
Muswellbrook	34.8%	0.78%	46	2
Denman	21.6%	0.45%	4	0
Total (excluding NSW)			**213**	**3**

Source: (Real Estate Investor, 2023).

With respect to houses available for rent and their contributions to this accommodation framework:

- It is assumed that approximately three workers per rented house may be housed in each rental property as house-sharing is common across rosters and most homes in the area are three or four bedrooms.
- It is recommended that Lightsource bp avoid accessing more than 5% of available rental homes in any locality to avoid displacing lower income households or increasing rental prices.
- Therefore, a **maximum of 3 homes, housing approximately 9 workers**, are likely to be available to the Project construction workforce.

4.2.4 Temporary Workforce Accommodation Facility

On-site accommodation that utilises temporary or demountable accommodation is not yet commonly used in the surrounding areas, although stakeholder engagement and EIS documentation from proximal projects suggests this is changing. While the region has a history of some temporary workforce facilities designed to house mining and infrastructure construction workforces, there are currently no temporary workforce accommodation facilities with the capacity to house workforces associated with the Project.

However as of November 2023, Lightsource bp has signed a Memorandum of Understanding (MOU) with a local developer who are proposing the development of 500 fully furnished, self-contained ensuite units within the township of Merriwa. Lightsource bp has an option in place to rent up to 300 rooms during the construction period of the Project, with potential to increase the number of rooms if required. The commencement of this facility is being coordinated between the two parties to align with the ramp up of workforce numbers onsite at Goulburn River.

4.2.5 Accommodation Overview Summary

Table 4.5 provides an overview of accommodation availability and likely distribution based on the accommodation profiling conducted for the Project. It reflects accommodation composition at a peak workforce of 350, with accommodation composition changing over the course of construction to reflect fluctuations in on-site workforce. Accommodation modelling has been based on conservative estimates and assumes all proposed proximal projects will proceed and at the times indicated in their EIS or website documentation. Access to accommodation may differ depending on changing timelines and local conditions and is likely to be higher than the figures modelled in the following table.

As shown in **Table 4.5** (and explained in **Section 5.2.1**), it is predicted that approximately 35 workers are likely to live locally and remain in their own homes. Further, approximately 14 rooms of existing short-term accommodation and 40 rooms of new short-term accommodation are likely to be available to construction workforce during peak construction, without materially infringing on short-term accommodation access for other users. Additionally, up to three rental homes are likely to be available to construction workforce. The remaining workers during the peak construction phase will need to be housed in the Temporary Workforce Accommodation Facility (TWA Facility) described in **Section 4.2.4**.

Table 4.5 Accommodation Option Breakdown at Peak Workforce

Accommodation Components (assumes peak workforce of 350)	Number of Workers housed	Housing Form
Local Workforce	Approximately 35	Existing homes
Existing short-term accommodation	14	14 rooms
New short-term accommodation	40	40 rooms
Rental Accommodation	9	3 rented homes
Subtotal available beds	**Up to 100**	
Custom-built Temporary Workforce Accommodation Facility	Up to 300[7]	Temporary Workforce Accommodation Facility
Total available beds	**Up to 400**	

Source: Umwelt, 2023.

4.3 Objectives/ Intended Social Outcomes

The key objectives of the accommodation framework for the Project are to:

- Maximise use of a temporary workforce accommodation facility to meet workforce needs in a location near to construction activities.
- Ensure accommodation is accompanied by sufficient recreational opportunities and health services to avoid negative impacts on existing communities.
- Prioritise sustainable use of local accommodation a maximum of 75 minutes-drive or 100 km from the development.
- Reduce or avoid upward pressure on housing prices, rental costs and demand that may result from development activities.
- Prioritise procurement and employment of local business and workers to reduce impact on housing demand.

These objectives inform the proposed actions and mitigation strategies in the following section.

[7] Note that Lightsource bp currently has a MOU in place with the Merriwa TWA Facility developer to lease 250 rooms during Project construction. There is potential to expand this number should additional rooms be required.

4.4 Accommodation Actions and Mitigation Strategies

The actions in **Table 4.6** are proposed to prioritise the use of local accommodation options for the Project planning and construction phase of the development.

Table 4.6 Accommodation – Implementation Actions and Objectives

Aspect	Mitigation/Management Objective	Development Phase				Responsible Party			Implementation Actions
		Early Works Construction	Main Works Construction	Operations and Maintenance	Decommissioning	Lightsource bp	EPC Contractor	All staff	
Short-term accommodation availability	Avoid placing unsustainable pressure on existing short-term and tourism accommodation and 'crowding out' other visitors.	X	X			X	X		Ensure sufficient access to a TWA Facility to avoid unsustainable pressure on existing short-term accommodation and rental accommodation in the social locality. See **Section 4.2.1** for justification.
	Avoid placing unsustainable pressure on existing short-term and tourism accommodation and 'crowding out' other visitors.	X	X			X	X		Work with local accommodation providers to provide advanced notice of accommodation requirements and anticipate timing of key tourism events.
									Engage with local stakeholders including local councils and accommodation providers to communicate upcoming accommodation and housing demand and to monitor, pre-empt and address accommodation issues as they arise. This includes planning to avoid times of peak demand due to local events and activities.
Workforce population impacts	Avoid placing unsustainable pressure on existing health systems due to workforce population influx.		X			X			Ensure provision of a telehealth service for construction workforce is delivered for all workers associated with Project construction.
Rental accommodation availability	Avoid placing inflationary pressures on rental prices or displacing other residents of the social locality by competing for limited rental housing.		X			X	X	X	Ensure sufficient access to a TWA Facility to avoid unsustainable pressure on existing short-term accommodation and rental accommodation in the social locality. See **Section 4.2.3** for justification.
Local workforce	Maximise local procurement and employment opportunities to reduce the need for accommodating a non-local workforce.	X	X	X	X	X	X		Follow the actions identified in the employment framework (See **Table 5.4**).
New accommodation availability	Encourage the development or expansion of existing accommodation providers where appropriate.	X	X			X	X		Consider partnering with or funding existing local accommodation providers to expand their accommodation capacity. See **Table 4.3** for a list of providers currently considering expansion.
Traffic management and workforce fatigue management	Reduce individual workforce traffic impacts and reduce worker fatigue and road safety risk.	X	X			X	X	X	Provide shuttle buses from key short-term accommodation locations to and from the Project Site. Prioritise social procurement from local companies or social enterprises for shuttle services.
Temporary workforce accommodation facility	Meet the accommodation and catering needs of a temporary workforce while reducing impacts on existing residents and communities.	X	X			X	X		Prioritise use of a new temporary workforce facility to minimise negative social and environmental impacts.

5.0 Employment and Procurement Framework

5.1 Employment and Procurement Framework Scope

The purpose of this local employment and procurement framework is to provide evidence-based recommendations to manage the local employment and procurement opportunities associated with the Project.

An effective local employment and procurement strategy ensures that local entities have full, fair and reasonable opportunity to bid for the supply of key goods or services for the Project. Therefore, outcomes of an effective local employment and procurement strategy will ideally include:

- Creation of training and employment opportunities through procurement processes, clauses and specifications in contracts. It is important to note that these opportunities may lag and trainees may not have the opportunity to benefit from the Project but will have the opportunity to benefit from future projects.
- Directly targeting harder-to-reach or more vulnerable and marginalised groups when creating employment and procurement opportunities.
- Encouragement of local economic development and growth.
- Engagement of local small-to-medium enterprises (SMEs) and social benefit suppliers, providing them with the same opportunities as other larger businesses, including the ability to engage in procurement processes.

5.2 Employment Profile - Employment and Procurement Context

The Project will generate an anticipated peak of around 350 FTE direct construction jobs, with an average of 250 FTE direct jobs from mid-2024 to 2026 (refer to **Figure 1.1** for employment histogram). Employment is likely to extend through local supply chains to fuel supply, vehicle servicing, uniform suppliers, hotels/motels, B&Bs, cafés, pubs, catering and cleaning companies, tradespersons, tool and equipment suppliers and many other businesses through Project multiplier effects.

Almost 75% of jobs in renewable energy over the next 15 years are likely to be available for labourers, trades and technicians and professionals (Briggs, Rutovitz, Dominish, & Nagrath, 2020). **Figure 5.1** illustrates the diverse range of jobs and skill sets that renewable projects require and shows the percentage breakdown of different roles on a typical solar farm project (for example, 11% of solar farm roles are for electrical trade assistants, and around 4.1% are for administrative workers).

As shown in **Figure 5.1**, electrical trade and technicians (18%), electrical trade assistants (11%) and solar roofers/ installers (9.8%) will be the largest number of jobs created.

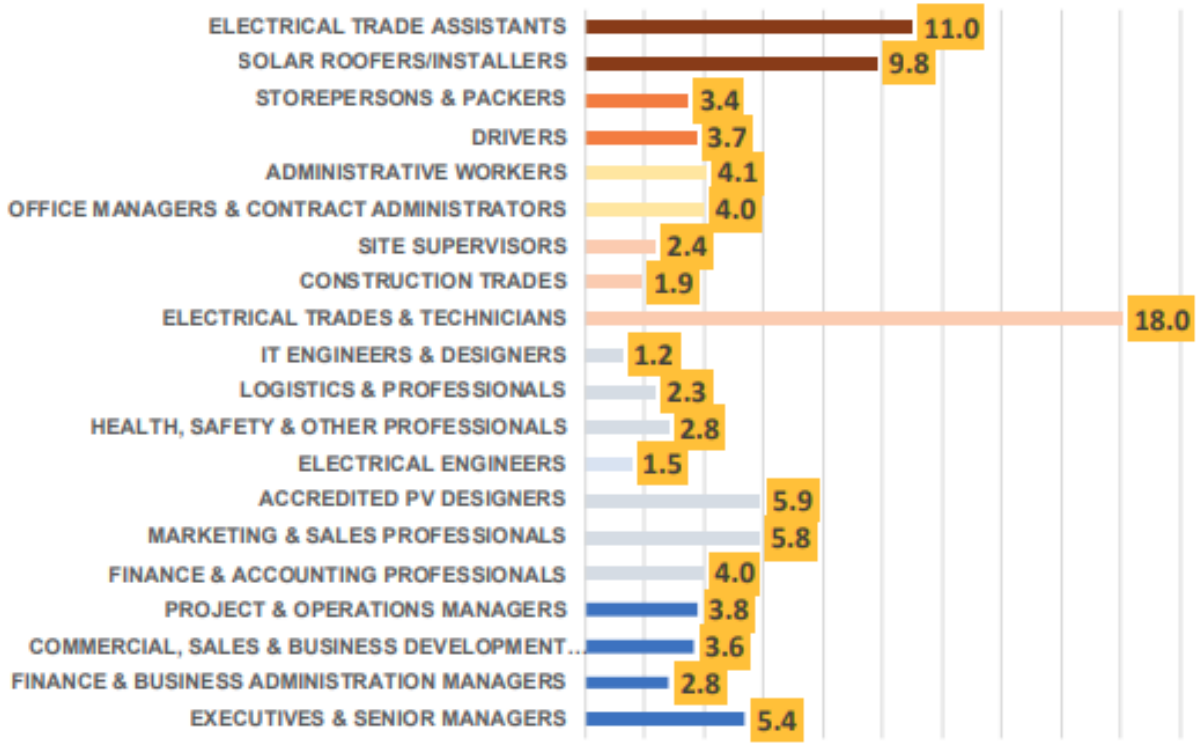

Figure 5.1 Key Occupations for Solar Farms

Source: (Briggs, Rutovitz, Dominish, & Nagrath, 2020).

5.2.1 Employment Profile and Opportunity Across the Social Locality

This section of the AES considers the existing employment profile of the social locality and assesses the degree to which jobs associated with the Project are likely to be filled by local residents. Analysis focuses on local workers employed in the construction sector or employed as trade workers and technicians, as existing research suggests these sectors and roles are most likely to benefit from jobs in renewable energy construction (Doyle, 2014). It also considers those who are currently unemployed and seeking work in the social locality, as another key potential source of workforce.

The AES tests three potential scenarios of local employment opportunities during peak construction (see **Table 5.1**), testing the likelihood of 5%, 10% or 15% of total peak workforce being derived from workers residing in the social locality.

Table 5.1 Local Employment Scenarios at Peak Construction

Local Employment Scenarios	Scenario One (5% of peak workforce)	Scenario Two (10% of peak workforce)	Scenario Three (15% of peak workforce)
Number of local people who could be employed	18	35	53

Source: Umwelt, 2023.

As **Table 5.2** shows, across Mid-Western Regional, Upper Hunter Shire and Muswellbrook LGAs there are a total of 32,696 people employed in any industry, 4,066 people employed as trade workers and technicians and 1,952 people employed in construction.

Table 5.2 Employment by Industry and Job Type Summary

	Mid-Western Regional LGA	Upper Hunter Shire LGA	Muswellbrook LGA	Total
Total Employed Workforce	11,231	6,651	14,814	32,696
Workforce Employed in Construction	942	478	505	1,952
Workforce Employed as Trade Workers and Technicians	1,998	1,152	1,466	4,066

Source: (ABS, 2021).

Considering those in the labour force who are currently unemployed, there are a total of 1,088 unemployed people across the three LGAs who are looking for either full-time or part-time work (see **Table 5.3**).

Table 5.3 Labour Force Status for the Social Locality

	Mid-Western Regional LGA	Upper Hunter Shire LGA	Muswellbrook LGA	Total
Unemployed, looking for full-time work	282	136	234	**652**
Unemployed, looking for part-time work	187	89	160	**436**
Total	**469**	**225**	**394**	**1,088**

Source: (ABS, 2021).

The estimated 18, 35 or 53 local workers represent 0.4%, 0.9% or 1.3% of all workers employed as trades workers and technicians, 0.9%, 1.8% or 2.7% of all those working in the construction industries or 1.7%, 3.2% or 4.9% of all unemployed people in the social localities[8].

Based on an assessment of cumulative proximal projects, stakeholder engagement and desktop analysis of local employment conditions, a 10% local employment proportion (or 35 local workers) is considered most likely. This is also the figure assumed for the preceding accommodation assessment (see **Section 4.2.5**).

5.2.2 Procurement Opportunities Across the Social Locality

The capacity for local businesses to benefit from procurement opportunities depends on both the internal processes, priorities and policy of the procuring company and the capacity and connectedness of local companies and organisations and the networks that support them (Esteves, Brereton, Samson, & Barclay, 2010). Additionally, the availability of appropriately skilled employees will need to be accounted for, as multiple projects will likely be under construction at the same time, with similar procurement and workforce needs. This is particularly relevant for the Upper Hunter Shire and Mid-Western Regional LGAs, due to their locations within the CWO REZ and the scale of concurrent renewable energy project predicted for the area.

This section of the report highlights the number of companies in each LGA, by annual turnover. While business size and industry does not directly reflect capacity to supply goods or services to the Project, it provides an overview of local business capacity and helps to inform Project procurement strategies.

[8] These figures do not consider the applicability of the skillsets of unemployed people in the social locality.

Note also that business locations are determined by the location in which the business is registered, which is complicated by businesses which operate in multiple locations. Therefore, the following business counts do not necessarily reflect all business operations within their respective LGA.

5.2.2.1 Upper Hunter Shire LGA

As **Figure 5.2** shows, there are currently 1,838 businesses operating within the Upper Hunter Shire. The majority of these businesses are in the agriculture, forestry and fishing sector and therefore are likely to have limited opportunity to service the Project. Within the LGA, 232 businesses were in the Construction sector, making it the second largest in the LGA. 42 businesses (2.3%) are Manufacturing-based. Around 49% of Construction businesses and 54% of Manufacturers are larger businesses with an annual turnover of over $200,000, providing some opportunity for Lightsource bp to source local contractors from within the LGA.

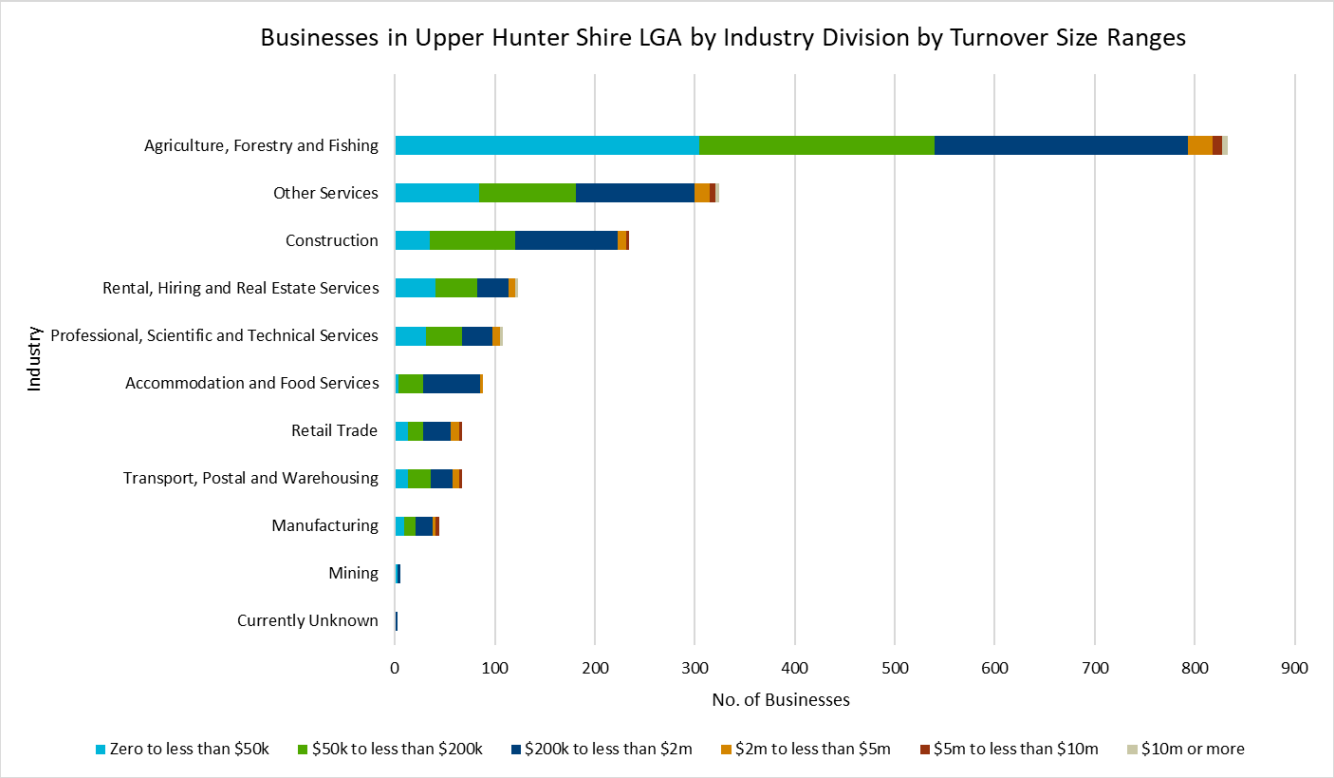

Figure 5.2 Businesses in Upper Hunter Shire LGA by Industry Division by Turnover Size Ranges

Source: (ABS, 2022).

5.2.2.2 Muswellbrook LGA

Figure 5.3 indicates that there are currently 1,067 businesses operating within Muswellbrook LGA. Like Upper Hunter LGA, the largest number of businesses relate to agriculture, forestry and fishing. Of all businesses, 117 were in the Construction sector (11%) and 33 businesses (3.1%) were Manufacturers. Around 46% of Construction businesses and 36% of Manufacturers have an annual turnover of over $200,000, providing some opportunity for Lightsource bp to source local contractors from within the LGA.

Note that Mining is Muswellbrook LGA's largest industry and employer, employing a third of the workforce (REMPLAN, 2023), however is not represented in **Figure 5.3** since virtually all mining businesses are registered outside of the LGA.

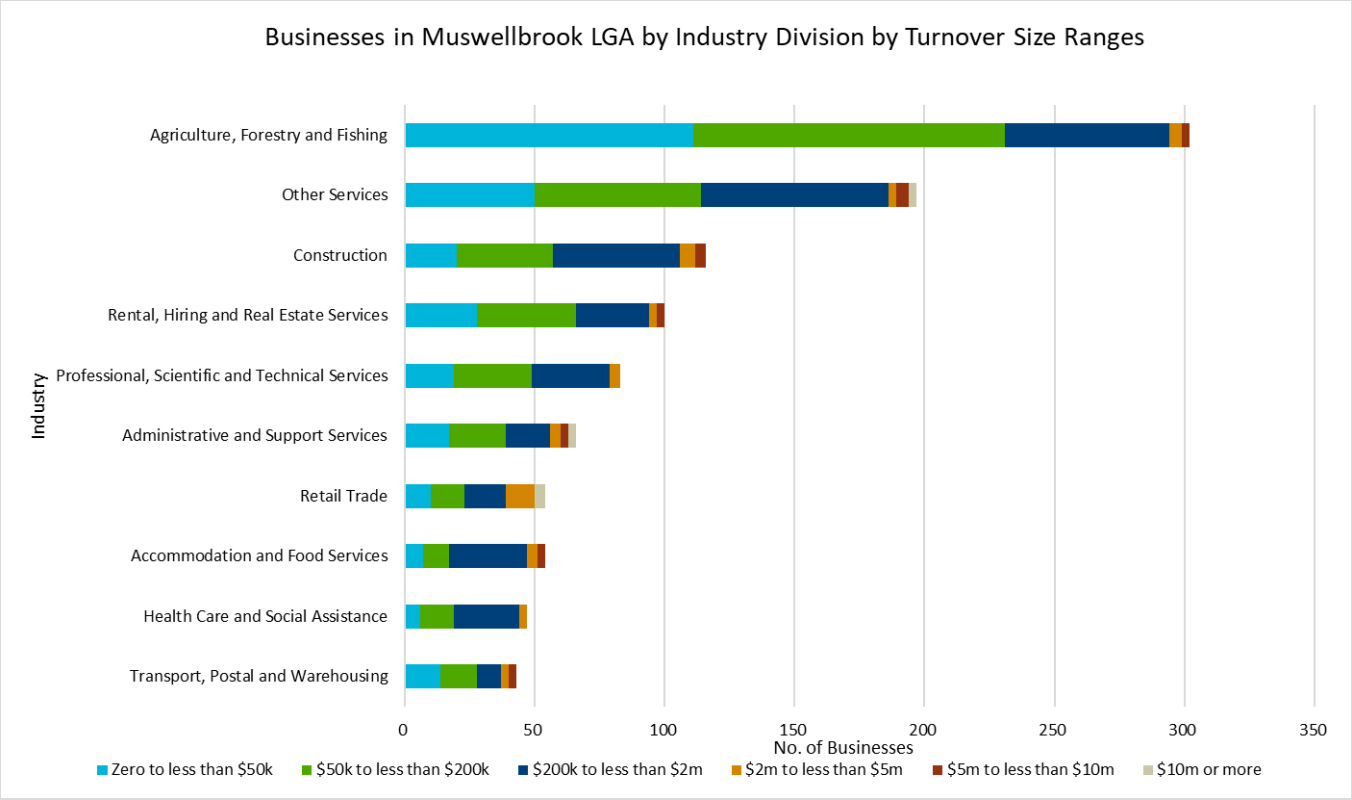

Figure 5.3 Businesses in Muswellbrook LGA by Industry Division by Turnover Size Ranges

Source: (ABS, 2022).

5.2.2.3 Mid-Western Regional LGA

As **Figure 5.4** illustrates, in the Mid-Western Regional LGA, there were 2,856 businesses operating in the LGA with over 42% of these businesses being in the Agricultural, Forestry and Fishing sector. Construction is the second largest industry by number of businesses (433), representing just over 15% all businesses in the LGA. Of these construction businesses, 42% have a turnover size of over $200,000 per year and 6% have a turnover size of over $2,000,000.

Manufacturing in the Mid-Western Regional LGA is the 9th largest industry by turnover size, with 117 businesses. 53% of these businesses have a turnover of over $200,000, while 11% have a turnover of above $2,000,000. As a result, Mid-Western Regional LGA is likely to have a larger capacity to benefit from procurement opportunities associated with the Project than Muswellbrook and Upper Hunter LGAs.

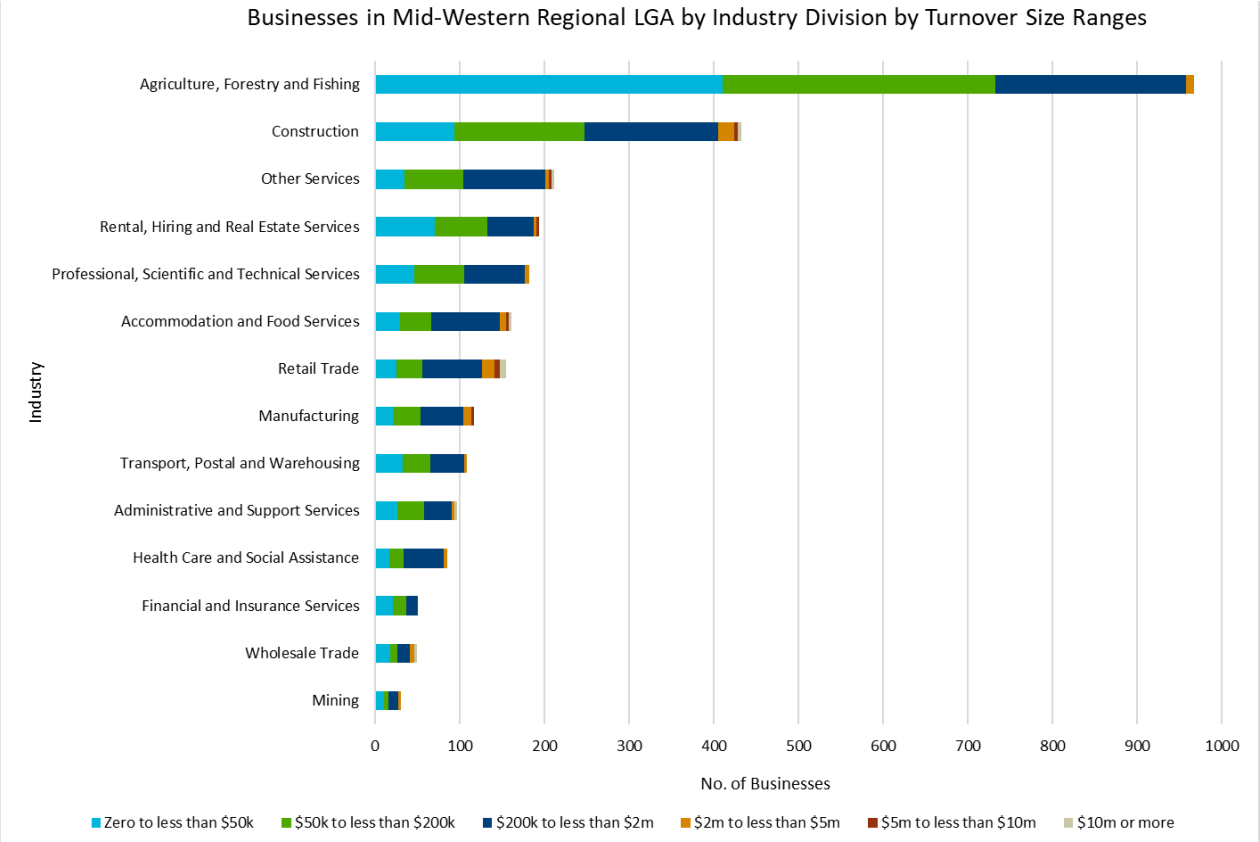

Figure 5.4 Businesses in Mid-Western Regional LGA by Industry Division by Turnover Size Ranges

Source: (ABS, 2022).

5.2.2.4 Local Procurement Summary

An analysis of existing Construction and Manufacturing businesses within the study area indicated that Mid-Western Regional LGA has the largest number of businesses with likely capability to service the Project.

Both Muswellbrook and Upper Hunter Shire LGAs are significantly smaller in terms of population and their Construction and Manufacturing capacity. While Muswellbrook may benefit from strong regional strengths in mining and related industries, Upper Hunter's existing reliance on agriculture may indicate a lower capability to benefit from Project procurement opportunities.

5.3 Objectives/Intended Social Outcomes

All local employment and procurement strategies will build on initiatives already undertaken by the renewable energy sector in enhancing sustainable and strategic procurement practice, thus contributing to building stronger communities and generating wider social benefits.

The key objectives of the employment framework for the Project are to:

- Implement strategies to target a minimum of 35 construction phase workers (representing 10% of the workforce) sourced locally (i.e., from neighbouring LGAs).

- Meet the baseline requirements and implement strategies to support achievement of the stretch goals of Merit Criteria 8 of the AEMO Tender Guidelines for regional economic development. This includes a goal of 40% of supply chain inputs coming from Australia and New Zealand during the development phase, 51% during the operations and maintenance phase and 10% of steel products and components using locally milled steel where doing so does not undermine the viability of the Project as a whole.
- Implement strategies and procurement weightings to maximise the number of sub-contractors and suppliers sourced locally.
- Generate lasting training and skills development opportunities for the region.
- Pro-actively generate opportunities for under-represented communities, including First Nations people, women, and unemployed and under-employed people.
- Transparently communicate employment and procurement opportunities to the local community and provide updates on whether objectives are achieved.
- These objectives inform the proposed actions and mitigation strategies in the following section.

5.4 Employment Actions and Mitigation Strategies

The following actions are proposed to prioritise and support local employment and procurement for the planning and construction phase of the development.

Table 5.4 Employment and Procurement – Implementation Actions and Objectives

Aspect	Mitigation/Management Objective	Project Phase				Responsible Party			Implementation Action for Consideration
		Early Works Construction	Main Works Construction	Operations and Maintenance	Decommissioning	Lightsource bp	EPC Contractor	All staff	
Local employment and procurement	Encourage local employment and procurement.	X	X	X	X		X		Establish, review and maintain a Lightsource bp Goods and Services Register database. Communicate regularly with the database via email updates or other communications method. Ensure the Goods and Services Register relates to ICN Gateway or other industry pathways. Engage with local training providers such as Blackrock Industries and Programmed to explore training and apprenticeship opportunities to maximise local employment.
Local employment and procurement	Build local familiarity and connections with Lightsource bp and the Project requirements.	X	X	X	X	X	X		Utilise Project newsletters, website, and media releases at key milestones throughout the Project development, construction and operation timeline to promote information on how local suppliers may become involved in the project. Attend and host industry forums that target local and regional business sectors to communicate employment and procurement opportunities on the projects, including: • Establish an ICN Gateway pre-construction. • Hold a "Meet the contractor" drop-in session for local businesses to familiarise themselves with the successful EPC contractor. • Schedule early ICN industry briefings in major towns around projects to give an overview of the projects and their resourcing needs. • Provide social procurement information and links to support for SMEs to respond to social procurement requirements. • Link attendees to industry partners that can assist with their tender. • Document events and register Expressions of Interest collected at these events. • Work directly with local stakeholders including the Merriwa Chamber of Commerce, Gulgong Chamber of Commerce, Regional Development Australia, Blackrock Industries, Programmed and local schools and TAFE to co-host local events to advertise employment and procurement opportunities.
Local employment and skills development	Ensure Australian entities have full, fair and reasonable opportunity to bid for the supply of key goods and services.	X	X	X		X			Include a requirement in contracts that procurement entities comply with any binding Australian Industry and Aboriginal Participation Plan (IAPP). Information and support will be offered through a workshop that outlines the AIP requirements, including procurement from local companies.

Aspect	Mitigation/Management Objective	Project Phase				Responsible Party			Implementation Action for Consideration
		Early Works Construction	Main Works Construction	Operations and Maintenance	Decommissioning	Lightsource bp	EPC Contractor	All staff	
Local employment and skills development	Collaborative approach to support pathways into training and regional employment and procurement opportunities.	X	X	X		X	X		Schedule workshops with regionally based local employment agencies to discuss opportunities and develop a collaborative approach to workforce opportunities.
Local procurement	Link local companies and organisations with larger contractors and manufacturers to support local opportunities across the entire supply chain.	X	X	X	X	X	X		Ensure supplier enquiries received via Lightsource bp Goods and Services Register are shared with solar panel manufacturers and major construction companies.
Local employment and skills development	Building local skills capacity.	X	X	X		X			Investigate partnering with local TAFEs and providers such as Blackrock Industries, Programmed and Protech to develop training programs and scholarships directly related to key skills shortages in the region, particularly electrical trades and engineering. Partnering with the Country Education Fund to provide opportunities for students to gain industry experience through work experience, internships, traineeships etc.
Local employment and skills development	Build pathways into the renewable energy sector for school leavers.	X	X			X	X		Work with local schools to establish annual excursions, vocational training partnerships and sponsorship of school awards nights.
Local employment and procurement	Contribute to the development of local supply chain and industry capability	X	X	X	X	X	X		Explore opportunities for investment and innovation in the local supply chain in the NSW renewable energy sector, including innovative responses to R&D related challenges faced by the project. LSbp is currently investigating the development of a renewable energy training centre based in Wellington.
First Nations local employment and skills development	Advertise employment and procurement opportunities broadly, with a particular focus on First Nations businesses and community members.	X	X	X		X	X		Partner with LGAs and organisations (e.g., NSW Indigenous Chamber of Commerce) to identify Certified and Registered Indigenous businesses. Engage with Aboriginal-owned companies to explore Aboriginal employment and training opportunities. Establish and maintain a register of key communication channels, key contacts and mechanisms for engaging with relevant stakeholders and ensure consistent use of these channels throughout construction and operation of the Project. Ensure that all direct recruitment activities, procurement opportunities, workforce and service needs targeting Aboriginal and local community members are visible through multiple channels, including: • LGAs • LALCs • Native Title holders or applicants • Traditional Owner Corporations • Aboriginal employment and health services • Community organisations and agencies that support opportunities for Aboriginal people.

Aspect	Mitigation/Management Objective	Project Phase				Responsible Party			Implementation Action for Consideration
		Early Works Construction	Main Works Construction	Operations and Maintenance	Decommissioning	Lightsource bp	EPC Contractor	All staff	
First Nations local employment and skills development	Increase First Nations participation and employment.	X	X	X		X	X		Partner with LGAs and organisations (e.g., NSW Indigenous Chamber of Commerce) to identify Certified and Registered Indigenous businesses. Establish processes and selection criteria that provide equal opportunity for First Nations employment and procurement. Register with organisation (e.g., Supply Nation) to enable access to their register of Aboriginal businesses. Establish and maintain a register of local and regional Certified and Registered Aboriginal businesses. Embed selection criteria to prioritise sub-contractors that are Certified and Registered Aboriginal businesses, or are owned, managed or staffed by Aboriginal people.
First Nations local employment and skills development	Facilitate pathways for Indigenous job seekers to build required skills and move into available employment opportunities.	X	X			X	X		Work with existing schools and relevant organisations (e.g., the Clontarf Foundation), to develop scholarships and training programs for Indigenous school leavers. Prioritise working with Registered Training Organisations with existing protocols and mechanisms for encouraging Indigenous trainees.
First Nations local employment and skills development	Build in participation targets for First Nations industry and community	X	X	X		X	X		Deliver Industry and Aboriginal Participation Plan (IAPP) that demonstrates commitments towards achieving baseline requirements and stretch goals for First Nations people.

6.0 Conclusion

The AES for the Goulburn River Solar Farm has provided an overview of the baseline economic, social and housing context relevant to the Project. It has identified considerable housing, accommodation, employment and procurement constraints in the social locality, linked to the Project's location. The impact of the Project has also been considered, with additional analysis to assess cumulative impacts of concurrent SSD projects proposed nearby; and has identified existing regional strengths, including regional expertise in mining and construction sectors and access to land with the capacity to host a temporary workforce accommodation facility for workers.

Data has been collected through a combination of desktop analysis of existing databases as well as direct engagement with key stakeholders. This information has been used to inform an evaluation of accommodation and employment options and opportunities.

The AES finds that a 10% local employment option (or 35 workers, assuming a peak workforce of 350 personnel) is most likely. Up to 100 workers may be accommodated in existing accommodation without creating undue strain on the existing local accommodation and housing environment (including the assumed 35 local workers who would be residing in their existing homes). These accommodation options, supplemented by the TWA Facility in Merriwa, will deliver enough accommodation to accommodate the construction workforce associated with the Project.

As detailed in **Section 4.4** and **Section 5.4**, this strategy includes several recommendations to enhance positive social outcomes and mitigate negative social outcomes for the Project. These include:

- Limiting the number of existing short-term accommodation beds accessed to no more than 14 existing short term accommodation beds across the study area on any given night. This is designed to avoid 'crowding out' effects on other accommodation users. This figure could be re-assessed if substantial reductions in local occupancy rates are identified and recorded in the social locality.
- Limit the use of existing rental accommodation as a housing source for the Project by ensuring sufficient access to custom-built temporary workforce accommodation.
- Work with local accommodation providers to provide advanced notice of accommodation requirements and anticipate timing of key tourism events.
- Consider partnering with or funding existing local accommodation providers to expand their accommodation capacity.
- Establish, review and maintain a Lightsource bp Goods and Services Register database and make this available to head contractors to support local procurement.
- Utilise Project newsletters, website and media releases at key milestones throughout the Project development, construction and operation timeline to promote information on how local suppliers may become involved in the project.
- Promote and fund Apprenticeships and Traineeships as a key employment strategy and work with regional employment agencies, Training Services NSW, education providers and Group Training Organisations to develop strategies to enable apprentices to access experience across different infrastructure projects.

This AES has identified substantial opportunities to house the anticipated construction and operational workforces, employ local workers, and procure local goods and services while also maximising social benefits to communities and reducing potential negative impacts. Proactive management and monitoring of outcomes will be achieved through post-approval management strategies and mechanisms, as outlined in this report.

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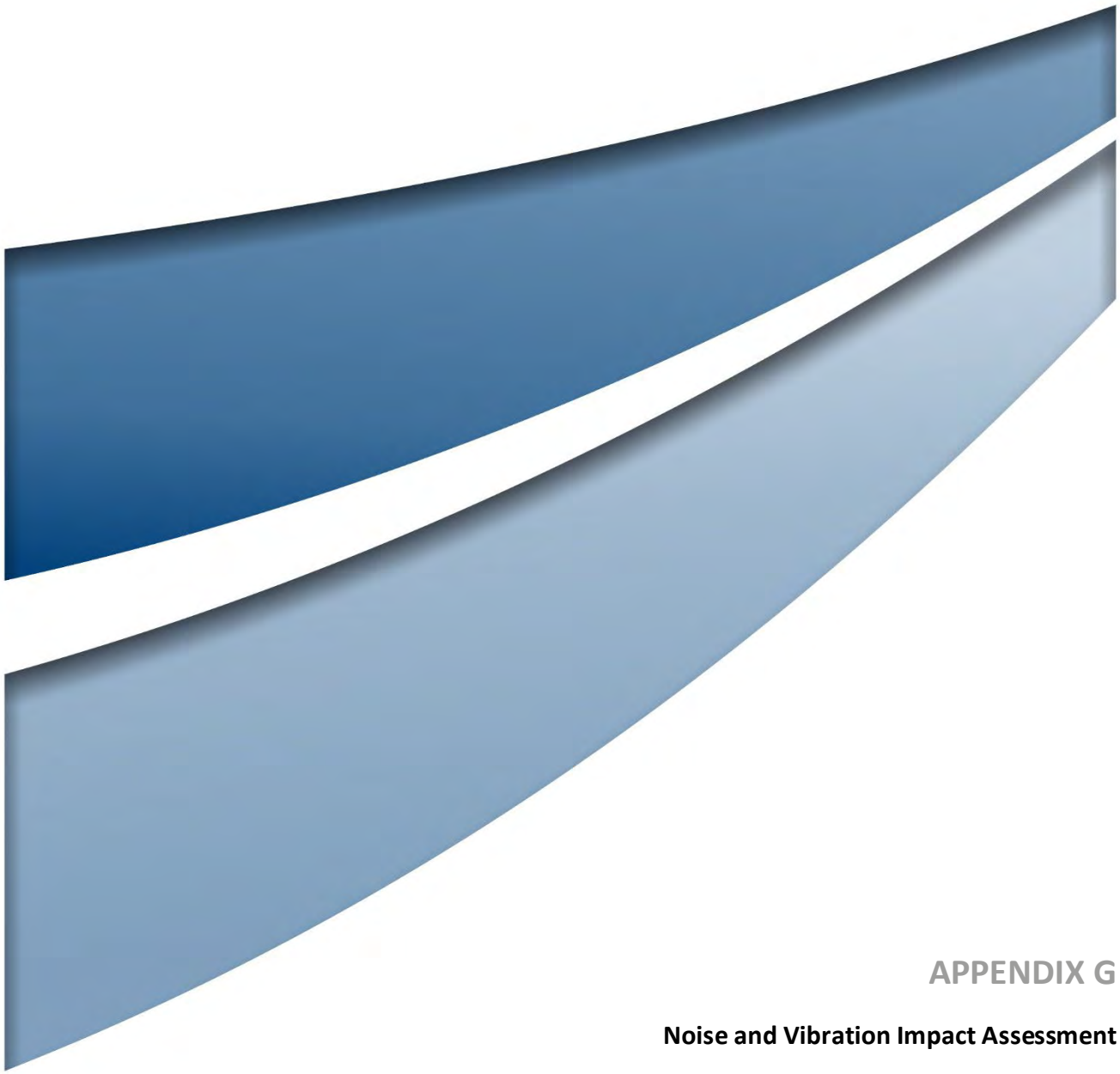

APPENDIX G

Noise and Vibration Impact Assessment

umwelt
Environmental & Social Consultants

lightsource bp

GOULBURN RIVER SOLAR FARM

Noise and Vibration Impact Assessment
Addendum Report

FINAL

December 2023

GOULBURN RIVER SOLAR FARM

Noise and Vibration Impact Assessment Addendum Report

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
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Report No.	23485 / R04
Date:	December 2023

Environmental & Social Consultants

This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Acknowledgement of Country

Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
V0	B Carlyle	30/11/2023	J Henderson-Wilson	30/11/2023
V1	B Carlyle	06/12/2023	J Henderson-Wilson	11/12/2023

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1.0 Introduction

Lightsource bp is proposing to develop the Goulburn River Solar Farm (the Project) to generate solar renewable energy to supply New South Wales (NSW).

The proposed Goulburn River Solar Farm (the Project), as described in the Environmental Impact Statement (EIS) (Umwelt, 2023) includes the construction, operation, maintenance and decommissioning of approximately 550 megawatt peak (MWp) of solar photovoltaic (PV) generation with a Battery Energy Storage System (BESS) with 280 MWp and 570 megawatt hour (MWh) capacity. The Project will also include supporting infrastructure, a substation and connection to an existing 500 kilovolt (kV) transmission line. Parts of Ringwood Road will be upgraded including two culverts at Bow River and Killoe Creek.

A number of amendments to the Project are proposed in response to public and agency submissions received following the public exhibition of the EIS and progression of the detailed design. This Noise and Vibration Impact Assessment addendum report (NVIA Addendum) is supplementary to the previously prepared Umwelt report, *Goulburn River Solar Farm Noise and Vibration Impact Assessment, Final*, dated April 2023 (EIS NVIA 2023).

This report has been prepared to address the amendments to the Project outlined in **Section 2.0**.

2.0 Description of Amendments

The proposed amendments to the Project are summarised below and addressed further in the subsequent sections of this addendum report.

- Transport route amendments, including:
    - A revised transport access/egress route, including the diversion of construction vehicles egress west at the Golden Highway and Ringwood Road intersection to a vehicle turning area on Barnett Street, Merriwa.
    - An upgrade of the intersection of the Golden Highway and Ringwood Road to support these movements.
- Upgrades to an additional 4.7 km section of Wollara Road and 1.6 km of Ringwood Road.
- Increased centralised BESS capacity and the additional option of a decentralised BESS.
- Minor Project layout modifications, including:
    - A re-alignment of the Project Area to avoid Travelling Stock Route (TSR) 44841.
    - Relocation or removal of solar arrays within the Development Footprint to further avoid significant and irreversible impacts (SAII) to important habitat, including Regent Honeyeater habitat and Box Gum Woodland.
    - An increase in the width of two (2) internal access roads which connect the western and northern portions of the site from 6 m (as originally proposed in the Project EIS) to 10 m, to allow for subterranean transmission corridors as part of the internal reticulation network, rather than overhead transmission cables.
    - As a result of these modifications, the development footprint is 792.5 ha (a reduction of 7.07 Ha).
- Construction of an additional transmission tower within the existing easement of the 500 kV transmission line adjacent to the BESS/substation.
- Additional assessment and revised approach for workforce accommodation.

The areas subject to the Amended Project are illustrated in **Figure 2.1**.

This NVIA Addendum addresses:

- Construction noise and vibration associated with the road upgrades,
- Operational noise from the site, and
- Traffic noise from the Barnett Street Vehicle Turning Area (**Figure 5.1**).

The above amendments do not necessitate an amendment to the EIS Solar Farm and BESS Construction and Vibration Assessment contained in Section 5 of the EIS NVIA 2023 or the Traffic Noise Assessment contained in Section 7 of the EIS NVIA 2023.

FIGURE 2.1

Summary of Proposed Amendments

Legend

- Watercourse
- Lot Boundary
- Road Upgrade Extent
- Waterbodies

Proposed Road Upgrades

1. Proposed Amendment - Road Upgrade - Golden Highway / Ringwood Road Intersection
2. Culvert Upgrade - Bow River
3. Culvert Upgrade - Kiloe Creek
4. Road Upgrade - Bow River to Kiloe Creek (1.8km)
5. Proposed Amendment - Road Upgrade - Kiloe Creek to Binks Road (1.6km)
6. Proposed Amendment - Road Sealing - Wollara Road Adjacent Tongo State Forest

0 2.5

Kilometres

Scale: 1:0 at A4
GDA2020 MGA Zone 56

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Image Source: ESRI Basemap (2022) | **Data Source:** NSW DFSI (2022)

3.0 Construction Noise and Vibration Assessment

3.1 Road Upgrades

3.1.1 Description of Works

Road repairs and upgrades are proposed outside of the Project Area as part of the amendments to the Project. The following works are proposed:

- **Work Area 1 – Golden Highway and Ringwood Road Intersection** – Pruning and removal of vegetation and trees, construction of a merge lane, extension of deceleration lane and formalisation of two (2) bus stops either side of Ringwood Road.
- **Work Area 2 – Ringwood Road** – Realignment, widening and sealing of an additional 1.6 km section of Ringwood Road between Killoe Creek and Binks Road.
- **Work Area 3 – Wollara Road** – Realignment, widening and sealing a 4.7 km unpaved section of Wollara Road between the Goulburn River National Park boundary and 1621 Wollara Road.

The location of the works areas are shown in **Figure 3.1**.

3.1.2 Receivers

Residences within approximately 2 km of the work areas have been identified and are shown in **Figure 3.1**. The nearest two (2) receivers to each of the work areas are shown in **Table 3.1**.

Table 3.1 Nearest Residential Receivers

Work Area	Receiver ID	Address / Description	Approximate Distance (m) from works
Work Area 1	R102	5993 Golden Highway, Merriwa	650 m
	R105	5706 Golden Highway, Merriwa	750 m
Work Area 2	R11	549 Ringwood Road, Merriwa	50 m
	R12	990 Ringwood Road, Merriwa	40 m
Work Area 3	R29	1752 Wollara Road, Merriwa	105 m
	R44	1803 Wollara Road, Merriwa	115 m

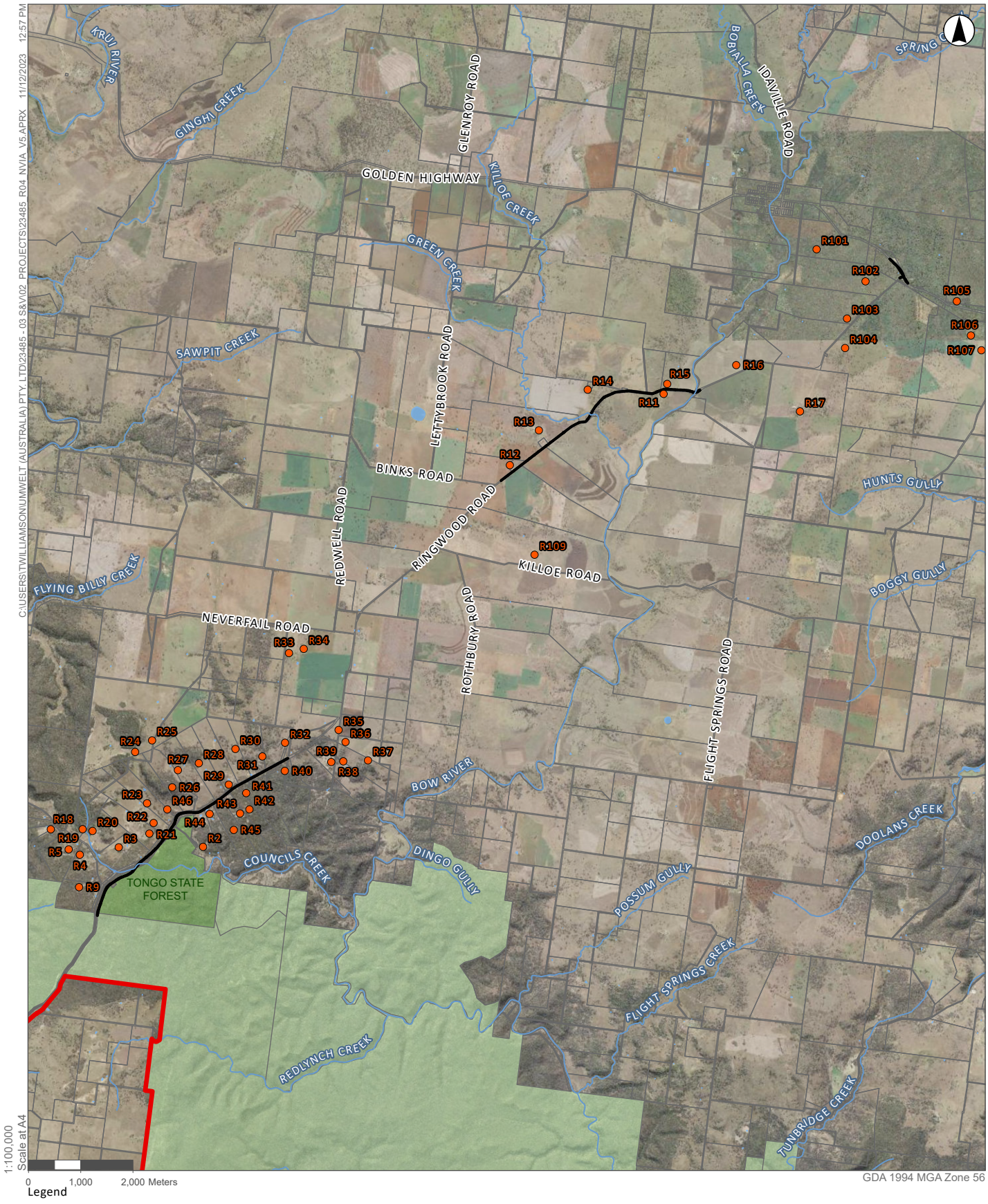


FIGURE 3.1

Work Areas and Sensitive Receivers

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)

3.1.3 Construction Hours and Noise Management Levels

Construction hours for the road upgrades are proposed to be undertaken during standard construction hours specified in the Interim Construction Noise Guideline (ICNG). The proposed construction hours are as follows:

- Monday to Friday: 7.00 am–6.00 pm.
- Saturday: 8.00 am–1.00 pm.
- Sunday and public holidays: No work.

The adopted construction noise management levels for standard construction hours are consistent with the EIS NVIA 2023 and shown within **Table 3.2**.

Table 3.2 Project Construction Noise Management Levels

Receiver	Noise Management Levels (NML), dB(A)			
	Standard hours of Construction [1]		Outside Standard hours of Construction [1]	
	Noise Affected $L_{Aeq(15\ min)}$	Highly Noise Affected $L_{Aeq(15\ min)}$	Noise Affected $L_{Aeq(15\ min)}$	
			Day	Evening & Night
All Residences	45	75	40	35

Note: [1] Recommended standard hours: Monday to Friday 7.00 am–6.00 pm; Saturday 8.00 am–1.00 pm.

3.1.4 Equipment

The typical construction activities (Scenarios 1 to 4) and associated equipment and respective sound power levels (SWLs) of equipment are outlined in **Table 3.3**. Typical sound power levels have been sourced from the Roads and Maritime Construction Noise Estimator Tool and Umwelt's noise source library.

Table 3.3 Indicative Construction Scenarios, Equipment and Sound Power Levels

Construction Stages / Scenarios	Activity description	Equipment	Sound Power Levels $L_{Aeq(15\ min)}$ dB(A)/ unit	Combined Sound Power Level $L_{Aeq(15\ min)}$ dB(A)	
				All equipment	All equipment without high noise emitting plant [2]
Sc.1	Vegetation Clearing	Tub Grinder	121 [2]	123	117
		Chainsaw	115 [2]		
		Dozer	110		
		Truck	108		
		Excavator	106		
Sc.2	Bulk earthworks	Excavator w/ hammer	122 (117 + 5) [1, 2]	123	117
		Grader	113		
		Dozer	110		
		Roller	109		

Construction Stages / Scenarios	Activity description	Equipment	Sound Power Levels $L_{Aeq(15\ min)}$ dB(A)/ unit	Combined Sound Power Level $L_{Aeq(15\ min)}$ dB(A)	
				All equipment	All equipment without high noise emitting plant [2]
		Truck	108		
		Water truck	107		
		Excavator	106		
Sc.3	Paving / asphalting (including concrete saw)	Concrete saw	122 (117 + 5) [1, 2]	123	117
		Asphalt paver	114		
		Roller	109		
		Trucks	108		
		Trencher	106		
		Bobcat	104		
Sc.4	Road furniture installation / bus stop	Power hand tools	110	113	113
		Line marking truck	108		
		Truck	98		
		Mobile crane / telehandler	98		
		Scissor Lift	98		

Notes: [1] Includes a +5 dB penalty for impulsiveness characteristics.

[2] For this assessment high noise emitting plant considered to be tub grinder, chainsaw, rock hammers, jackhammers and concrete saws.

3.1.5 Construction Noise Levels

Prediction of the construction noise levels was undertaken with CadnaA under worst-case noise-enhancing meteorological conditions (D-class with 3 m/s windspeed).

Construction noise levels have been predicted for the four (4) indicative construction scenarios described in **Table 3.3**. The predictions are conservative and assume all equipment associated with each scenario is operating simultaneously at the closest point to the receiver. In reality, a receiver would experience a range of construction noise levels, dependent upon the number of plant items operating at any one time and their location as the works progress along the roadway.

For each work area, the results for each construction scenario (Sc.1 to Sc.4) for the identified receivers are presented in **Table 3.4**. Two circumstances have been presented:

- High impact (H), which includes high noise emitting plant (i.e., tub grinder, chainsaw, rock hammers, jackhammers and concrete saws).
- Low impact (L), which excludes high noise emitting plant (i.e., tub grinder, chainsaw, rock hammers, jackhammers and concrete saws).

For each work area, the predicted noise level contours for the worst-case scenario(s) with all equipment operating (Sc. 1, Sc. 2 and Sc. 3) are presented graphically in **Figure 3.2** to **Figure 3.4**. Construction scenario 4 was not represented visually as the potential impacts are less than the presented worst-case scenarios.

The construction noise levels are predicted to exceed the noise management levels (i.e. **Table 3.2**) at some receivers for some of the work areas and scenarios. However, no receivers are predicted to be highly noise affected (i.e., exposed to construction noise levels greater than 75 dB(A)).

Reasonable and feasible noise mitigation and management strategies were provided in Section 5.4 of the EIS NVIA 2023.

Table 3.4 Predicted Construction Noise Levels, dB(A)

Receiver ID	Noise Management Level, $L_{Aeq(15\ min)}$	Construction Scenario Noise Prediction, $L_{Aeq(15\ min)}$			
	Standard Hours	Sc.1, 2 & 3		Sc.4	
		H	L	H	L
Work Area 1					
R101	45	21	<20	n/a	<20
R102	45	**49**	43	n/a	39
R103	45	38	32	n/a	28
R104	45	40	34	n/a	30
R105	45	40	34	n/a	30
R106	45	43	37	n/a	33
R107	45	40	34	n/a	30
R108	45	40	34	n/a	30
Work Area 2					
R11	45	**73**	**67**	n/a	**63**
R12	45	**70**	**64**	n/a	**60**
R13	45	**60**	**54**	n/a	**50**
R14	45	**60**	**54**	n/a	**50**
R15	45	**72**	**66**	n/a	**62**
R16	45	42	36	n/a	32
R17	45	27	21	n/a	<20
R109	45	37	31	n/a	27
Work Area 3					
R2	45	**45**	39	n/a	35
R3	45	**50**	44	n/a	40
R4	45	**49**	43	n/a	39

Receiver ID	Noise Management Level, $L_{Aeq(15\ min)}$	Construction Scenario Noise Prediction, $L_{Aeq(15\ min)}$			
	Standard Hours	Sc.1, 2 & 3		Sc.4	
		H	L	H	L
R5	45	47	41	n/a	37
R9	45	51	45	n/a	41
R18	45	33	27	n/a	23
R19	45	45	39	n/a	35
R20	45	46	40	n/a	36
R21	45	61	55	n/a	51
R22	45	58	52	n/a	48
R23	45	53	47	n/a	43
R24	45	40	34	n/a	30
R25	45	35	29	n/a	25
R26	45	49	43	n/a	39
R27	45	47	41	n/a	37
R28	45	50	44	n/a	40
R29	45	72	66	n/a	62
R30	45	52	46	n/a	42
R31	45	61	55	n/a	51
R32	45	54	48	n/a	44
R33	45	41	35	n/a	31
R34	45	38	32	n/a	28
R35	45	67	61	n/a	57
R36	45	52	46	n/a	42
R37	45	47	41	n/a	37
R38	45	39	33	n/a	29

Receiver ID	Noise Management Level, $L_{Aeq(15\ min)}$	Construction Scenario Noise Prediction, $L_{Aeq(15\ min)}$			
	Standard Hours	Sc.1, 2 & 3		Sc.4	
		H	L	H	L
R39	45	**55**	**49**	n/a	45
R40	45	**66**	**60**	n/a	**56**
R41	45	**62**	**56**	n/a	**52**
R42	45	**55**	**49**	n/a	45
R43	45	**55**	**49**	n/a	45
R44	45	**69**	**63**	n/a	**59**
R45	45	**51**	45	n/a	41
R46	45	**64**	**58**	n/a	**54**

Notes:

[1] *Predictions below 20 dB(A) have been presented as <20.*

[2] *Scenario not applicable for work area.*

[3] *Receivers outside of assessment area for work area.*

[4] *H – Includes high noise emitting plant (i.e., tub grinder, chainsaw, rock hammers, jackhammers and concrete saws).*

[5] *L – Excludes high noise emitting plant (i.e., tub grinder, chainsaw, rock hammers, jackhammers and concrete saws).*

[6] *Predicted exceedances are in **Red**.*

FIGURE 3.2

Work Area 1 - Construction Scenario 1, 2 and 3 – Predicted Noise Levels, LAeq(15 min) dB(A)

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)

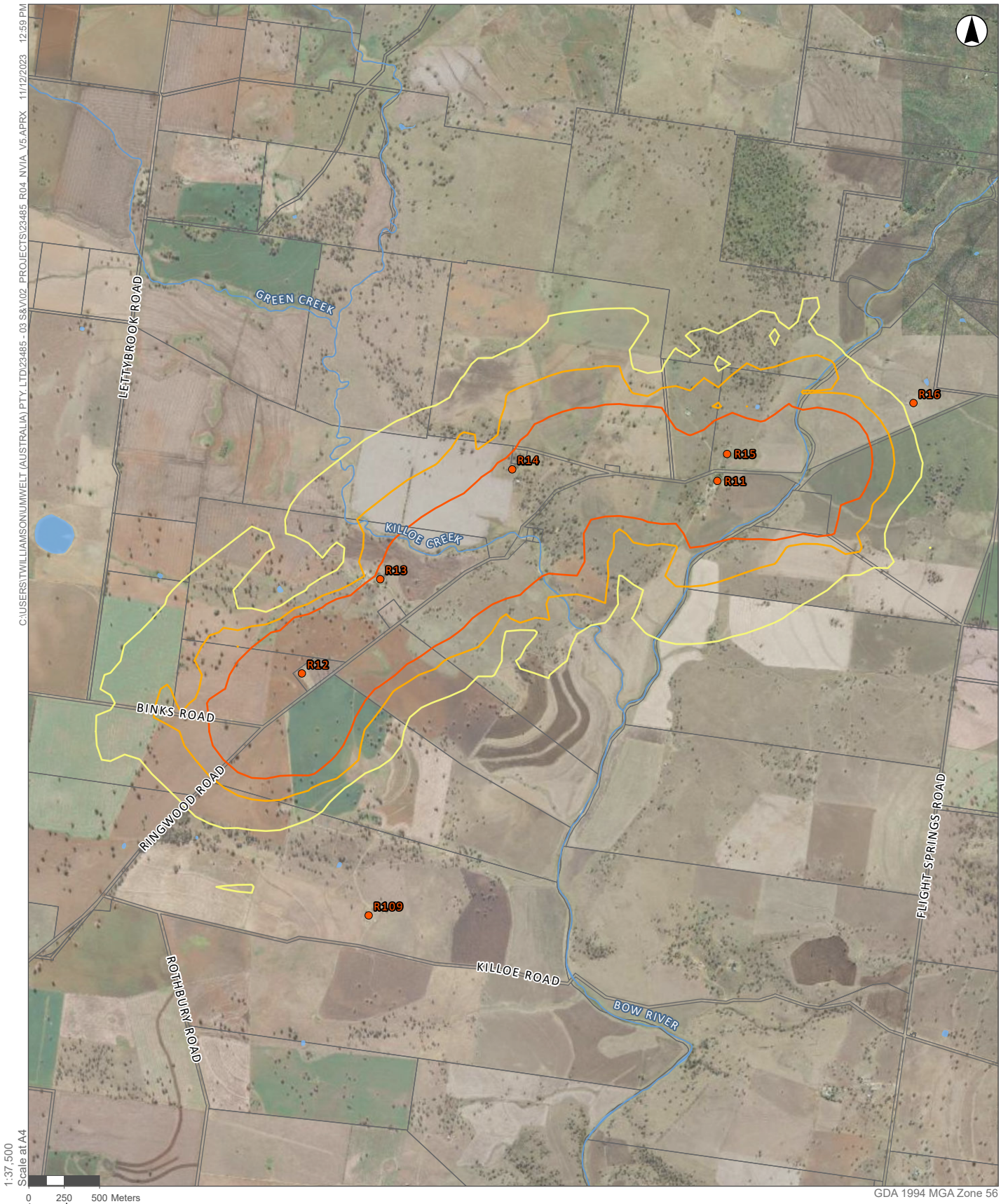


FIGURE 3.3

Work Area 2 - Construction Scenario 1, 2 and 3 – Predicted Noise Levels, LAeq(15 min) dB(A)

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)

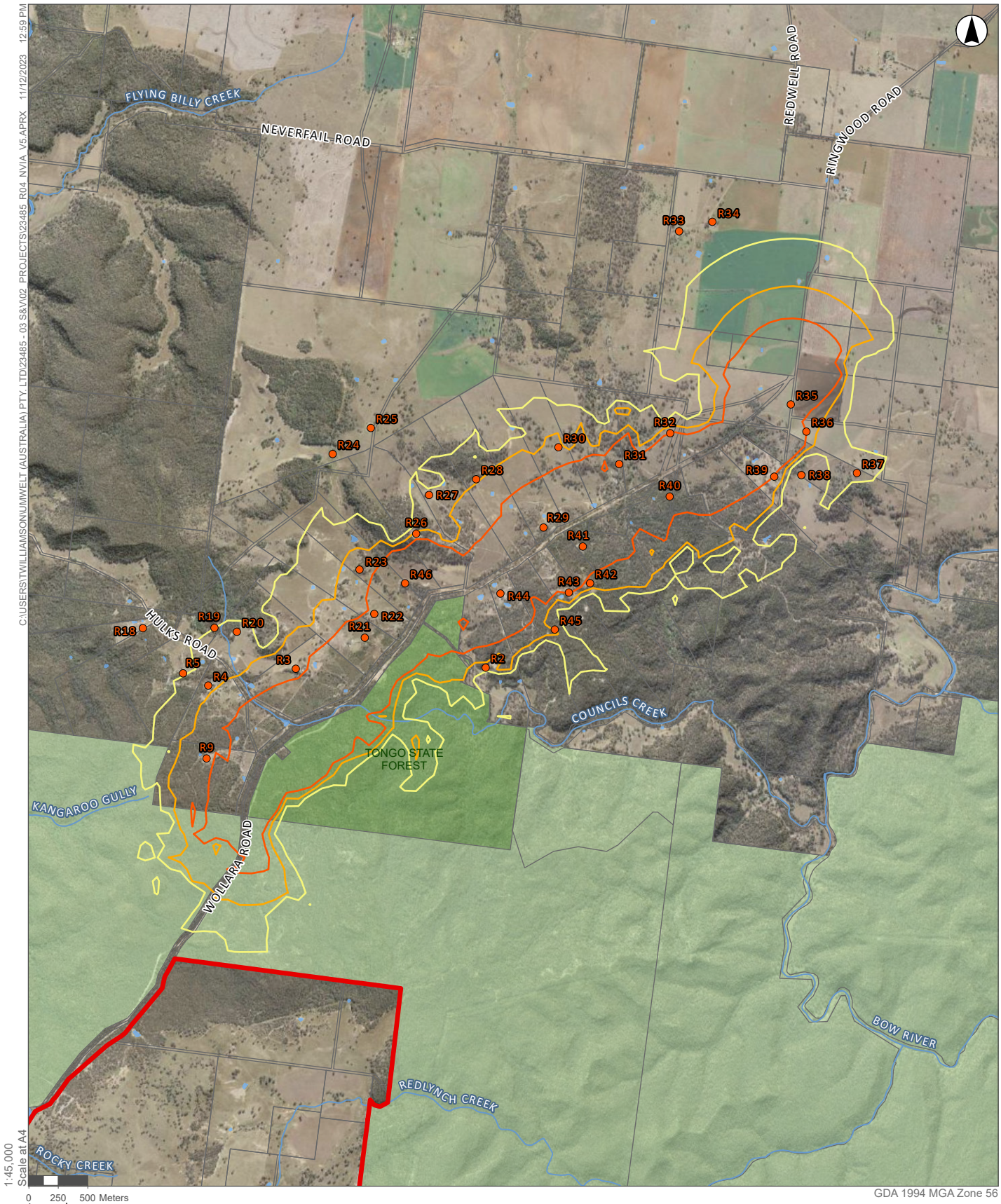


FIGURE 3.4

Work Area 3 - Construction Scenario 1, 2 and 3 – Predicted Noise Levels, LAeq(15 min) dB(A)

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)

3.2 Construction Vibration Levels

The recommended safe working distances for vibration-generating equipment from sensitive receivers (i.e., the receiver building or its occupants) are consistent with the EIS NVIA 2023 and are shown in **Table 3.5**.

Table 3.5 Recommended Minimum Working Distances for Vibration Generating Plant from a Residential Sensitive Receiver (CNVG Table 2)

Plant Item	Rating/Description	Minimum Working Distance [1, 2]	
		Cosmetic Damage (Residential Building)	Human Response
Vibratory Roller	< 50 kN (Typically 1–2 tonnes)	5 m	15 m to 20 m
	< 100 kN (Typically 2–4 tonnes)	6 m	20 m
	< 200 kN (Typically 4–6 tonnes)	12 m	40 m
	< 300 kN (Typically 7–13 tonnes)	15 m	100 m
	> 300 kN (Typically 13–18 tonnes)	20 m	100 m
	> 300 kN (> 18 tonnes)	25 m	100 m
Small Hydraulic Hammer	300 kg – 5 to 12 t excavator	2 m	7 m
Medium Hydraulic Hammer	900 kg – 12 to 18 t excavator	7 m	23 m
Large Hydraulic Hammer	1600 kg – 18 to 34 t excavator	22 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	20 m
Pile Boring	≤ 800 mm	2 m (nominal)	4 m
Jackhammer	Handheld	1 m (nominal)	2 m

Notes: [1] For alternative equipment with higher vibration levels, larger minimum working distances are required.

[2] More stringent conditions may apply to heritage or other sensitive structures.

Except for receiver R11, R12 and R15, all the identified residential dwellings fall outside of the minimum working distances. For Work Area 2, receiver R11, R12 and R15 fall within the minimum working for human response for some plant items (i.e., vibratory roller >7 tonnes and large hydraulic hammer >18 tonnes). However, given the transient nature of the works, human disturbance impacts are anticipated to be low.

Construction vibration mitigation strategies were provided in Section 5.4 of the EIS NVIA 2023 and remain relevant to the Amended Project.

4.0 Operational Noise Assessment

4.1 Receivers and Criteria

The nearest sensitive receivers and operational Project Noise Trigger Levels (PNTLs) are consistent with the EIS NVIA 2023. The nearest receivers are shown in **Figure 4.1** and the PNTLs are shown in **Table 4.1**.

Table 4.1 Project Noise Trigger Levels – Residential Receivers, $L_{Aeq(15\ minute)}$, dB(A)

Receiver	Time of day [1]	PINL [3]	PANL [4]	PNTL
All residential receivers [2]	Day	40	53	40
	Evening	35	48	35
	Night	35	43	35
Passive recreation area	When in use	-	53	53

Notes:

[1] Day period is 7.00 am–6.00 pm Monday-Saturday and 8.00 am–6.00 pm Sunday and Public Holidays, evening period is 6.00 pm–10.00 pm and night period is 10.00 pm to commencement of day period.

[2] Residential receiver R01 is involved in the Project (host receiver) and the PNTLs are not applicable.

[3] PINL – Project Intrusive Noise Level.

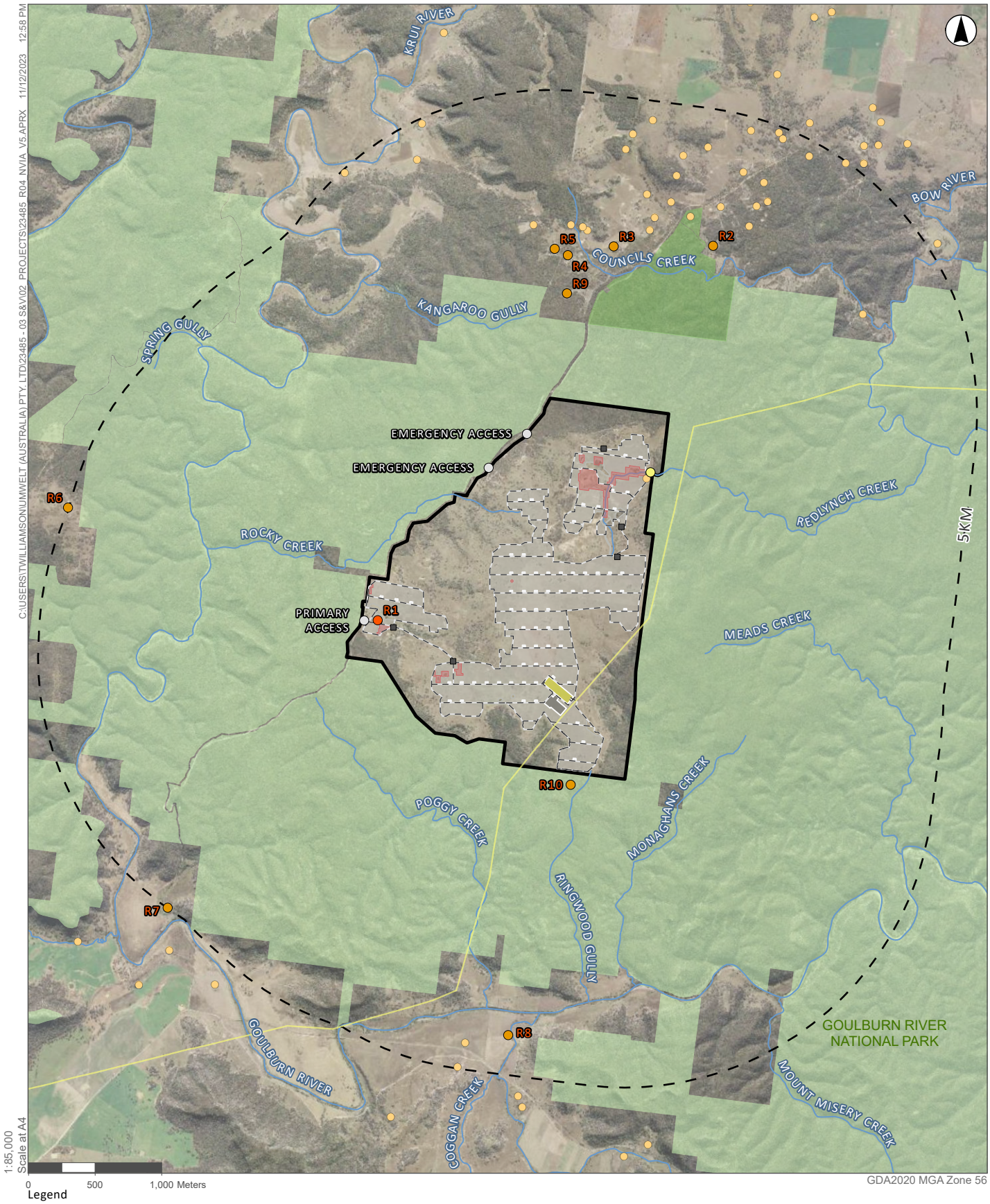
[4] PANL – Project Amenity Noise Level.

4.2 Modelling Methodology

Prediction of the operational noise levels was undertaken with the proprietary computer noise modelling software CadnaA (Version 2023), using the CONCAWE noise prediction algorithms. The operational noise model was developed using 3-Dimensional terrain data (10 m contour interval). Ground absorption for the area was modelled as acoustically soft ground.

4.3 Noise Source Data

Lightsource bp has provided indicative reference noise data for the proposed equipment/plant to be installed on-site for the Project. This has been supplemented with additional source data from Umwelt's noise source library. The proposed equipment, utilisation, quantities and sound power levels are summarised in **Table 4.2**.



Legend

- Host Receiver
- Sensitive Receiver
- Dwelling (abandoned)
- Dwellings
- Access Points
- Gate
- Proposed Access Tracks
- Electricity Transmission Line
- Watercourse
- Roads and Tracks
- Project Area (5km buffer)
- Project Area
- Exclusion Zones - Environmentally Sensitive Areas
- Battery Energy Storage System
- Inverter
- Substation
- NSW National Parks
- NSW State Forests
- Development Footprint - Amended Project

FIGURE 4.1

Sensitive Receivers

For the Goulburn River National Park (R10), given the vastness of the park and available bushwalking area, a receiver point 200 m from the Project Area was adopted for noise prediction purposes. For the predictions, the receiver point was located proximity to the substation and BESS (the highest noise emitting source on site)

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)

Table 4.2 Indicative Equipment Quantities and Sound Power Levels

Plant Item	Quantity	Indicative Sound Power Level per unit, dB(A)	Assumed Utilisation per unit per 15-minute period
Decentralised BESS			
Tracker motor	12,057	74	3% (30 seconds per 15 minutes)
PV Inverters	140	99 (94 dB(A) + 5 dB) [1]	100%
Battery Containers	1120	92	100%
DC BESS Converters	1120	98 (93 dB(A) + 5 dB) [1]	100%
Substation (270 MVA transformer)	2	99 (94 dB(A) + 5 dB) [1]	100%
HVAC (O&M building & control room)	2	70 [2]	100%
Light vehicle	2	89 [2]	100%
Centralised BESS			
Tracker motor	12,057	74	3% (30 seconds per 15 minutes)
PV Inverters	140	99 (94 dB(A) + 5 dB) [1]	100%
Battery Containers	560	92	100%
Substation (270 MVA transformer)	2	99 (94 dB(A) + 5 dB) [1]	100%
HVAC (O&M building & control room)	2	70 [2]	100%
Light vehicle	2	89 [2]	100%

Notes: [1] *Includes an assumed +5 dB penalty for tonality.*

[2] *Assumed sound power level sourced from Umwelt noise source library.*

4.4 Operational Noise Levels

The noise levels have been predicted under default worst-case meteorological conditions (D-class with 3 m/s windspeed or F-class with 2 m/s windspeed) in accordance with the NPfI. For a conservative assessment against the night-time noise goal, it was assumed that all plant and equipment within **Table 4.2**, would be operating concurrently at 100% capacity.

Predicted operational noise levels have been undertaken for the following scenarios:

1. Decentralised BESS (1160 MWh).
2. Centralised BESS (900 MWh).
3. Decentralised plus Centralised BESS (2060 MWh).

The predicted operational noise levels at the identified receivers are presented in **Table 4.3** and shown graphically as noise contours in **Figure 4.2**, **Figure 4.3** and **Figure 4.4**.

Table 4.3 Predicted Operational Noise Levels, dB(A)

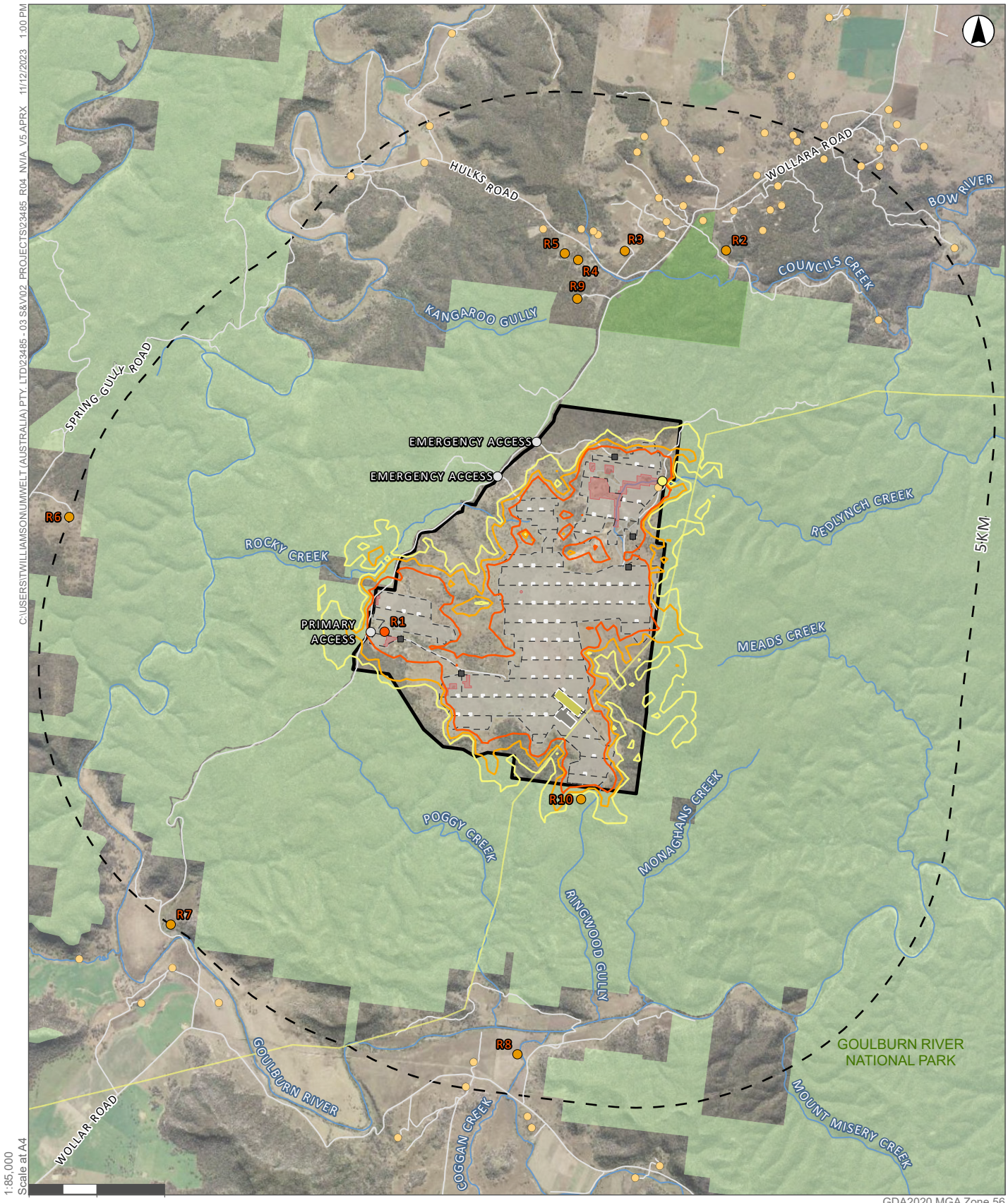
Rec ID	Predicted Noise Level, $L_{Aeq(15\ min)}$			Night-time PNTL, $L_{Aeq(15\ min)}$
	Decentralised BESS	Centralised BESS	Decentralised plus Centralised	
R01 (host receiver) [1]	52	30	52	-
R02	<20	<20	<20	35
R03	<20	<20	<20	35
R04	<20	<20	<20	35
R05	<20	<20	<20	35
R06	<20	<20	<20	35
R07	<20	<20	<20	35
R08	<20	<20	<20	35
R09	<20	<20	<20	35
R10 [2]	36	35	38	53

Notes:

[1] *Residential receiver R01 is involved in the Project (host receiver) and the PNTLs are not applicable.*

[2] *This is a worst-case representative location for passive recreational users of the National Park.*

[3] *Predictions below 20 dB(A) have been presented as <20.*



Legend

- Host Receiver
- Sensitive Receiver
- Dwelling (abandoned)
- Dwellings
- Access Points
- Gate
- Proposed Access Tracks
- Electricity Transmission Line
- Watercourse
- Roads and Tracks
- Project Area (5km buffer)
- Project Area
- Exclusion Zones - Environmentally Sensitive Areas

Name

- BESS - Centralised Option
- Inverter
- Substation
- NSW National Parks
- NSW State Forests
- Development Footprint - Amended Project

Predicted Noise Levels

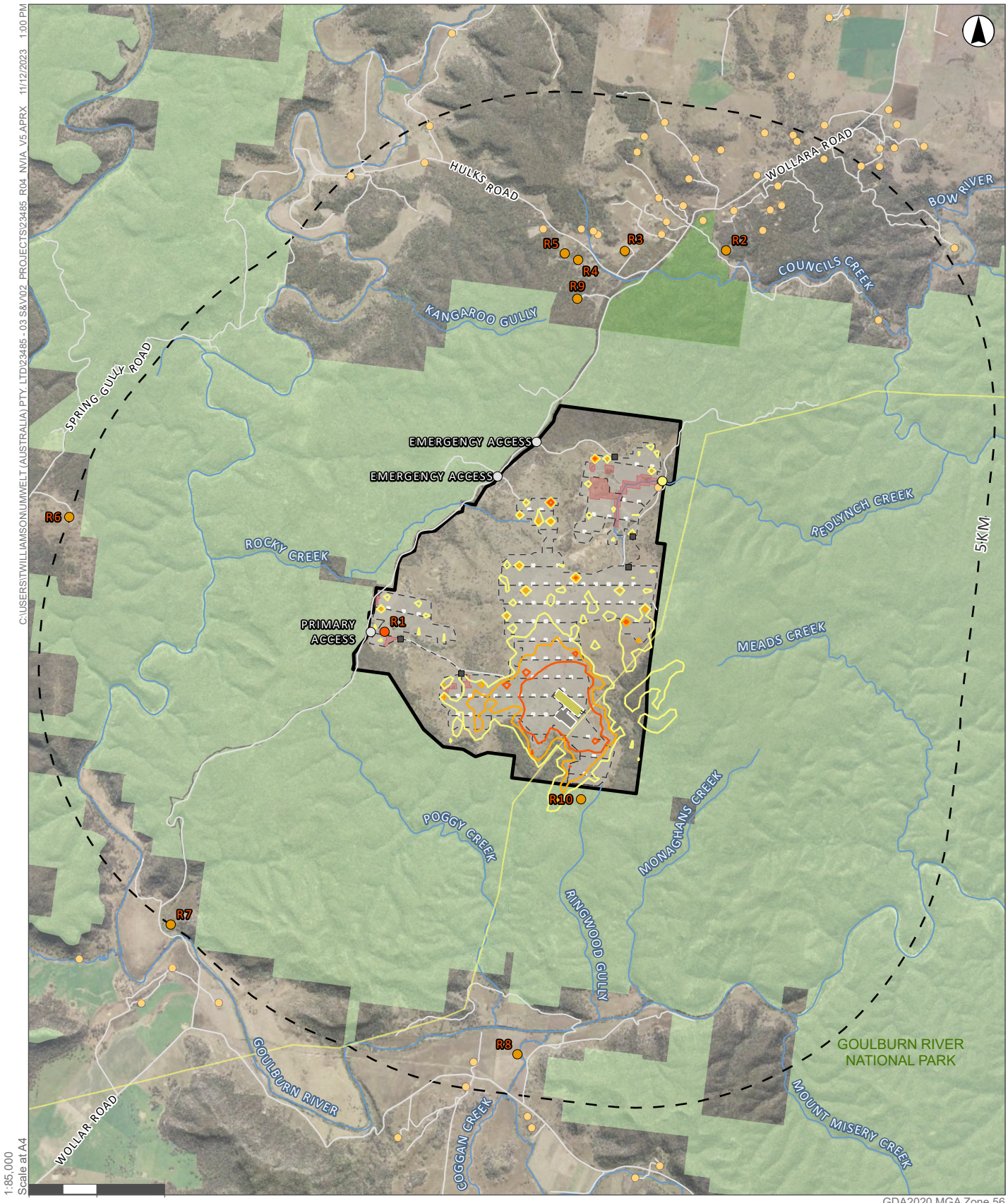
- 35 dB(A)
- 40 dB(A)
- 45 dB(A)

FIGURE 4.2

Decentralised BESS Predicted Operational Noise Levels, LAeq(15 min) dB(A)

For the Goulburn River National Park (R10), given the vastness of the park and available bushwalking area, a receiver point 200 m from the Project Area was adopted for noise prediction purposes. For the predictions, the receiver point was located proximity to the substation and BESS (the highest noise emitting source on site)

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)



Legend

- Host Receiver
- Sensitive Receiver
- Dwelling (abandoned)
- Dwellings
- Access Points
- Gate
- Proposed Access Tracks
- Electricity Transmission Line
- Watercourse
- Roads and Tracks

- Project Area (5km buffer)
- Project Area
- Exclusion Zones - Environmentally Sensitive Areas

Name

- BESS - Centralised Option
- Inverter
- Substation
- NSW National Parks
- NSW State Forests
- Development Footprint - Amended Project

Predicted Noise Levels

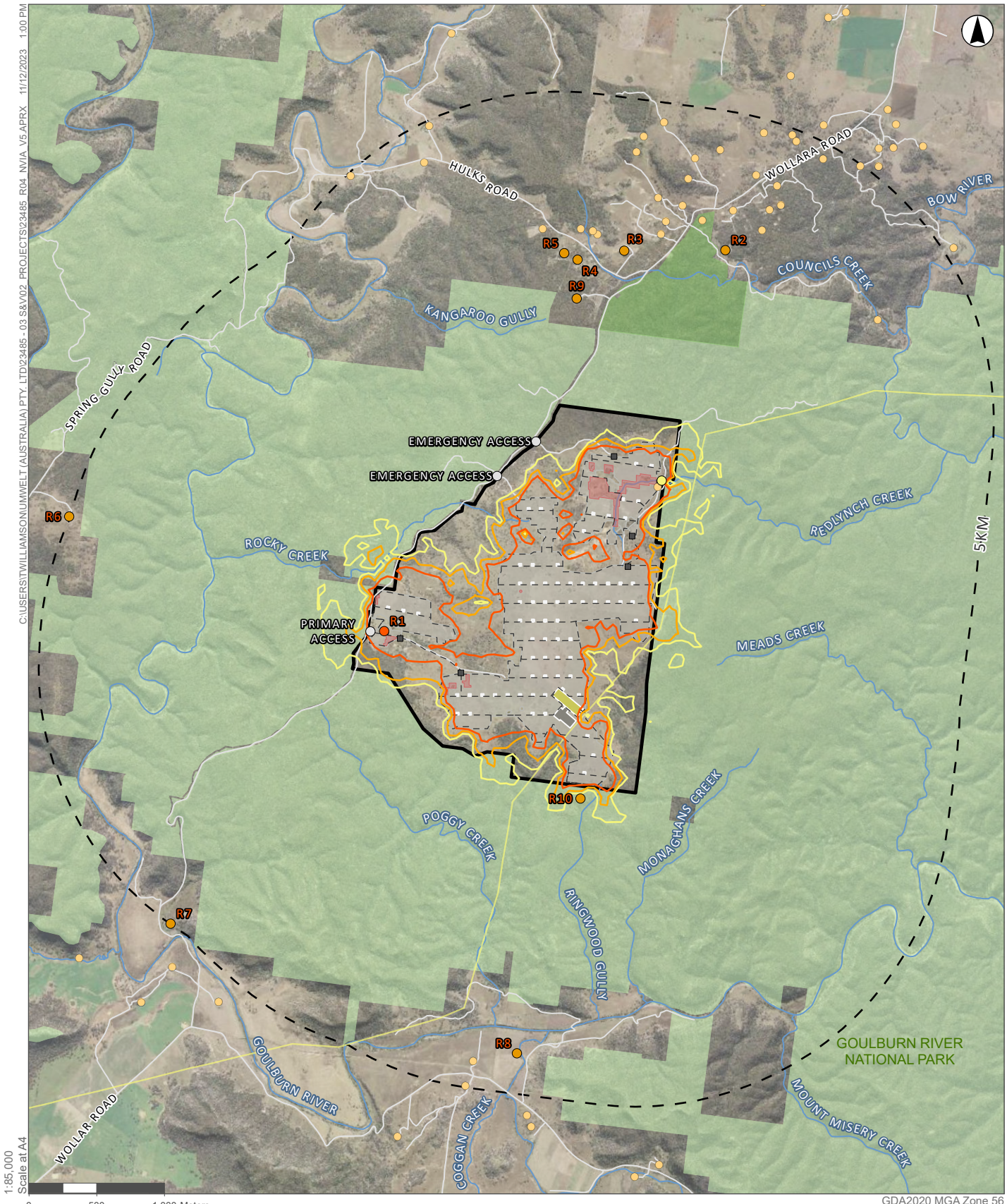
- 35 dB(A)
- 40 dB(A)
- 45 dB(A)

FIGURE 4.3

Centralised BESS Predicted Operational Noise Levels, LAeq(15 min) dB(A)

For the Goulburn River National Park (R10), given the vastness of the park and available bushwalking area, a receiver point 200 m from the Project Area was adopted for noise prediction purposes. For the predictions, the receiver point was located proximity to the substation and BESS (the highest noise emitting source on site)

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)



Legend

- Host Receiver
- Sensitive Receiver
- Dwelling (abandoned)
- Dwellings
- Access Points
- Gate
- Proposed Access Tracks
- Electricity Transmission Line
- Watercourse
- Roads and Tracks
- Project Area (5km buffer)
- Project Area
- Exclusion Zones - Environmentally Sensitive Areas

Name

- BESS - Centralised Option
- Inverter
- Substation
- NSW National Parks
- NSW State Forests
- Development Footprint - Amended Project

Predicted Noise Levels

- 35 dB(A)
- 40 dB(A)
- 45 dB(A)

FIGURE 4.4

Decentralised plus Centralised BESS Predicted Operational Noise Levels, LAeq(15 min) dB(A)

For the Goulburn River National Park (R10), given the vastness of the park and available bushwalking area, a receiver point 200 m from the Project Area was adopted for noise prediction purposes. For the predictions, the receiver point was located proximity to the substation and BESS (the highest noise emitting source on site)

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)

5.0 Construction Traffic Noise Assessment

5.1 Barnett Street Vehicle Turning Area

The following assumptions have been applied in evaluating the potential traffic noise impacts from the Barnett Street vehicle turning area:

- Given existing traffic volume along the Golden Highway (Average Annual Daily Traffic (AADT) 3,810 vehicles [ref: TfNSW 2007 Station ID 92456]), Project related traffic noise impacts at receivers located along the highway are anticipated to be negligible.
- The existing traffic volumes for Ringwood Road/Wollara Road have been derived from local traffic counts conducted in 2022, as provided in the Traffic Impact Assessment (Turnbull Engineering, 2022).
- According to the Turnbull Engineering traffic report *Goulburn River Solar Farm – Traffic and Transport Impact Assessment, Revision 10* (TTIA), the predicted daily traffic generated during peak construction will be 60 light vehicles (120 movements), 15 shuttle buses (30 movements) and 55 heavy vehicles (110 movements).
- According to the Traffic Impact Assessment, all standard project construction vehicles including light vehicles, shuttle buses and heavy vehicles are anticipated to originate from the Golden Highway east of Ringwood Road.
- The following assumptions in relation to traffic movements have been made:
    - No project related construction vehicles are anticipated to utilise Barnett Street turning area during the night period (i.e., prior to 7.00 am and after 10.00 pm).
    - The majority of daily Project-related light-vehicle movements and shuttle buses will utilise the Barnett Street turning area when egressing the site (i.e., 5.30 pm to 6.30 pm). A worst-case assumption that 50% of the daily movements would occur during any given hour. The shuttle buses for construction workers have been assessed as heavy vehicles.
    - Daily Project-related heavy-vehicle movements will be spread evenly throughout the day (i.e., averaged on an hourly basis).
    - There are negligible existing traffic movements along Barnett Street that are not associated with the operations of Receiver R110 in **Figure 5.1**.
    - For the purposes of this assessment, Barnett Street has been classified as a local road with a daytime assessment criterion of 55 $L_{Aeq(1hr)}$.
    - A Barnett Street traffic speed of 40 km/h has been adopted.

The nearest and potentially most affected receiver is Receiver R110 (6210-6212 Golden Highway, Merriwa). The nearest residential building located on this property is located approximately 120 metres from the Barnett Street turning area and is shown on **Figure 5.1**. The Receiver is a private residence and an agricultural operation.

FIGURE 5.1

Sensitive Receiver – Barnett Street Traffic Noise Assessment

Image Source: ESRI Basemap (2023) **Data source:** NSW LPI (2023), NSW DSFI (2023); NPWS Estate (2023); Lightsource BP (2023)

Based on the above inputs and assumptions, the indicative construction-related traffic volumes adopted for the noise assessment are presented in **Table 5.1**.

Table 5.1 Indicative Construction Related Traffic Volumes

Road	Period	Parameter	Existing traffic volume (without Project) [1]	Project Related traffic volume [2]	Combined traffic volume (Existing + Project)
Barnett Street	Day LAeq(1 hour)	Light Vehicles	0	60	60
		Heavy Vehicles	0	24 [3]	24
		Total	0	84	84

Notes: [1] *Assumed to be negligible.*

[2] *Based on the Traffic Impact Assessment.*

[3] *The shuttle buses for construction workers have been assessed as heavy vehicles.*

Road traffic noise calculations were performed with CadnaA (Version 2023), using the Calculation of Road Traffic Noise (CoRTN) algorithms.

Based upon the traffic volumes in **Table 5.1**, the predicted traffic noise levels for the nearest receiver located along Barnett Street is shown in **Table 5.2**.

Table 5.2 Predicted Traffic Noise levels, L_{Aeq}, dB(A)

Receiver	Time Period	RNP criteria	Combined traffic noise levels	Comply / Exceed
6210-6212 Golden Highway, Merriwa	Day LAeq(1 hour)	55 [1]	44	Complies

Notes: [1] *The road noise from Barnett Street has been assessed against the LAeq,1hour daytime criterion for a Local Road.*

As shown in **Table 5.2** the construction traffic noise levels are predicted to comply with the criteria. In accordance with the RNP the Project construction traffic noise is predicted to be acceptable and have minor impact. Further, as indicted in the Amendment Report, consent has been received from the adjacent private landowners for the intended use of the turnaround facility.

6.0 Cumulative Assessment

Consistent with Section 8 of the EIS NVIA 2023, cumulative noise impacts from existing and approved projects in the area are not anticipated.

7.0 Conclusion

This addendum report to the previously prepared Umwelt report, *Goulburn River Solar Farm Noise and Vibration Impact Assessment, Final*, dated April 2023 (EIS NVIA 2023) was prepared to address the amendments to the Project outlined in **Section 2.0** of the proposed Goulburn River Solar Farm located near Merriwa, NSW.

Potential construction noise and vibration impacts from the road upgrades have been assessed in accordance with the *Interim Construction Noise Guideline* (ICNG, 2009). Construction noise levels were predicted to exceed the established NMLs at some receivers. Noise and vibration mitigation measures and strategies are consistent with that provided in the EIS NVIA 2023.

Potential operational noise levels have been assessed in accordance with the *Noise Policy for Industry* (NPfI, 2017). This addendum found that the Project is expected to comply with the applicable day, evening and night-time noise limits at nearby sensitive receivers not involved with the Project. Therefore, no additional noise mitigation is anticipated to be required for the operation of the Project.

Construction-related road traffic noise associated with the Barrnett Street vehicle turning area has been assessed and was found to comply at the nearest most potentially affected dwelling. In accordance with the RNP, the Project construction traffic noise is predicted to be acceptable and have minor impact.

Cumulative noise impacts from existing and approved projects in the area are not anticipated due to large separation distances and therefore comply with the NPfI requirements.

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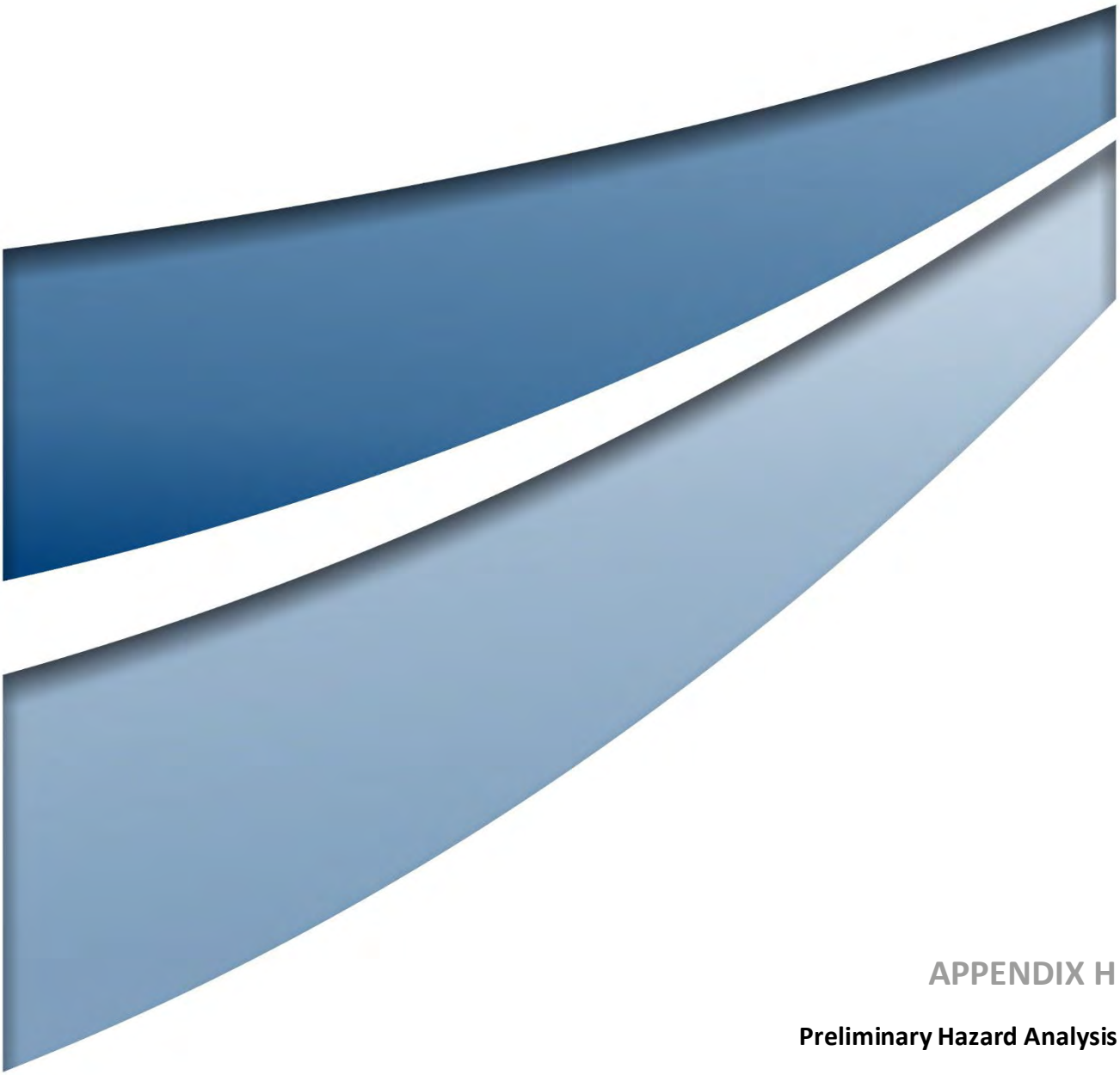

APPENDIX H

Preliminary Hazard Analysis

umwelt
Environmental & Social Consultants

lightsource bp

GOULBURN RIVER SOLAR FARM

Preliminary Hazard Analysis Addendum Report

FINAL

December 2023

GOULBURN RIVER SOLAR FARM

Preliminary Hazard Analysis Addendum Report

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Lightsource bp

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Project Manager: Jessica Henderson-Wilson
Technical Director: Tim Procter
Technical Manager: Tim Procter
Report No. 23485 / R12
Date: December 2023

Environmental & Social Consultants

This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Acknowledgement of Country

Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
V0	J Henderson-Wilson	04/12/2023	M Facey	04/12/2023
V1	T Procter	05/12/2023	J Henderson-Wilson	05/12/2023

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1.0 Introduction

Lightsource bp is proposing to develop the Goulburn River Solar Farm (the Project) to generate solar renewable energy to supply New South Wales (NSW) (refer to **Figure 1.1**).

The proposed Goulburn River Solar Farm (the Project), as described in the Environmental Impact Statement (EIS) (Umwelt, 2023) includes the construction, operation, maintenance and decommissioning of approximately 550 megawatt peak (MWp) of solar photovoltaic (PV) generation with a Battery Energy Storage System (BESS) with 280 MWp and 570 megawatt hour (MWh) capacity. The Project will also include supporting infrastructure, a substation and connection to an existing 500 kilovolt (kV) transmission line. Parts of Ringwood Road will be upgraded including two culverts at Bow River and Killoe Creek.

A number of amendments to the Project are proposed in response to public and agency submissions received following the public exhibition of the EIS and progression of the detailed design. This Preliminary Hazard Analysis addendum report (PHA Addendum) has been prepared to address the amendments to the Project (outlined in **Section 2.0**) and is supplementary to the previously prepared Umwelt report, *Goulburn River Solar Farm Preliminary Hazard Analysis, Final*, dated April 2023 (EIS PHA 2023).

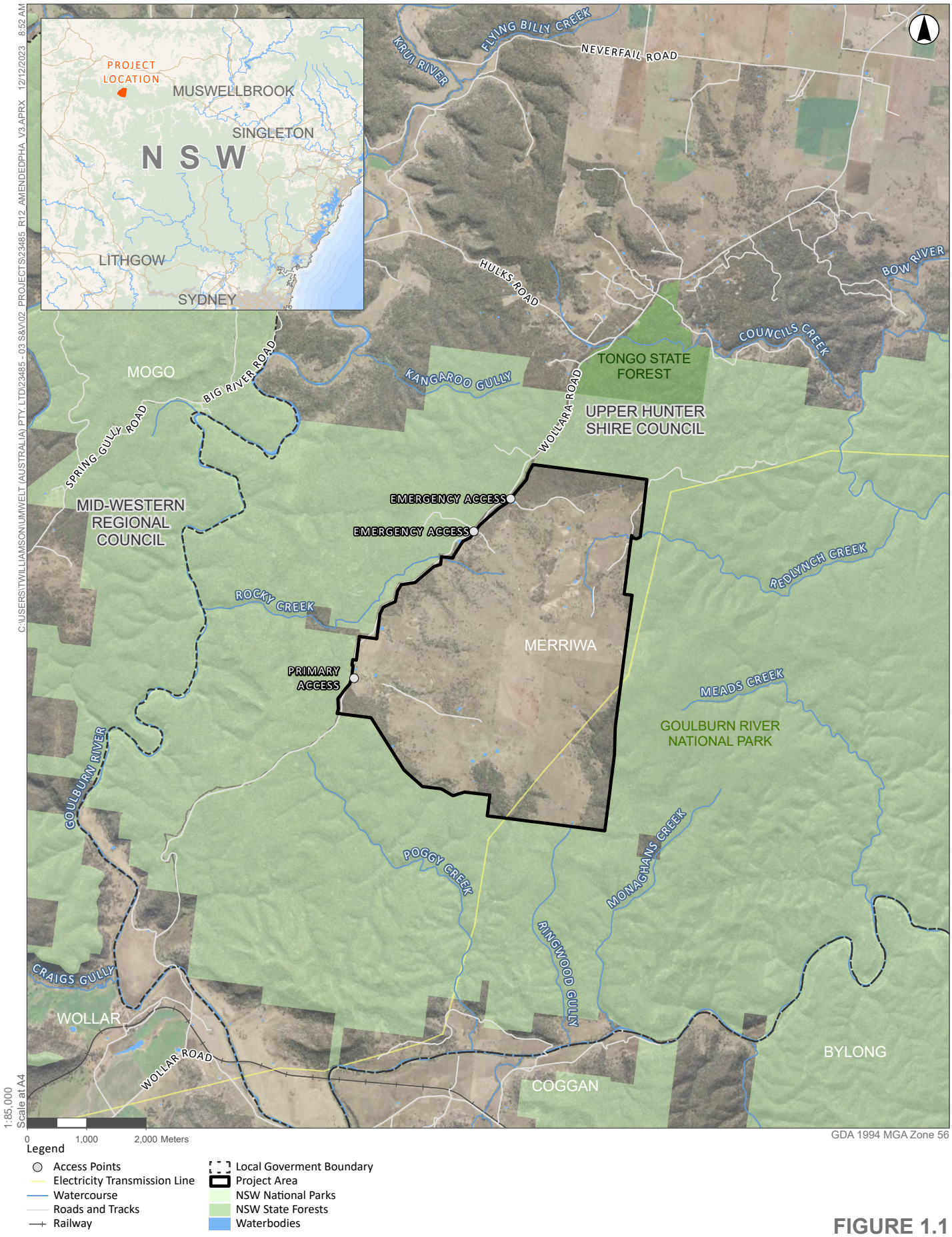

FIGURE 1.1

Locality

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)

2.0 Description of Amendments

The proposed amendments to the Project are summarised below and addressed further in the subsequent sections of this addendum report. **Table 2.1** provides a comparison of the proposed amendments to the EIS Project and the Amendment Project's BESS components.

- Transport route amendments and upgrade of the intersection of the Golden Highway and Ringwood Road.
- Upgrades to additional parts of Wollara Road and Ringwood Road.
- Options for the BESS including:
    - Increasing the capacity of the centralised BESS from 280 MWp/570 MWh to 450 MWp/900 MWh.
    - Constructing a decentralised BESS option consisting of 560 individual 6.1 m (i.e., 20 foot) battery containers and DC-DC converters, and associated infrastructure being situated next to the PV inverter stations located throughout the solar arrays.
    - Constructing a combination of the centralised and decentralised BESS units.
- Minor modifications to the Development Footprint and internal layout including:
    - removal of travelling stock route (TSR) 4481 from within the Project Area although site access will remain through the TSR with no access upgrades.
    - relocation and/or removal of solar arrays within the Development Footprint to avoid Regent Honeyeater Habitat, scattered trees and Box Gum Woodland.
    - increased width of selected internal access roads to accommodate subterranean power cables.
- Construction of an additional transmission tower within the existing easement of the 500 kV transmission line adjacent to the BESS/substation.
- Additional assessment and revised approach for workforce accommodation.

This PHA Addendum addresses the increased BESS capacity and option of a decentralised BESS and the choice to host both centralised and decentralised BESS units. The location of the BESS options addressed in this PHA Addendum report are illustrated in **Figure 2.1**.

Table 2.1 Comparison of Proposed Amendments to the Project's BESS

Project Stage	EIS Project	Amended Project	Difference Between EIS Project and Amended Project
BESS Configuration	Centralised BESS option proposed.	Centralised and decentralised BESS options proposed.	Addition of a decentralised BESS option or a combined centralised and decentralised combined BESS option. Project will be delivered with one of the three options permitted.
Centralised BESS capacity (MWp)	280 MWp	450 MWp	+170 MWp
Centralised BESS capacity (MWh)	570 MWh	900 MWh	+330 MWh
Decentralised BESS capacity (MWp)	Not proposed in EIS.	580 MWp	+580 MWp
Decentralised BESS capacity (MWh)	Not proposed in EIS.	1160 MWh	+1160 MWh
Centralised and Decentralised BESS capacity (MWp)	Not proposed in EIS.	1,030 MWp	+750 MWp
Centralised and Decentralised BESS capacity (MWh)	Not proposed in EIS.	2,060 MWh	+1,490 MWh
Transformers	4	4	No change.
Inverters (PCS)	104	140	+36

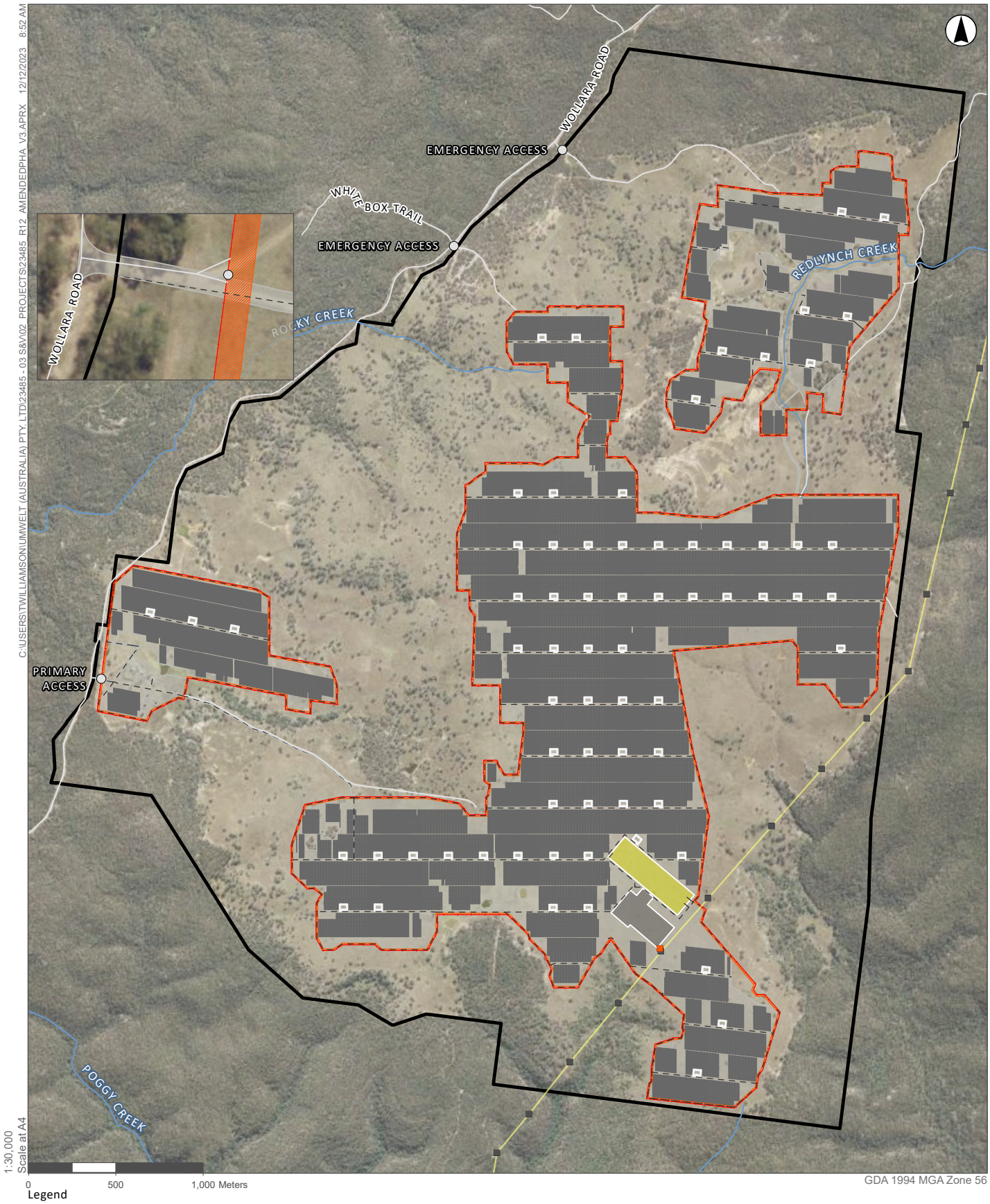

FIGURE 2.1

Amended Project – Development Footprint & Internal Layout

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)

3.0 Battery Energy Storage Systems

3.1 BESS Alternatives

The conceptual layout of the proposed AC Coupled (Centralised) BESS shown on **Figure 2.1** is presented in **Figure 3.1**. The proposed Centralised BESS includes:

- The installation of 700 battery cabinets each approximately 6 metres long and 2.5 metres wide and 2.9 metres high.
- An approximate aggregate energy storage capacity of 588 MW/2,583 MWh.
- A dedicated compound approximately 520 metres long by 150 metres wide.
- A buffer zone around the battery compound including a 10 metre Asset Protection Zone inside the compound fence.
- A perimeter road around the battery storage inside the compound fence.
- Access roads between each set of battery cabinets.
- Cabinets installed in rows with a minimum of 2.5 metre distance (length wise) between each battery cabinet and 3 metre space between cabinets.
- A battery storage footprint (including the internal access roads but not the perimeter road) of approximately 77,700 m^2. Based on a 2,583 MWh capacity, the approximate stored energy density of the Centralised BESS would be 33 kWh/m^2.

The conceptual layout of the proposed DC Coupled (Decentralised) BESS shown on **Figure 2.1** is presented in **Figure 3.2**. Each of the 68 proposed Decentralised BESS stations includes:

- The installation of 10 battery cabinets per station with each cabinet approximately 6 metres long, 2.5 metres wide and 2.9 metres high.
- A total approximate aggregate energy storage capacity of 571 MW/2,509 MWh.
- A dedicated compound for each Decentralised BESS station of approximately 25 metres long by 37 metres wide.
- A buffer zone between each battery station and the solar panels approximately 5 metre wide.
- An access road running adjacent to each battery station.
- Cabinets installed with a minimum of 2.5 metre distance (length wise) between each battery cabinet and 3 metre space between cabinets.
- A battery station would have a footprint of approximately 925 m^2. Based on a 36.9 MWh capacity, the approximate stored energy density of the Decentralised BESS station would be 40 kWh/m^2.

The conceptual layout of the proposed Project shown on **Figure 2.1** could also include a combination of both the AC Coupled (Centralised) BESS and the DC Coupled (Decentralised) BESS.

It is noted that FM Global's Property Loss Prevention Data Sheet 5-33 Lithium-Ion Battery Energy Storage Systems (2023) provides loss prevention recommendations for the minimum separation distances for battery storage installations. This includes:

- 1.8 m separation between the accessible face of LIB rack to non-combustible construction elements, non-combustible materials and adjacent racks.
- 2.7 m separation between accessible face of LIB rack to combustible construction elements and materials.
- Separation between non-accessible sides of adjacent racks to be determined by installation fire level testing (e.g. UL9540A testing).

Given the low energy density of the proposed battery storage for the Project, it is considered that there will be sufficient area within the battery storage compound(s) to enable adequate separation distances between adjacent battery cabinets and other sensitive equipment to achieve non-propagation of thermal incidents.

As noted in Section 4 of Appendix 17 of the EIS, the LIB cell type that will most likely be utilised at the Project will be lithium iron phosphate (LFP) which is considered to have greater thermal stability compared to other typical LIB cell types.

3.2 Separation Distances

The *Goulburn River Solar Farm Preliminary Hazard Analysis* (2023) reported the modelled consequence distances presented in **Table 3.1** from lithium-ion batteries (LIBs) to fatal impacts and injury associated with fire, explosion and toxic gas release events.

Table 3.1 Modelled Consequence Distances

Hazard Event	Distance (m)
Fatal Impacts	
Fire (12.6 kW/m^2 contour)	5
Explosion (14 kPa contour)*	26
Toxic Gas Release (HF AEGL 3 contour, 44 ppm contour)	42
Injury Impacts	
Fire (4.7 kW/m^2 contour)	9
Explosion (7 kPa contour)*	43
Toxic Gas Release – Injury (HF AEGL 2 contour, 24 ppm contour)	68

* *Conservative assumption.*

The proposed location of the AC Centralised BESS shown in **Figure 2.1** is over 1,000 m from the site boundary and over 3,000 m from the single involved dwelling to the west-northwest.

The distances from the DC Decentralised BESS stations to the Project boundary ranges from 530 m in the north, 200 from the eastern boundary, 210 m from the southern boundary and 260 m from Wollara Road in the west. The closest DC Decentralised BESS station to the single involved dwelling on the Project site is 330 metres to the north. Note: this dwelling will be vacated prior to construction.

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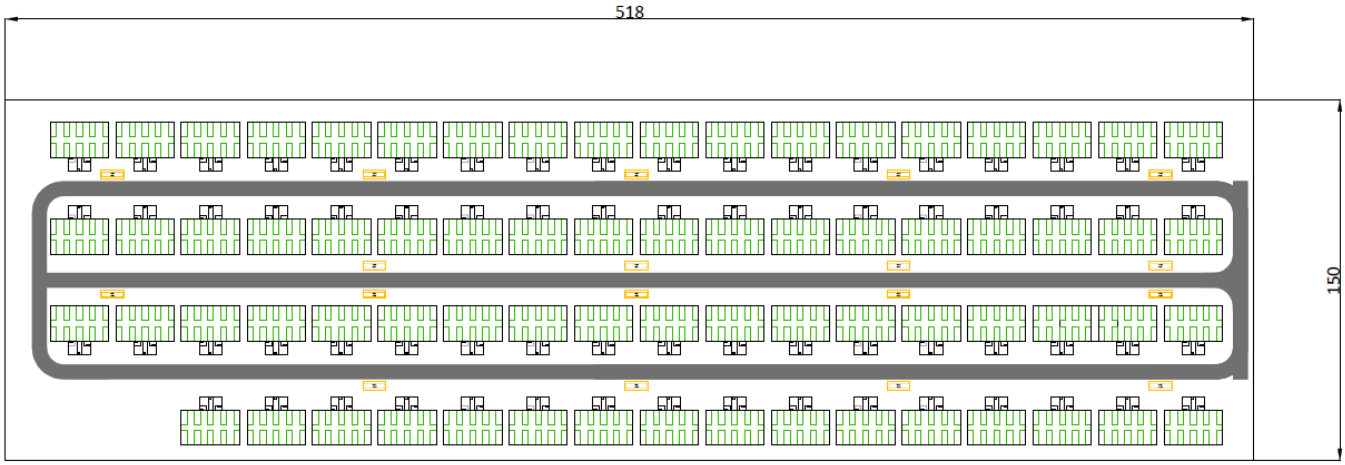
10 containers x 3.69MWh per PCS
70 PCS x 4.2MWac inverters per PCS
18 Aux Skids
588MW/2583MWh system



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Scale at A4

0 500 1,000 Meters

GDA2020 MGA Zone 56

Legend

- Hithium ESS Container 3.686MWh
- DC-DC Converter
- Power Conversion Station (PCS)

FIGURE 3.1

Indicative Layout of the AC Coupled Centralised BESS

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)

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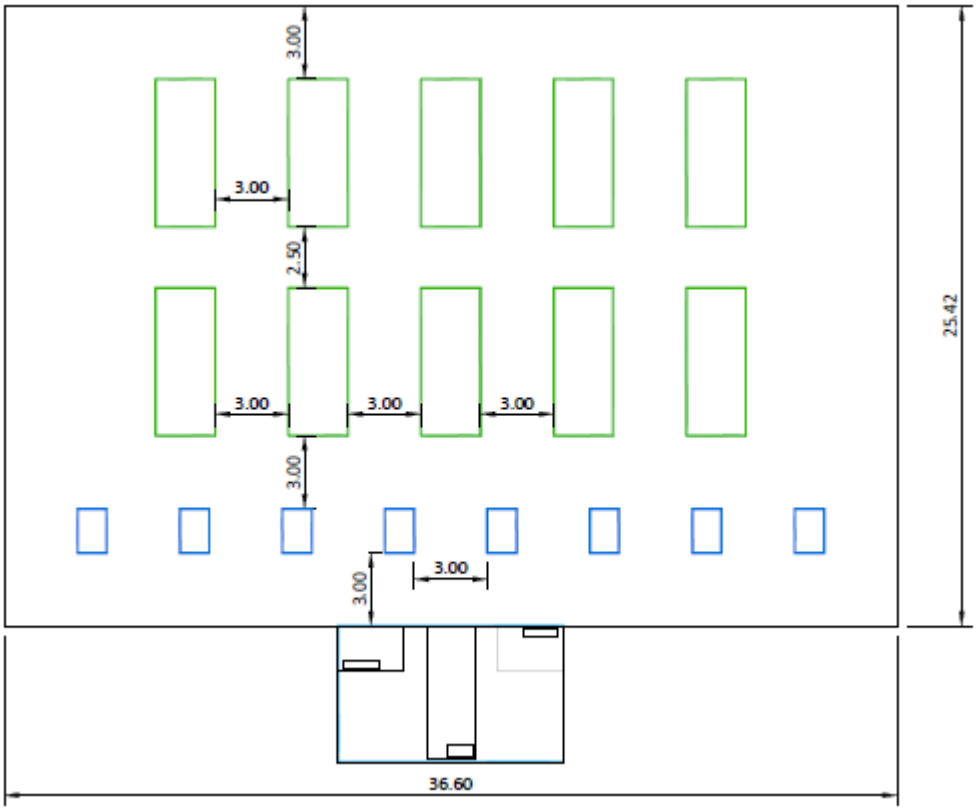
10 containers x 3.69MWh per PCS
2 Inverters x 4.2MWac per PCS
8 DC-DC converter x 1.12MW DC-DC converter per PCS
8.4MW/36.9MWh system



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GDA2020 MGA Zone 56

Legend

Hithium ESS Container 3.686MWh

DC-DC Converter

Power Conversion Station (PCS)

FIGURE 3.2

Indicative Layout of the DC Coupled Decentralised BESS

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)

4.0 Risk Management

The *Goulburn River Solar Farm Preliminary Hazard Analysis* (2023) provides a comprehensive description of the risk control strategies that would be implemented as part of the EIS Project. These remain applicable to the Amended Project.

In response to the agency submissions received during exhibition of the EIS, further information is provided regarding management of residual risks. The following section outlines LSbp's commitment to the development and documentation of the site-specific plans and procedures designed to manage the residual risk presented by the EIS Project following the implementation of technical and non-technical controls described in the EIS PHA. As stated above, these remain applicable to the Amended Project.

A Fire Safety Study (FSS) will be prepared in accordance with HIPAP 2 prior to commencing construction of the BESS. The FSS will consider:

- the operational capability of local fire agencies and the need for the facility to achieve an adequate level of on-site fire and life safety independence
- fire propagation and a worst-case scenario
- the requirements of the Fire Management Plan (FMP) that would be prepared in consultation with NSW Rural Fire Service.

It is noted the FSS will also inform the requirements of the FMP including:

- the methods and resources needed to manage and extinguish lithium battery fires
- the management of a defendable Asset Protection Zone (APZ) as described in *Planning for Bush Fire Protection* 2019.

The FSS will inform the requirements of an Emergency Response Plan (ERP) that will be prepared in accordance with HIPAP 2 prior to commencing construction of the BESS. The ERP will inform the requirements of an Emergency Services Information Package (ESIP) that would be prepared in accordance with FRNSW fire safety guideline – *Emergency services information package and tactical fire plans*. Both the ERP and the ESIP will:

- inform first responders of site-specific features and safety measures required to ensure they are able to undertake their duties effectively
- include agency specific Standard Operational Guidelines.

5.0 Conclusion

The *Goulburn River Solar Farm Preliminary Hazard Analysis* (2023) prepared for the EIS Project identified a number of hazard events involving lithium-ion batteries (LIBs) with the potential for harmful impacts. The consequence modelling identified maximum distances to fatal impacts and injury impacts for thermal radiation, explosion overpressure and toxic gas dispersion. The *Goulburn River Solar Farm Preliminary Hazard Analysis* (2023) found that these impacts were contained within the site and that the potential for adverse impacts was associated with first responders attending a hazard event.

The impacts from hazard events associated with the proposed amendments to the Project, specifically the increased BESS capacity and options of a decentralised BESS or the choice to host a combination of both centralised and decentralised BESS units will also be contained within the site. As noted above, the potential for adverse impacts would be associated with first responders attending a hazard event.
As outlined in **Section 4.0**, this will be address through LSbp's commitment to the development and documentation of the site-specific plans and procedure designed to manage the residual risk presented by the Project.

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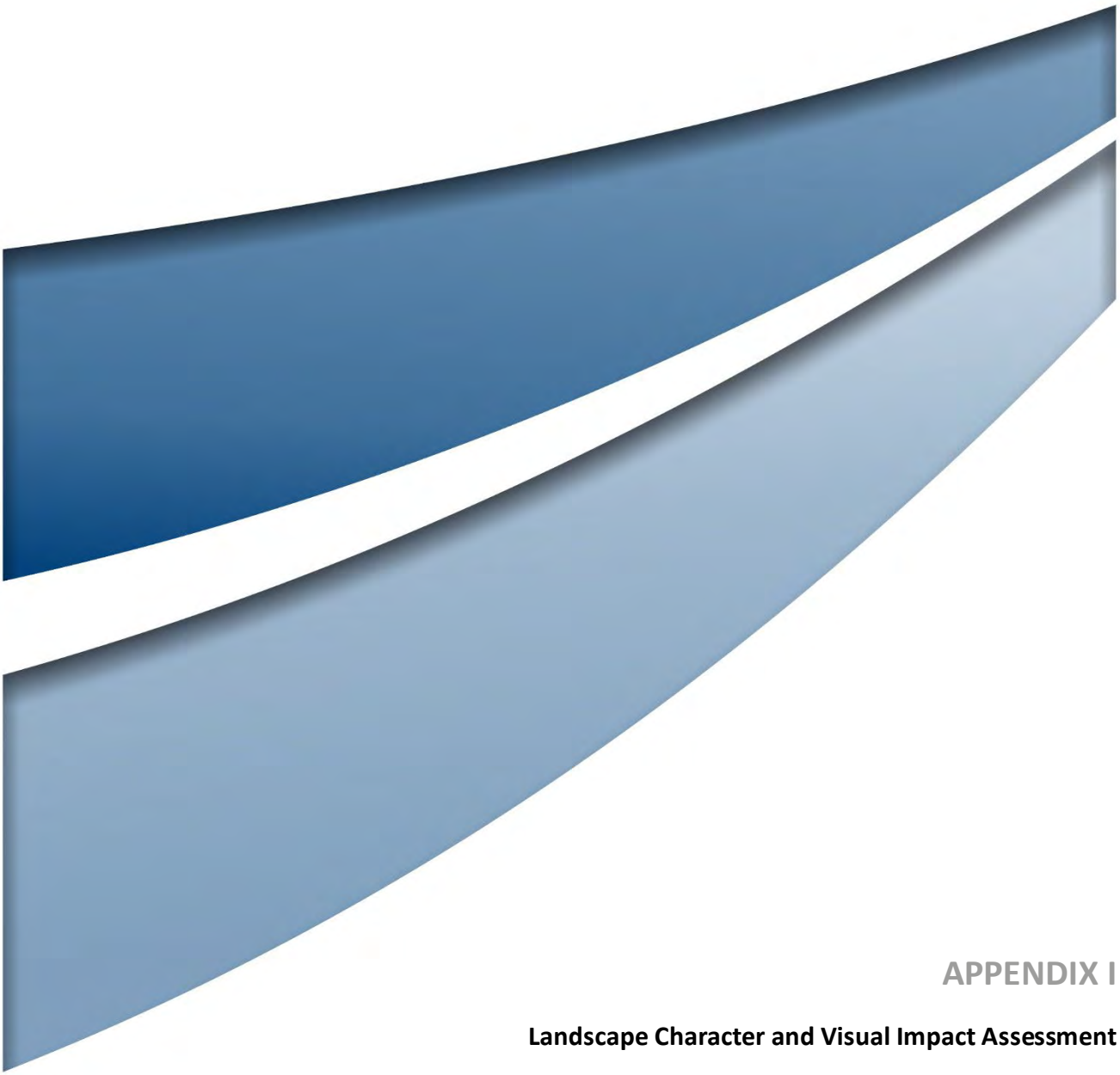
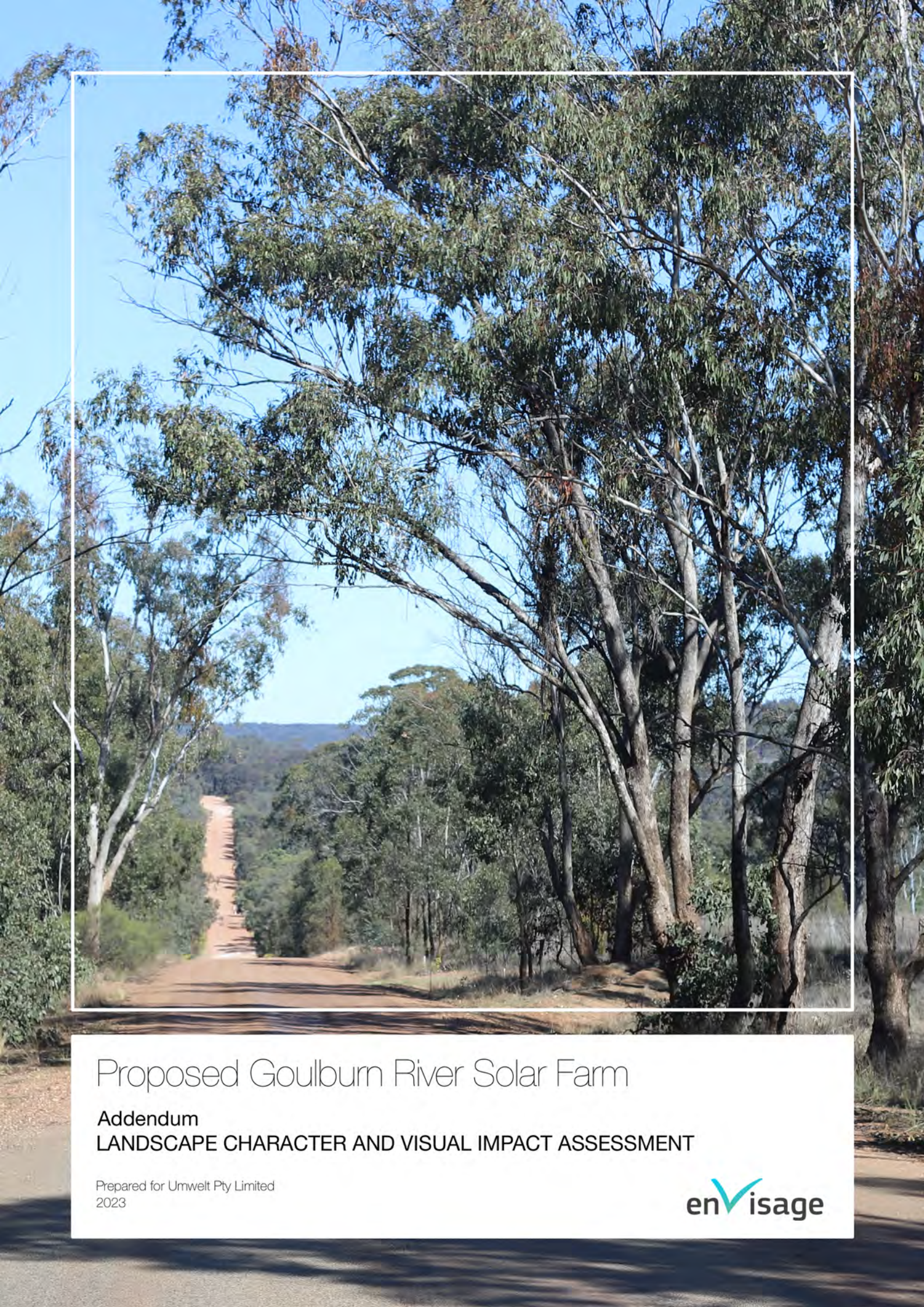


APPENDIX I

Landscape Character and Visual Impact Assessment



Proposed Goulburn River Solar Farm

Addendum
LANDSCAPE CHARACTER AND VISUAL IMPACT ASSESSMENT

Prepared for Umwelt Pty Limited
2023

enVisage

Proposed Goulburn River Solar Farm

Addendum

LANDSCAPE CHARACTER AND VISUAL IMPACT ASSESSMENT

PREPARED FOR: Umwelt (Australia) Pty Limited on behalf of Lightsource bp
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DOCUMENT NO.: 21523

Addendum revision	Date of Issue	Author	Reviewed/ Approved for issue
Rev 1	15 November 2023	Alison Dodds	Stacey Brodbeck
Rev 2	12 December 2023	Alison Dodds	Stacey Brodbeck

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1 Introduction

1.1 Purpose of this report

This report is an addendum to the landscape character and visual impact assessment (LCVIA[1]) which assessed a proposed Solar Farm and Battery Energy Storage System (BESS) at Goulburn River near Merriwa (the EIS Project). The LCVIA informed the Environmental Impact Statement (EIS) and development application for the Project, submitted to the Department of Planning and Environment (DPE) for determination in May 2023.

Following exhibition of the Project, amendments have been proposed by the proponent, Lightsource Development Services Australia Pty Ltd (Lightsource bp), to address community and agency submissions, and technical aspects of the Project. Amendments include road upgrades and modifications to the solar array and BESS (referred to as the 'Amended Project').

This addendum to the LCVIA describes and assesses the potential landscape character and visual impacts that may result from the Amended Project in the following sections:

Section 2	Describes the proposed amendments.
Section 3	Addresses potential change to landscape character impacts.
Section 4	Addresses potential change to visual impact, including lighting and cumulative impact.

1.2 Methodology

The methodology applied in this addendum is consistent with that applied in the LCVIA, and follows the methodology prescribed in *Technical Supplement – Landscape and Visual Impact Assessment* which accompanies the NSW Government's *Large-Scale Solar Guideline* (August 2022). In summary, impact is determined by combining *sensitivity* to change, with the *magnitude of change* that would result from the Project. The possible level of impact ranges from 'high' to 'very low' as shown in Table 1-1.

Table 1-1: Matrix of impact[2]

	High visual sensitivity	Moderate visual sensitivity	Low visual sensitivity	Very low visual sensitivity
Very high magnitude	High	High	Moderate	Moderate
High magnitude	High	Moderate	Moderate	Low
Moderate magnitude	Moderate	Moderate	Low	Low
Low magnitude	Moderate	Low	Low	Very low
Very low magnitude	Low	Low	Very low	Very low

However, the *Technical Supplement* applies only to large-scale solar farms, and the amendments include road upgrades located beyond the Project Area. Therefore, an alternative NSW Government methodology has been applied to assess the road upgrades: *'Guideline for Landscape Character and Visual Impact Assessment - Environmental Impact Assessment Guidance Note EIA–N04',* Transport for NSW, 2020.

The Transport for NSW methodology is similar to the *Technical Supplement*, in that it combines ratings of *sensitivity* and *magnitude* of change, however, it uses qualitative assessment (of scale, distance and contrast) to determine *magnitude* rather than quantitative cell count within a 180-degree photomontage.

An additional site inspection was undertaken 1 September 2023 to view the locations affected by the proposed amendments. The day of the inspection was dry and sunny.

[1] Envisage Consulting, April 2023, *Goulburn River Solar Farm, Landscape Character and Visual Impact Assessment.* The LCVIA is referred to in this report as the 'original assessment'.
[2] Table 9 from the *Technical Supplement.* Colour added by Envisage

2 Proposed amendments

Lightsource bp propose the following amendments to the EIS Project:

1. Upgrading the intersection of the Golden Highway and Ringwood Road.
2. Additional upgrades to Ringwood Road.
3. Upgrading parts of Wollara Road.
4. Increasing BESS capacity (centralised BESS).
5. The option of a decentralised BESS (and the choice to host both centralised and decentralised BESS units)
6. Minor Project layout modifications (which, together, reduce the size of the development footprint by around 7 ha), being:
   a. Re-aligning the Project Area to avoid a Travelling Stock Route.
   b. Relocating solar arrays within the development footprint to avoid habitat.
7. Increasing the width of two internal access roads to approximately 10 m.
8. Constructing an additional transmission tower adjacent to the BESS/substation.
9. Revised approach for workforce accommodation.

The location of proposed amendments is shown in Figure 2-1. Visual changes associated with the Amended Project (compared to the EIS Project), are described in Table 2-1.

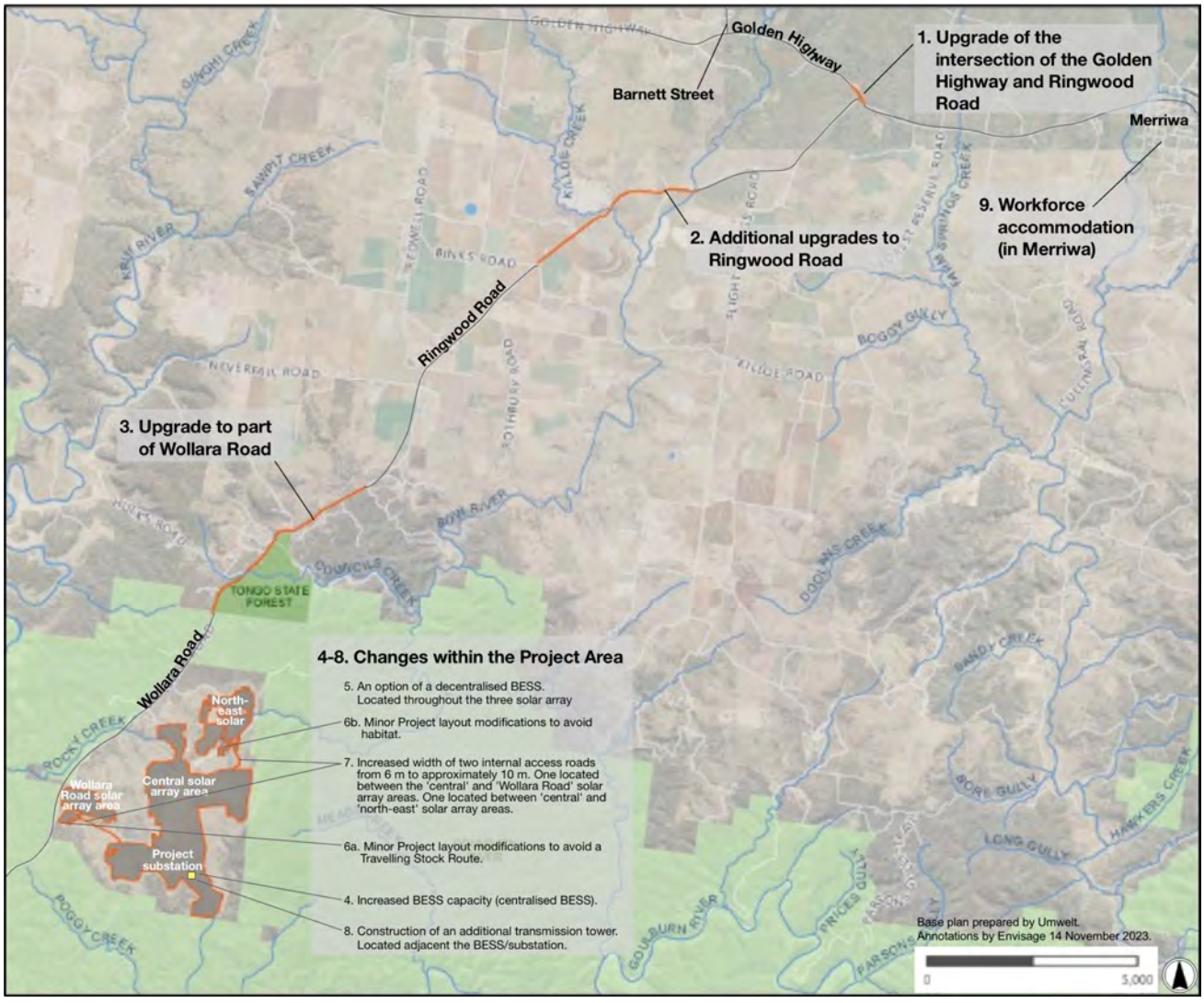

Figure 2-1: Location of Proposed Amendments

Table 2-1: Description of Amended Project and visible changes

Amendment	Description of amendment / Visual changes compared to EIS Project	Assessment required? / Where addressed
1. Golden Highway and Ringwood Road upgrade	The EIS Project did not include an upgrade to the intersection of Ringwood Road and the Golden Highway. An intersection upgrade is now proposed to: a) Facilitate 'left in left out' movement of construction vehicles (includes the use of a vehicle turn-around facility on Barnett Street) b) Improve safety/sight lines at the intersection. The Amended Project includes: • Pruning of vegetation and likely removal of around 6 mature trees on the western side of the intersection and pruning of vegetation on the eastern side of the intersection. The proposed vegetation clearance area is shown on Figure 2-2. • Embankment shaping (cut and fill) for a wider road surface, including minor lane widening on the eastern side of the intersection, a new 325 m long acceleration lane and extension of the deceleration lane on the western side of the intersection. • Formalisation of a bus stop. • Relocating power poles.	The potential impact to landscape character is assessed in Section 3. The potential impact to views is assessed in Section 4.
2. Additional upgrades to Ringwood Road.	The EIS Project included a 1.8 km upgrade to Ringwood Road (between Bow River and Killoe Creek). Ringwood Road is a local sealed road around 5.5 m wide. The Amended Project includes additional works on Ringwood Road comprising realignment, widening, and sealing of an additional 1.6 km section between Killoe Creek and Binks Road, increasing the total length of Ringwood Road to be upgraded to 3.4 km. The proposed road upgrade involves: • Widening an existing 5.5 m sealed road to 8 m for an additional 1.8 km • The upgrade being fully within the existing road corridor. • No change to the EIS Project inclusions of a stockpile, temporary construction side tracks, and possible additional signage. • Removal of approximately 20 trees. The proposed tree clearance area is shown on Figure 2-3.	The potential impact to landscape character is assessed in Section 3. The potential impact to views is assessed in Section 4.
3. Upgrade to part of Wollara Road.	The EIS Project did not include an upgrade to Wollara Road. Wollara Road is a local, partly sealed road. The Amended Project includes an upgrade to realign, widen, and seal a 4.7 km unpaved section of Wollara Road between the Goulburn River National Park boundary and 1621 Wollara Road (around 2 km north of the Project Area, to around 6.7 km north of the Project Area). The proposed road upgrade involves: • Changing an unsealed road surface to an 8 m wide, bitumen-sealed road surface with 0.5 m unsealed shoulders (4.7 km long). • The upgrade being fully within the existing road corridor. • Removing vegetation within the road corridor for 4.7 km. The proposed disturbance area is shown on Figure 2-4.	The potential impact to landscape character is assessed in Section 3. The potential impact to views is assessed in Section 4.
4. Increased capacity of centralised BESS	The EIS Project included a centralised BESS with 280 MWp / 570 MWh capacity, housed in approximately 33 BESS containers, adjacent to the substation, not seen from public viewpoints. The Amended Project increases the capacity of the centralised BESS by 170 MWp / 330 MWh to 450 MWp /900 MWh, and: • Does not increase the size of the development footprint. • Does not change the number, height, or type of BESS modules proposed. • Would remain located adjacent to the proposed substation, not seen from public viewpoints.	There is no change to the LCVIA assessment of impact to landscape character or views.
5. Decentralised BESS	The EIS Project did not include a decentralised BESS, or the option to host both centralised and decentralised BESS units). The Amended Project includes a decentralised BESS option with 560 battery containers and 560 DC-DC converters located next to inverters within the development footprint. An additional 36 inverters would be required. The capacity of the proposed decentralised BESS option would be 580 MWp / 1160 MWh. The proposed decentralised BESS and additional inverters: • Would not change the development footprint. • Would not exacerbate the extent of visual change to occur in the landscape (from agricultural to solar farm). • May be seen from Wollara Road.	There is no change to the LCVIA assessment of landscape character from the proposed decentralised BESS, or the option to host both centralised and decentralised BESS The potential impact to views is assessed in Section 4

Amendment		Description of amendment / Visual changes compared to EIS Project	Assessment required? / Where addressed
6.	Project layout modifications	The EIS Project development footprint occupied around 799.5 ha located within three distinct, cleared areas: • 1 x adjacent to Wollara Road (the smallest of the three areas) • 1 x centrally located (the largest of the three areas) • 1 x an area in the north-east. Only one of the three areas (the area adjacent to Wollara Road) would be seen from external viewpoints. The Amended Project would: a) Remove Project infrastructure (including fencing, landscaping, and solar panels) from Travelling Stock Route (TSR44841) within the area adjacent to Wollara Road. b) Relocate solar panels from the north-east area to previously unused areas (also within the north-east) to increase avoidance of plant community types and threatened species habitat. Proposed amendments to the layout: • Reduce the Project Area from 2,000 ha to 1996.5 ha and the development footprint from approximately 799.5 ha to approximately 792.2 ha (around 7.3 ha). • Changes to avoid threatened species habitat (in the north-east) would not be seen from public viewpoints. • Changes to avoid the TSR (adjacent to Wollara Road) may result in a visible change. Under the EIS Project the panels were located south-west of the existing residence. Under the Amended Project the panels would be relocated to the east of the existing residence. Therefore, there would be fewer panels in the immediate vicinity of Wollara Road. • Changes do not alter the height, or type of solar modules proposed, and general extent of agricultural area affected by the Project, and therefore, do not change the predicted impact to landscape character determined in the original Proposal.	There is no change to the LCVIA assessment of impact to landscape character. The potential impact to views is assessed in Section 4.
7.	Increased width of two internal access roads	The EIS Project included internal access tracks (4 m and 6 m wide) allowing for site maintenance. The Amended Project increases the width of two internal access roads to approximately 10 m, to accommodate subterranean transmission corridors proposed to travel adjacent to the internal access roads. The proposed wider internal roads: • Would not change the size of the development footprint. • Would not exacerbate the extent of visual change to occur in the landscape (from agricultural to solar farm). • One of the two proposed roads would be within the solar panel area adjacent to Wollara Road. • The other road would be located between the central and north-east solar array areas, not seen from external viewpoints.	There is no change to the LCVIA assessment of landscape character. The potential impact to views is assessed in Section 4.
8.	Construction of an additional transmission tower	The EIS Project did not include new transmission towers. The Amended Project includes one new transmission tower to be installed within the existing 500 kV transmission line easement within the Project Area, adjacent to an existing transmission tower. The additional transmission tower would be constructed at a height of approximately 65 m, in line with the existing transmission towers. The additional transmission tower: • Would not change the size of the development footprint. • Would be located adjacent to an existing tower, which is not seen from Wollara Road. • Would not be seen from accessible public locations.	There is no change to the LCVIA assessment of impact to landscape character or views.
9.	Workforce accommodation	The original LCVIA scope did not include workforce accommodation. The Amended Project includes the option of using an accommodation camp for up to 300 personnel (in Merriwa), along with other alternative accommodation options in and around Merriwa. The workforce accommodation amendment is not within the scope to be assessed in this addendum to the LCVIA.	There is no change to the LCVIA assessment of impact to landscape character or views.

Figure 2-2
Proposed vegetation clearance, Golden Highway / Ringwood Road intersection

GOULBURN RIVER SOLAR FARM
ADDENDUM LANDSCAPE CHARACTER AND VISUAL IMPACT ASSESSMENT

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Figure 2-3

Proposed disturbance footprint, Ringwood Road

GOULBURN RIVER SOLAR FARM

ADDENDUM LANDSCAPE CHARACTER AND VISUAL IMPACT ASSESSMENT

Figure 2-4
Proposed disturbance footprint, Wollara Road

GOULBURN RIVER SOLAR FARM
ADDENDUM LANDSCAPE CHARACTER AND VISUAL IMPACT ASSESSMENT

3 Landscape character impact with amendments

3.1 Amendments that may affect landscape character

As shown in Table 2-1, the following amendments to the EIS Project may affect landscape character:

- Golden Highway/Ringwood Road intersection upgrade.
- Upgrade to part of Ringwood Road (around 3.4 km).
- Upgrade to part of Wollara Road (around 4.7 km).

3.2 Landscape character zones

The LCVIA identified two distinct landscape character zones[3]:

- Open, agricultural landscape, distinguished by grazing pastures, rural infrastructure, and agricultural land use, including the project site, and
- Dense, forested landscape distinguished by tall, native vegetation, including the Goulburn River National Park.

Photographs illustrating landscape character in the vicinity of the road upgrades are shown in Figure 3-1.

Golden Highway landscape at the location of the proposed Golden Highway / Ringwood Road intersection upgrade

Open, agricultural landscape along Ringwood Road at location of proposed road upgrade

Dense, forested landscape along the route of the proposed Wollara Road upgrade

Figure 3-1: Photographs illustrating landscape character in the vicinity of proposed road upgrades

[3] The character of the landscape was described within approximately 5 km from the proposed development (as per the *Technical Supplement*).

The proposed Ringwood Road upgrade is located within the open, agricultural landscape, and the proposed Wollara Road upgrade is located wholly within the road corridor contained within the dense forested landscape character zone. However, the proposed Golden Highway intersection upgrade is located beyond the two originally described landscape character areas.

The Highway intersection is generally within an open, agricultural landscape, however, the character of the intersection is dominated by, the highway. Therefore, a new landscape character zone has been added to the assessment. This landscape character zone is typified by the two-lane, sealed highway, which carries comparatively higher-speed, greater-volume, heavier traffic than other roads within the study area. The terrain at the intersection is undulating, with cut and fill embankments. Individual tall native trees occur either side of the road within a grassed verge, and there are areas of dense shrubs and trees. For the purposes of this report, this character zone is called the 'Golden Highway' landscape character zone.

3.3 Assessment of landscape character impact

The assessment of impact to landscape character (of the Amended Project), is shown in Table 3-1. In summary:

- Sensitivity: Landscape character sensitivity is presented in Column A:
  - There is no change to the *low* rating of landscape sensitivity within the open, agricultural, or the dense forested landscape (determined in the LCVIA).
  - Landscape character sensitivity within the Golden Highway landscape is determined to be *low*.
- Magnitude. The assessment of magnitude of change is presented in Column B:
  - There is no change to the *low* rating of landscape magnitude within the open, agricultural landscape.
  - Magnitude of change to the dense, forested landscape zone increases to *moderate* from very low in the LCVIA.
  - Magnitude of change to the Golden Highway landscape character zone is assessed as *low*.
- Landscape character impact. The overall impact to landscape character impact is shown in Column C:
  - There is no change to the *low* rating of landscape character impact within the open, agricultural landscape.
  - Landscape character impact to the dense, forested landscape zone increases to *low* from very low in the LCVIA.
  - Landscape character impact to the Golden Highway landscape zone is assessed as *low*.

Table 3-1: Assessment of landscape character impacts

Landscape character zone	Column A Sensitivity of existing landscape character to the Project		Column B Magnitude of change to landscape character		Column C Landscape Character Impact	
	LCVIA	Amended Project	LCVIA	Amended Project	LCVIA	Amended Project
Golden Highway landscape	Not applicable. The EIS Project did not include changes to the Golden Highway.	Low The existing landscape is: ▪ Not recognised as having national or regional landscape values, and the highway is not a designated tourist route or scenic drive. ▪ Zoned SP2 Infrastructure (classified road) under the *Upper Hunter Local Environmental Plan (LEP) 2013*. There are no visual or amenity-related objectives for the zone. The purpose of the zone is to provide for infrastructure and prevent development that is not compatible or may detract from provision of infrastructure. ▪ However, the road is a main route from the Hunter Valley / east coast of NSW to western NSW, and is used by tourists, residents and heavy transport. ▪ And although the road corridor has been modified from its natural state, it has a rural countryside character established by the presence of tall native trees either along many parts of the road.	Not applicable. The EIS Project did not include changes to the Golden Highway.	Low ▪ Although apparent, particularly initially, the proposed removal of trees, road widening, and cut and fill are within the anticipated visual experience of a main road corridor, and overall would have a minor change on the visual environment of the intersection. ▪ The amendments are not uncharacteristic of the landscape character zone.	Not applicable. The EIS Project did not include changes to the Golden Highway.	Low
Open, agricultural landscape	Low (As determined in the LCVIA).	Low (no change)	Low (As determined in the LCVIA).	Low (no change) ▪ Some trees to be removed are mature and contribute to the landscape character of the road. ▪ Most trees to be removed are single, isolated trees; some are grouped together. Tree removal would be apparent, particularly initially. ▪ The proposed road widening and associated realignment of the road are within the anticipated visual experience of a road corridor. ▪ Although tree removal would change the visual environment, the amendments are not uncharacteristic of a road corridor. ▪ Trees to be removed are near the existing road edge. Trees beyond the construction zone would be retained and maintain the overall character of the road corridor.	Low (As determined in the LCVIA).	Low (no change)
Dense forested landscape	Low (As determined in the LCVIA).	Low (no change)	Very Low (As determined in the LCVIA).	Moderate ▪ There would be a noticeable change to the character of Wollara Road through the removal of tall native trees and shrubs within the road corridor for 4.7 km, and sealing of the road. ▪ Native vegetation would still flank both sides of the road, enclosing and restricting the view to the road corridor; however, the view within the road corridor would be wider, featuring more sky and less overhead canopy, and the new sealed road would be a prominent feature. ▪ The changes would be permanent.	Very low (As determined in the LCVIA).	Low (Increases from Very Low)

4 Visual impact with amendments

4.1 Amendments that may affect views

As shown in Table 2-1, the following amendments to the EIS Project may affect views:

- Golden Highway/Ringwood Road intersection upgrade.
- Upgrade to part of Ringwood Road (around 3.4 km).
- Upgrade to part of Wollara Road (around 4.7 km).
- Decentralised BESS
- Project layout modifications (removal and relocation of solar panels)
- Increased width to two internal roads

4.2 Assessment viewpoints

Solar farm

The amendments associated with the decentralised BESS, layout modifications, and internal roads, would occur within the EIS Project Development Footprint (the solar farm). The LCVIA identified five residences (R3, R5, R9, R21, R46) and one public road (Wollara Road) within 4 km of the Development Footprint which required 'detailed assessment'[4]. Two of those viewpoints (R9 and R21) were subsequently eliminated from the detailed assessment, as vegetation obstructed views toward the Project.

As the Amended Project involves removal of trees between R9 and R21 residences and the Project Area, the potential impact to these viewpoints has been re-examined. Table 4-1 describes the changes:

- There was no change in the view of R9 and R21 toward the solar farm due to the Amended Project.
- However, R9 would view the Wollara Road upgrade, and has therefore been included in the assessment of the road upgrade.

Table 4-1: Visibility of R9 and R21

Viewpoint	Original LVIA assessment	With proposed tree clearing on Wollara Road (Amended Project)	
		View of solar farm?	View of Wollara Road upgrade?
R9	Vegetation obstructs the view toward the solar farm. The view from R9 is shown in Figure A-1, Appendix A.	Proposed tree removal along Wollara Road would not affect the view south toward the solar farm.	Proposed tree removal may affect the view east, of Wollara Road at the entry to the property.
R21	Vegetation obstructs the view toward the solar farm. The view from R21 is shown in Figure A-2, Appendix A.	Existing trees in the foreground not affected by proposed tree removal would continue to limit the view toward the solar farm. There is over 2 km of dense trees south of Wollara Road (between Wollara Road and the Development Footprint) that would continue to screen the solar farm.	Proposed tree removal along Wollara Road would not affect the view south toward Wollara Road. Wollara Road is around 10 m or so lower in elevation than the residence, and there is an area of trees (around 150 m wide) between the residence and Wollara Road that would continue to screen Wollara Road.

Road upgrades

In addition to R9, two other viewpoints already identified (R46 and Wollara Road) would potentially have views of the proposed Wollara Road upgrade, and have been included in the assessment.

Other viewpoints in the vicinity of the proposed road upgrades (which did not require 'detailed assessment' in the LVIA) have been investigated to determine if they would have potential views. It was found that:

[4] Viewpoints were identified within 4 km from the proposed development (as per the *Technical Supplement*).

- There were no residences with a view of the proposed Golden Highway / Ringwood Road intersection.
- Road users travelling through the Golden Highway / Ringwood Road intersection would see the upgrade.
- There are five Ringwood Road residences (not previously identified in the LCVIA) with a potential view of the proposed Ringwood Road upgrade (R11, R12, R13, R14 and R15). These residences have similar characteristics and are assessed as a 'representative viewpoint'.
- Road users travelling along Ringwood Road would see the upgrade.
- In addition to R9, there are new Wollara Road residences (not previously identified in the LCVIA) which would have potential views of the Amended Project (being the Wollara Road upgrade): R22, R29, R32, R39, R41and R44.

Consolidated viewpoints

As a result of the above investigations there are now a total of 14 viewpoints to be assessed: 10 private residential viewpoints along Wollara Road (three of which were previously assessed), one viewpoint representing residences along Ringwood Road, and three viewpoints representing users of public roads). A consolidated list of viewpoints is shown in Table 4-2. Wollara Road residential receivers are mapped on Figure 4-1 and Figure 4-2.

Table 4-2: Consolidated viewpoints for assessment

Type of viewer	Receiver number	Aspect of Amended Project potentially in view			
		Solar Farm	Ringwood Road upgrade	Wollara Road upgrade	Golden Highway / Ringwood Road intersection
Private residential	R3	Originally assessed for views of solar farm	No	No	No
	R5	Originally assessed for views of solar farm	No	No	No
	R9	Previously identified, however, eliminated from detailed assessment	No	Included in this addendum for impact of Wollara Road upgrade.	No
	R22	New viewpoint. Not previously assessed.	No	Included in this addendum for impact of Wollara Road upgrade.	No
	R29	New viewpoint. Not previously assessed.	No	Included in this addendum for impact of Wollara Road upgrade.	No
	R32	New viewpoint. Not previously assessed.	No	Included in this addendum for impact of Wollara Road upgrade.	No
	R39	New viewpoint. Not previously assessed.	No	Included in this addendum for impact of Wollara Road upgrade.	No
	R41	New viewpoint. Not previously assessed.	No	Included in this addendum for impact of Wollara Road upgrade.	No
	R44	New viewpoint. Not previously assessed.	No	Included in this addendum for impact of Wollara Road upgrade.	No
	R46	Originally assessed for views of solar farm.	No	Included in this addendum for impact of Wollara Road upgrade.	No
	Ringwood Rd residences (representative)	No. New viewpoint. Not previously assessed.	New viewpoint. Included in this addendum for impact of Ringwood Road upgrade.	No	No
Public	Ringwood Rd users	No. New viewpoint. Not previously assessed.	New viewpoint. Included in this addendum for impact of Ringwood Road upgrade.	No	No
	Wollara Road users	Originally assessed for views of solar farm.	No	Included in this addendum for impact of Wollara Road upgrade.	No
	Golden Hwy / Ringwood Rd intersection users	No. New viewpoint. Not previously assessed.	No	No	Included in this addendum for impact of Golden Hwy / Ringwood Rd upgrade.

Figure 4-1
Receivers - Wollara Road

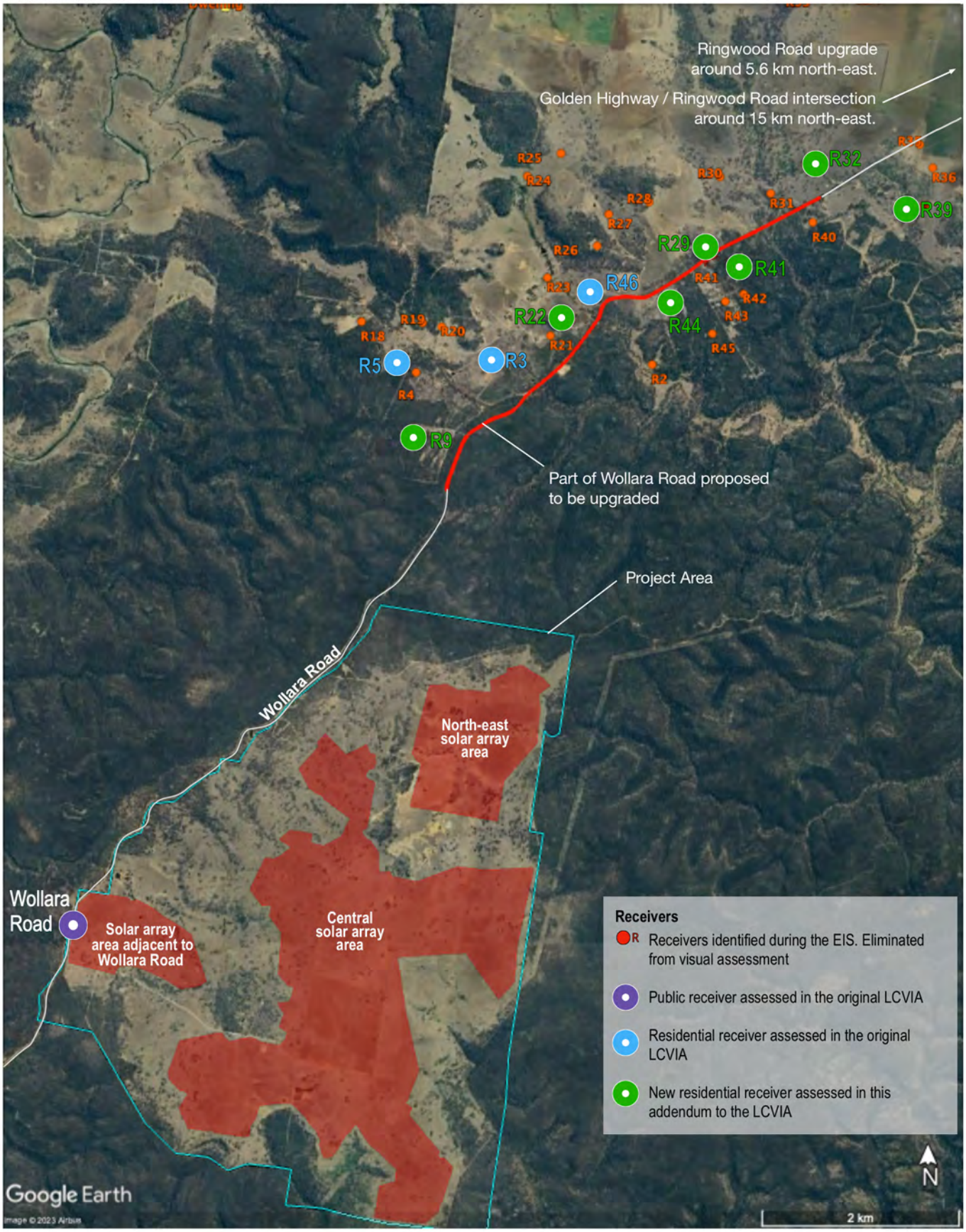

Figure 4-2
Receivers - Ringwood Road

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4.3 Assessment of impact

The assessment of visual impact to the 14 viewpoints is presented in Table 4-3. The key points are:

- Sensitivity: Viewpoint sensitivity is presented in Column A:
  - There is no change to the rating of sensitivity for the four originally assessed viewpoints (R3, R5, R46 and Wollara Road).
  - Viewpoint sensitivity rating for the additional seven Wollara Road viewpoints (R9, R22, R29, R32, R39, R41 and R44) was determined using Tables 5, 6 and 7 of the *Technical Supplement*. Sensitivity was determined as *low or very low.*
  - Viewpoint sensitivity for Ringwood Road residents (representative viewpoint) was determined as *low.*
  - Viewpoint sensitivity for the two new public road user viewpoints (Ringwood Road and the Golden Highway/Ringwood Road intersection) was determined as *very low.*
- Magnitude: The assessment of magnitude is presented in Column B:
  - There is no change to the rating of magnitude for the four originally assessed viewpoints.
  - The magnitude rating for the additional seven Wollara Road residential viewpoints, and the representative Ringwood Road residential viewpoint was determined as *low.*
  - The magnitude rating for the two new public road user viewpoints (Ringwood Road and the Golden Highway/Ringwood Road intersection) was determined as *low*.
- Visual impact: The overall rating of visual impact of the Amended Project is presented in Column C:
  - There is no change to the visual impact rating for the four originally assessed viewpoints.
  - The visual impact rating for the additional seven Wollara Road residential viewpoints is *low.*
  - The visual impact rating for the representative Ringwood Road residential viewpoint is *low.*
  - The visual impact rating for the additional two public viewpoints(that would see the proposed Ringwood Road upgrade or Golden Highway / Ringwood Road upgrade) is *very low.*

Table 4-3: Updated visual impact assessment – Project with amendments

Viewpoint		Column A Visual sensitivity rating		Column B Visual magnitude rating		Column C Visual impact rating		Column D Residual impact rating	
		LCVIA	Amended Project	LCVIA	Amended Project	LCVIA	Amended Project	LCVIA	Amended Project
Private residences	R3	Moderate	Moderate	Very low	Very Low (no change) ▪ The Amended Project would not affect the cell count of the 'modelled view' of the EIS Project. Therefore, there is no change to the original rating of magnitude. ▪ Although there would be tree removal along Wollara Road, an area of trees (over 450 m wide) would remain between the residence and Wollara Road reserve. Therefore, the proposed Wollara Road upgrade would not be seen from the residence.	Low	Low (no change)	Low	Low (no change)
	R5	Moderate	Moderate	Very low	Very Low (no change) ▪ The Amended Project would not affect the cell count of the 'modelled view' of the EIS Project Therefore, there is no change to the original rating of magnitude. ▪ The residence is over 3 km from Wollara Road and there are tall trees between the residence and the road reserve. Therefore, the proposed Wollara Road upgrade would not be seen from the residence.	Low	Low (no change)	Low	Low (no change)
	R9	N/A	Low There is a secondary view from the rural dwelling toward Wollara Road which includes forested landscape.	N/A	Low The residence is around 530 m from Wollara Road. There may be a minor change to the existing view east because of proposed tree removal. There may be a larger section of Wollara Road seen, and therefore, more traffic visible from the residence. However, overall, there would be a minor change to the view.	N/A	Low	N/A	Low
	R22	N/A	Low It has been assumed there would be a secondary view from the rural dwelling toward Wollara Road which would include forested landscape.	N/A	Low The residence is over 340 m from Wollara Road. There would be a minor change to the existing view east because of proposed tree removal. There may be a larger section of Wollara Road seen, and therefore, more traffic visible from the residence, however, overall, there would be a minor change to the view.	N/A	Low	N/A	Low
	R29	N/A	Low It has been assumed there would be a secondary view from the rural dwelling toward Wollara Road which would include forested landscape	N/A	Low The residence is around 90 m from Wollara Road. There is an area of trees (around 50 m wide) between the residence and the road, however, it is likely Wollara Road would be seen beyond the trees. There would be a change to the existing view south-east because of proposed tree removal within the road reserve, however, overall, there would be a minor change to the view.	N/A	Low	N/A	Low
	R32	N/A	Low It has been assumed there would be a secondary view from the rural dwelling toward	N/A	Low The residence is around 250 m from Wollara Road. There are relatively few trees between the residence and the road reserve. There would be a change to the existing view south to south-east because of proposed tree removal. There would be a larger section of the road seen, and therefore, more traffic	N/A	Low	N/A	Low

Viewpoint		Column A Visual sensitivity rating		Column B Visual magnitude rating		Column C Visual impact rating		Column D Residual impact rating	
		LCVIA	Amended Project	LCVIA	Amended Project	LCVIA	Amended Project	LCVIA	Amended Project
			Wollara Road which would include forested landscape		visible from the residence, however, overall, there would be a minor change to the view.				
	R39	N/A	Low It has been assumed there would be a secondary view from the rural dwelling toward Wollara Road which would include forested landscape	N/A	Low Wollara Road is over 500 m from the residence, however, there are relatively few trees between the residence and the road reserve. There would be a change to the existing view west because of proposed tree removal. There would be a larger section of the road seen, and therefore, more traffic visible from the residence, however, However, overall, there would be a minor change to the view.	N/A	Low	N/A	Low
	R44	N/A	Low It has been assumed there would be a secondary view from the rural dwelling toward Wollara Road which would include forested landscape	N/A	Low The residence is over 120 m from Wollara Road. There are relatively few trees between the residence and the road reserve. There would be a change to the existing view north to north-west because of proposed tree removal. There would be a larger section of the road seen, and therefore, more traffic visible from the residence, however, overall, there would be a minor change to the view.	N/A	Low	N/A	Low
	R46	Moderate	Moderate	Very low	Very Low (no change) ▪ The Amended Project does not affect the cell count of the 'modelled view' of the EIS Project. Therefore, there is no change to the original rating of magnitude. ▪ Although there would be tree removal along Wollara Road, an area of trees (around 180 m wide) would remain between the residence and Wollara Road reserve. Therefore, the proposed Wollara Road upgrade would not be seen from the residence.	Low	Low (no change)	Low	Low (no change)
	Ringwood Road residential (repres-entative)	N/A	Low It has been assumed there would be a secondary view from the rural dwelling toward Ringwood Road which would include the open, agricultural landscape.	N/A	Low ▪ The five residences range from around 100 m to 300 m to the road corridor. ▪ The road corridor is generally at a lower elevation compared to the residence, and it is likely the road would not be prominent in views. ▪ All residences have trees surrounding the residence, or between the residence and the road corridor, that would be retained. ▪ Tree removal would not result in a significant change to the view. It would be unlikely to increase the extent of road surface in view. It may open the view slightly to agricultural landscape.	N/A	Low	N/A	Low
Public	Ringwood Road	N/A	Very low Local sealed road with view of open, agricultural landscape.	N/A	Low ▪ Ringwood Road users would initially notice removal of mature trees, however, visual changes associated with road upgrades (such as the widened road surface, and realignment of the road) are an expected experience for road users and, would be unlikely to significantly impact views.	N/A	Very low	N/A	Very low

Viewpoint		Column A Visual sensitivity rating		Column B Visual magnitude rating		Column C Visual impact rating		Column D Residual impact rating	
		LCVIA	Amended Project	LCVIA	Amended Project	LCVIA	Amended Project	LCVIA	Amended Project
	Wollara Road	Low	Low	Very high	Very high (no change) ▪ The visual magnitude cell count of the 'modelled view' of the EIS Project, was 'very high'. This is the highest magnitude rating (as per the *Technical Supplement*). ▪ The Amended Project reduces the extent of solar panels that would be in view (due to relocation of panels from the TSR). However, as the originally modelled view represents a 'worst-case scenario' and was used as the basis to develop the landscape plan. the 'modelled view' has not been updated. ▪ However, the following visual differences associated with the Amended Project are noted compared to the EIS Project: o The proposed decentralised BESS units, although a similar height to the solar panels, would be lighter in colour and contrast to the darker panels, and be seen within the solar array. o One of the wider internal roads may be partly seen; however, it would not be prominent. ▪ Tree removal along the 4.7 km section of Wollara Road to be upgraded would be clearly apparent and adversely affect the scenic experience for many road users. The extent of trees to be removed would change the view - from an enclosed, tree-lined, unsealed road corridor to a wider, more open, sealed road corridor.	Moderate	Moderate (no change)	Moderate	Moderate (no change)
	Golden Hwy / Ringwood Rd intersection	N/A	Very low The Golden Highway is a classified main road.	N/A	Low ▪ Views of the intersection for road users would be brief and temporary. ▪ Proposed tree removal would be apparent, at least initially, to regular travellers using the intersection. ▪ However, visual changes associated with highway upgrades (such as the proposed new acceleration lane and widened road surface) are an expected experience for road users of a main road and, would be unlikely to impact views.	N/A	Very low	N/A	Very low

N/A – Not applicable. This viewpoint did not require 'detailed assessment' in the LCVIA

4.4 Performance objectives and mitigation

There is no change to the EIS Project assessment which found the Wollara Road public viewpoint (with a moderate visual impact rating) was the only viewpoint requiring mandatory consideration against the 'performance objectives' in the *Technical Supplement*.

Draft landscape plan

To address 'performance objectives', the EIS Project assessment included a draft landscape plan (presented in the LCVIA as Figure 6-11).

Due to the relatively minor amendments, there is no change to the intended landscape strategy or draft planting schedule. The draft landscape plan would be finalised as part of management plans, including adjustment of any fencing to accommodate the proposed landscaping.

Additional mitigation measures

Mitigation measures were included in the LCVIA and are shown in Column A, Table 4-4. Additional mitigation measures, including clarification of measures associated with the landscape plan, have been added to address impacts associated with the Amended Project, as shown in Column B, Table 4-4.

Lighting

There is no change to operational lighting from the EIS Project, however, the proposed road upgrades increase the construction zone, and likelihood for lighting during construction. To reduce the potential impact of construction light, mitigation measures included in the EIS Project assessment (to address potential dark sky impacts) are applicable and should be implemented for the Amended Project.

4.5 Residual visual impact

The residual visual impact of the Amended Project is presented in Column D, Table 4-3, and shows:

- There is no change to the residual visual impact rating for the four originally assessed viewpoints. A photomontage of Wollara Road with proposed mitigation screening was included in the LCVIA and showed the likely effectiveness of proposed landscaping, reducing the magnitude rating from very high (67 cells) to very low (3 cells), and the visual impact from *moderate* to *very low.*
- The residual visual impact rating for the additional seven Wollara Road residential viewpoints (that would see the Wollara Road upgrade) and the representative Ringwood Road residential viewpoint is *low,* consistent with the visual impact determined following construction.
- The residual visual impact rating for the two additional public viewpoints (that would see the proposed Ringwood Road upgrade or Golden Highway / Ringwood Road upgrade) is *very low,* consistent with the visual impact determined following construction.

4.6 Cumulative visual impact

There is no change to the LCVIA of cumulative impact. The Amended Project would increase the area affected by construction; however, construction would be temporary and road upgrades would occur within existing road corridors. Following construction there would be no ongoing visual connection or association between the upgraded roads and the solar farm.

Table 4-4: Mitigation measures

Intent	Timing	Column A Original mitigation measures	Column B Additional mitigation measures to address Amended Project
Avoid night sky impacts	Design	- Design and install lighting to follow best practice lighting principles identified within the Dark Sky Planning Guidelines [5]: 1. Eliminate upward spill light 2. Direct light downwards, not upwards 3. Use shielded fittings 4. Avoid 'over' lighting 5. Switch lights off when not required 6. Use energy efficient bulbs 7. Use asymmetric beams, where floodlights are used 8. Ensure lights are not directed towards reflective surfaces 9. Use warm white lighting colours.	No change
	Construction	- Ensure all lights are turned off before vacating the construction site at the end of the day. - Lighting to be installed in accordance with AS4228-1997 - Control of Obtrusive Effects of Outdoor Lighting.	No change
	Operation	- Switch lights off when not required. - Ensure lights are only used in exceptional circumstances – emergency or security situations.	No change
Reduce visibility and contrast of Project in the landscape	Design	- Select an inconspicuous colour for the office/storage containers if possible, so they are darker in colour and less prominent[6]. Dark grey is generally considered a good colour for ancillary infrastructure. - Fences surrounding the solar modules should have a dulled finish to reduce contrast. Do not install highly reflective materials.	- Subsequent to project approval, as part of the management plans, the draft landscape plan would be refined, detailed and finalised, including adjustment of any fencing to accommodate the proposed landscaping. - The aim of the detailed landscape plan is to establish a quick growing, dense screen to reduce public views of the solar panels from Wollara Road, as well as providing additional ecological benefits. - The detailed landscape plan is to be: ▪ Prepared prior to landscape implementation. ▪ Be guided by ongoing consultation with NP&WS, Upper Hunter Shire Council and TfNSW (particularly regarding plant species, spacing, and whether soil improvement is required and road safety measures/tree clearance zones and TFNSW relevant policy).
	Construction	- Locate the construction compound, vehicle parking and equipment storage areas, in the vicinity of the Post War homestead (as shown on Project Area plans) so they are set back from Wollara Road and partially (or fully) screened from view (from Wollara Road) via existing vegetation or landform. - Keep site tidy and neat. - If soils are disturbed (e.g., during the construction of internal roads or due to wear and tear of surfaces from vehicle movement), introduce wind erosion controls to reduce the potential for dust: ▪ bring water cart to site and water exposed surfaces ▪ avoid ground disturbance on high wind days - cover stockpiles of loose materials (if any).	- Implement the detailed landscape plan. - Progressively stabilise surfaces as construction is completed.

[5] Australian Government, Department of the Environment and Energy, *National Light Pollution Guidelines for Wildlife*, January 2020 and New South Wales Department of Planning & Environment, *The Dark Sky Planning Guideline*, 2023

[6] Inverters and other larger facility components that are colour-treated two to three shades darker than the background landscape colour, better match the surroundings and decrease their visibility and contrast. White is generally the most conspicuous colour. Lighter colours should be avoided.

Intent	Timing	Column A Original mitigation measures	Column B Additional mitigation measures to address Amended Project
	Operation	- Do not install commercial messages or large-scale signage. Signage (if required) should be of sufficient size to contain only information sufficient for the basic facility and company identification, for safety, navigation, and delivery purposes.	- Implement ongoing maintenance of landscaping as detailed in the landscape plan. - Monitor road upgrade to ensure the stabilisation of verges. - Implement correctional measures if erosion occurs or dust is an issue.
Minimise impact to existing landscape character	Design	- Retain as much existing vegetation within the solar farm Project Area as possible.	- Retain trees where possible within/near the road upgrade construction zone.
	Construction	- Protect existing trees (that are to be retained) during construction activities.	- Protect trees within/near the road upgrade construction zone in accordance with TfNSW guidelines *(Vegetation Management (Protection and Removal) Guideline. DMS-SD-111)*. - Replace native trees to be removed at the Ringwood Road upgrade, and the Golden Highway / Ringwood Road intersection, in accordance with TfNSW guidelines (*Vegetation Offset Guide DMS-SD-087*).
	Operation		- Monitor disturbed trees that have been heavily impacted within their root zone for stability and longevity. - Stabilise exposed surfaces.

5 Key findings

5.1 Summary of visual changes

The Amended Project would result in the following *visible* changes compared to the originally assessed Project:

- Tree clearing, earthworks and road widening associated with an upgrade of the Golden Highway / Ringwood Road intersection.
- Road widening, realignment, and likely removal of around 20 trees along Ringwood Road at the location of the upgrade. Some trees to be removed are mature native trees.
- Tree clearing, vegetation removal, realignment and bitumen surfacing of a 4.7 km unsealed section of Wollara Road.
- Option for decentralised BESS units throughout all three (originally identified) solar array areas.
- Minor relocation of solar panels within the solar array area adjacent to Wollara Road.
- Increased width of an internal access road within the solar farm.

The following proposed amendments would not be seen:

- Increased capacity of centralised BESS (located near the Project substation)
- Relocation of solar array to avoid threatened species habitat (located in the north-eastern solar array area)
- One of the widened internal roads (located between the central and north-east solar array areas).
- Construction of an additional transmission tower (located near the substation).

5.2 Landscape character impact with amendments

Additional landscape character zone

A new 'Golden Highway' landscape character zone has been added to the assessment, as the proposed Golden Highway / Ringwood Road intersection upgrade is beyond the two originally described landscape character areas. The intersection is within a distinct landscape character zone centred along the highway.

Landscape sensitivity

There was no change to the *low* rating of landscape sensitivity for the two original landscape character zones. The Golden Highway character zone was determined by this assessment to have *low* sensitivity.

Landscape magnitude to change

The magnitude of change to landscape character from the Amended Project:

- Remains at *low* within the open agricultural landscape zone. The Amended Project would not exacerbate the extent of visual change to occur in the landscape.
- Increases to *moderate* (from *very low*) along the road corridor within the dense, forested landscape zone due to proposed tree removal, widening and sealing of Wollara Road. Although native vegetation would still flank both sides of the road, visual character would change from a narrower enclosed landscape with an unsealed road; to a more open landscape, with a wider, sealed, road.
- Is assessed as *low* within the Golden Highway landscape zone. Removal of trees, road widening, cut and fill would have a minor change overall on the visual environment of the intersection.

Impact to landscape character

Landscape character findings are summarised in Table 5-1. The overall rating of impact to each landscape character zone from the Amended Project is determined as:

- *low* within the open agricultural landscape character zone (no change from the LCVIA)
- *low* within the dense, forested landscape character zone (increasing from *very low* in the LCVIA)
- *low* within the Golden Highway landscape character zone.

Table 5-1: Summary of assessment of landscape character impacts

Landscape character zone	Column A Sensitivity	Column B Magnitude of change		Column C Landscape Character Impact	
		LCVIA	Amended Project	LCVIA	Amended Project
Open, agricultural landscape	Low	Low	Low	Low	Low
Dense forested landscape	Low	Very Low	Moderate	Very low	Low
Golden Highway landscape	Low	Not applicable	Low	Not applicable	Low

5.3 Visual impact with amendments

Viewpoints

The LCVIA identified viewpoints within 4 km of the Project Area and determined four viewpoints (three residences: R3, R5 and R46); and one public receiver: Wollara Road users) required 'detailed assessment'[7]. In this Addendum, viewpoints within 4 km of the Project Area that were previously eliminated from 'detailed assessment', as well as viewpoints beyond 4 km of the Project Area, were re-examined to determine if there would be potential views of the Amended Project.

Ten additional viewpoints have subsequently been identified for detailed assessment in this Addendum:

- Seven additional Wollara Road residential receivers (R9, R22, R29, R32, R39, R41 and R44)
- One representative Ringwood Road residential viewpoint (representing five Ringwood Road residences (R11, R12, R13, R14 and R15), and
- Two public road user viewpoints (Ringwood Road users and Golden Highway / Ringwood Road intersection users).

There is now a total of 14 viewpoints assessed in this addendum.

Viewpoint sensitivity

There is no change to the rating of sensitivity for the four originally assessed viewpoints.

Viewpoint sensitivity ratings for the additional viewpoints have been determined to be *low* or *very low* for the seven residences and *very low* for the two public road viewpoints.

Magnitude

There is no change to the rating of magnitude for the four originally assessed viewpoints.

The magnitude rating for the additional residential and public road user viewpoints was determined as *low*.

Visual impact

There is no change to the visual impact rating for the four originally assessed viewpoints. The visual impact rating for the additional eight viewpoints was determined as:

- *low* for the additional seven residences (that would see the proposed Wollara Road upgrade) and the viewpoint representative of Ringwood Road residences.
- *very* low for the two additional public road user viewpoints (that would see the proposed Ringwood Road upgrade or Golden Highway / Ringwood Road upgrade).

[7] Detailed assessment as per the *Technical Supplement*. Originally five receivers within 4 km of the Project required 'detailed assessment', however, two were subsequently eliminated as vegetation obstructed views.

Visual impact findings are summarised in Table 5-2.

Table 5-2: Summary of visual impact assessment impacts

Viewpoint		Column A Visual sensitivity rating		Column B Visual magnitude rating		Column C Visual impact rating		Column D Residual impact rating	
		LCVIA	Amended Project	LCVIA	Amended Project	LCVIA	Amended Project	LCVIA	Amended Project
Private residences	R3	Moderate	Moderate	Very low	Very Low	Low	Low	Low	Low
	R5	Moderate	Moderate	Very low	Very Low	Low	Low	Low	Low
	R9	N/A	Low	N/A	Low	N/A	Low	N/A	Low
	R22	N/A	Low	N/A	Low	N/A	Low	N/A	Low
	R29	N/A	Low	N/A	Low	N/A	Low	N/A	Low
	R32	N/A	Low	N/A	Low	N/A	Low	N/A	Low
	R39	N/A	Low	N/A	Low	N/A	Low	N/A	Low
	R44	N/A	Low	N/A	Low	N/A	Low	N/A	Low
	R46	Moderate	Moderate	Very low	Very Low	Low	Low	Low	Low
	Ringwood Road residential	N/A	Low	N/A	Low	N/A	Low	N/A	Low
Public	Ringwood Road	N/A	Very low	N/A	Low	N/A	Very low	N/A	Very low
	Wollara Road	Low	Low	Very high	Very high	Moderate	Moderate	Moderate	Moderate
	Golden Highway / Ringwood Road intersection	N/A	Very low	N/A	Low	N/A	Very low	N/A	Very low

5.4 Performance objectives

There is no change to the LCVIA which determined that the Wollara Road viewpoint (with a moderate visual impact rating) is the only viewpoint requiring mandatory assessment against the *Technical Supplement* 'performance objectives'.

The draft landscape plan prepared to address those performance objectives has been prepared and would be detailed prior to implementation of the Project to reflect the final solar farm layout, and additional mitigation measures have been recommended to address impacts associated with the Amended Project, including removal of trees associated with road upgrades.

There is no change to the findings of cumulative visual impact associated with the Amended Project.

6 References

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Transport for NSW, 2022, *Vegetation Offset Guide. DMS-SD-087.*

Appendix A

Figure A - 1: Existing view from R9 looking toward the Project Area (8 February 2023)

Figure A - 2: Existing view from R21 looking toward the Project Area (8 February 2023)

APPENDIX J

Aboriginal Cultural Heritage Assessment Report

Axe grinding groove site at Killoe Creek (37-1-1033 [Killoe Creek GG1]).

ADDENDUM ABORIGINAL CULTURAL HERITAGE ASSESSMENT REPORT

GOULBURN RIVER SOLAR FARM

UPPER HUNTER LOCAL GOVERNMENT AREA, NSW

DECEMBER 2023

Report prepared by

OzArk Environment & Heritage

for Umwelt (Australia)

on behalf of Lightsource Development Services Australia Pty Ltd

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ABORIGINAL CULTURAL HERITAGE ASSESSMENT REPORT COVER SHEET

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Proponent	Lightsource Development Services Australia Pty Ltd
Client	Umwelt (Australia)
Document Description	Addendum Aboriginal Cultural Heritage Assessment Report: Goulburn River Solar Farm
File Location	OzArk Job No.
Umwelt Australia\Goulburn River solar farm\Addendum ACHAR	3414

Document Status: V3.0 Final	Date:11 December 2023
OzArk internal edits	V1.0: BD author 18/9/23 V1.1: BC edit 29/9/23
OzArk and client edits	V2.0 BC prepares for client release 16/10/23 V2.1: BC amends with new project description V2.2: BC amends with new project description 9/11/23 V2.3 BC amends with client comments 25/11/23 V2.4 BC amends with new project figures 9/12/23 V2.5 BC amends 10/12/23
Final document	V3.0 BC finalises 11/12/23
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Enquiries should be addressed to OzArk Environment & Heritage.

Acknowledgement

OzArk acknowledge the traditional custodians of the area on which this assessment took place and pay respect to their beliefs, cultural heritage, and continuing connection with the land. We also acknowledge and pay respect to the post-contact experiences of Aboriginal people with attachment to the area and to the Elders, past and present, as the next generation of role models and vessels for memories, traditions, culture and hopes of local Aboriginal people.

ABBREVIATIONS AND GLOSSARY

ACHAR	Aboriginal Cultural Heritage Assessment Report. As set out in the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales*, all developments where harm to Aboriginal objects is likely must be assessed in an ACHAR.
ACHCRs	*Aboriginal Cultural Heritage Consultation Requirements for Proponents.* Guidelines for conducting Aboriginal community consultation for developments where harm to Aboriginal objects is likely.
Addendum Study Area	Areas of proposed additional impact related to Wollara and Ringwood Roads and the intersection with the Golden Highway.
AHIMS	Aboriginal Heritage Information Management System. Administered by the DPE, AHIMS is the central register of all Aboriginal sites within NSW.
Code of Practice	*Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* under Part 6 NPW Act. Issued by DECCW in 2010, the Code of Practice is a set of guidelines that allows limited test excavation without the need to apply for an AHIP.
Development Footprint	The area within which all project impacts will be located.
EIS	Environmental Impact Statement. A required document for major projects documenting all potential impacts to the environment, including heritage, that may arise due to the development.
Heritage NSW	Government department tasked with ensuring compliance with the NPW Act. Heritage NSW is advised by the Aboriginal Cultural Heritage Advisory Committee (ACHAC).
Lightsource bp	Lightsource Development Services Australia Pty Ltd
NPW Act	*National Parks and Wildlife Act 1974*. Primary legislation governing Aboriginal cultural heritage within NSW.
RAP	Registered Aboriginal Party. An individual or group who have indicated through the ACHCR process that they wish to be consulted regarding the project.

EXECUTIVE SUMMARY

OzArk Environment and Heritage (OzArk) has been engaged by Umwelt (Australia) Pty Ltd on behalf of Lightsource Development Services Australia Pty Ltd (Lightsource bp) (the proponent) to complete an Addendum Aboriginal Cultural Heritage Assessment Report for several amendments to the original project design as outlined in the Environmental Impact Statement (EIS), associated with the Goulburn River Solar Farm (SSD-33951458) (the Project). The amendments are termed 'the Amended Project' in this report.

The Amended Project is in the Upper Hunter Local Government Area.

Proposed amendments to the Project following public exhibition of the EIS and additional design refinements are summarised below.

1. Transport route amendments and upgrade of the intersection of the Golden Highway and Ringwood Road.
2. Upgrades to additional parts of Wollara Road and Ringwood Road.
3. Increased BESS capacity and option of a decentralised BESS and the choice to host both centralised and decentralised BESS units.
4. Minor modifications to the Development Footprint and internal layout including:
    - Removal of travelling stock route (TSR) 4481 from within the Project Area although site access will remain through the TSR with no access upgrades.
    - Relocation and/or removal of solar arrays within the Development Footprint to avoid Regent Honeyeater Habitat, scattered trees and Box Gum Woodland.
    - Increased width of selected internal access roads to accommodate subterranean power cables
5. Construction of an additional transmission tower adjacent the BESS/substation.

As a result of these modifications the Development Footprint is approximately 792 hectares (ha), a reduction of 7 ha from the EIS.

In 2022–2023 OzArk completed the Aboriginal Cultural Heritage Assessment Report (ACHAR) for the Project (OzArk 2023) and the report was included as part of the Project's EIS. This Addendum ACHAR should be read in conjunction with the ACHAR for the EIS (OzArk 2023).

OzArk 2023 included survey and reporting of upgrades to sections of Wollara Road and Ringwood Road, as well as the landforms proposed for the relocated solar arrays and the additional transmission tower. The upgrade to the intersection of the Golden Highway and Ringwood Road was not included in OzArk 2023. This Addendum ACHAR repeats the results of the upgrades to sections of Wollara Road and Ringwood Road to remain consistent with other specialist reports discussing the Amended Project.

The Addendum study area includes the intersection of the Golden Highway with Ringwood Road, located approximately seven kilometres from Merriwa and the current road corridor along Ringwood Road and Wollara Road, connecting the Project area with the Golden Highway. The Addendum study area also includes landforms proposed for the realigned Development Footprint, the relocated solar arrays, and the additional transmission tower that are located within the previously assessed Development Footprint.

Survey of the Wollara Road and Ringwood Road portions of the Addendum study area, as well as the landforms proposed for the realigned Development Footprint, the relocated solar arrays, and the additional transmission tower, took place with the assistance of representatives from Registered Aboriginal Parties (RAPs) in August 2022.

Assessment of the intersection of the Golden Highway with Ringwood Road has been completed at a desktop level using knowledge gained from the survey of identical and contiguous landforms as part of the survey of Ringwood Road, as well as photographs and information provided by ecologists working for the Project who inspected the intersection study area on foot.

The survey of the Development Footprint during 2022 recorded 11 previously unidentified sites consisting of a grinding groove site, four artefact scatters, and six isolated finds.

Within the Addendum study area, a grinding groove site, 37-1-1033 (Killoe Creek GG1), was recorded in 2022. The grinding groove site was recorded approximately 50 metres (m) east of the Killoe Creek crossing, therefore outside the impact area of the Amended Project. It has limited scientific research potential and the significance of the grooves primarily relates to their educational and aesthetic values based on their association with Killoe Creek.

The survey in 2022 identified eight Aboriginal sites within the Development Footprint (OzArk 2023). The Amended Project has realigned the Development Footprint and is able to avoid 37-1-1027 (Redlynch Creek IF1) and this site will no longer be harmed by the Amended Project. This changes Recommendations 2 and 3 in the ACHAR to read:

> ACHAR Recommendation 2 now reads: 37-1-1027 (Redlynch Creek IF1), 37-1-1032 (Ringwood Gully IF6), 37-1-1033 (Killoe Creek GG1), and 37-1-1037 (Rocky Creek Gully OS4) will not be harmed by the Project as they are located the Development Footprint.
>
> ACHAR Recommendation 3 now reads: Seven Aboriginal sites, 37-1-1028 (Rocky Creek Slope IF2), 37-1-1029 (Wollara Road IF3), 37-1-1030 (Monaghans Creek IF4), 37-1-1031 (Rocky Creek Gully IF5), 37-1-1034 (Redlynch Creek OS2), 37-1-1035 (Redlynch Creek OS1), and 37-1-1036 (Redlynch Creek OS3) will be salvaged by a surface collection of visible artefacts. The recommended methodology for the salvage will be set out in the Aboriginal Cultural Heritage Management Plan (ACHMP) and will include the measures outlined in Section 9.2.1 of the ACHAR.

The additional recommendations concerning Aboriginal cultural values associated with the Amended Project build upon those provided in OzArk 2023:

1. 37-1-1027 (Redlynch Creek IF1) and 37-1-1033 (Killoe Creek GG1) will not be harmed by the Amended Project as they are located outside the Development Footprint. The location of these sites must be shown on all applicable Project plans to ensure that they are not inadvertently harmed.
2. Further recording and investigation of the grinding groove site (Killoe Creek GG1) prior to construction activities will be conducted. The methodology of this investigation will be set out in the ACHMP that will be developed following Project approval but will include detailed mapping and photography of the site by a suitably qualified archaeologist.
3. All land-disturbing activities must be confined to within the Development Footprint. Should the parameters of the proposed work extend beyond this, then further archaeological assessment will be required.

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1 INTRODUCTION

OzArk Environment & Heritage (OzArk) has been engaged by Umwelt (Australia) Pty Ltd on behalf of Lightsource Development Services Australia Pty Ltd (Lightsource bp) (the proponent) to complete an Addendum Aboriginal Cultural Heritage Assessment Report for proposed amendments associated with the Goulburn River Solar Farm (SSD-33951458) (the Project) (the Amended Project). The Amended Project is in the Upper Hunter Local Government Area (LGA).

This assessment has been completed as an addendum to the *Aboriginal Cultural Heritage Assessment Report – Goulburn River Solar Farm* (ACHAR, OzArk 2023) which reports on the results of the Aboriginal cultural heritage assessment completed for the Project in August 2022. Following the finalisation of the ACHAR, the report was included in the Environmental Impact Statement (EIS) for the Project and placed on public exhibition from Tuesday 13 June 2023 until Monday 10 July 2023.

1.1 BACKGROUND

The ACHAR prepared by OzArk in 2023 formed part of the EIS prepared by Umwelt to accompany an application for development consent for the Goulburn River Solar Farm under Division 4.7 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Assessment of the Amended Project follows the *Secretary's Environmental Assessment Requirements* (SEARs) that were issued for the Project on 1 February 2022. The SEARs indicate that assessment must follow the *Code of Practice for the Investigation of Aboriginal Objects in New South Wales* (the Code of Practice; DECCW 2010a) and the *Aboriginal cultural heritage consultation requirements for proponents* (the ACHCRs; DECCW 2010b).

1.2 ADDENDUM STUDY AREA

The Addendum study area comprises the intersection of the Golden Highway with Ringwood Road, located approximately 7 km from Merriwa and the current road corridor and shoulders along Ringwood Road and Wollara Road, connecting the Project Area with the Golden Highway (**Figure 1-1**). The road corridor crosses two named waterways, the Bow River and Killoe Creek and several smaller ephemeral creeks. The Addendum study area is situated on mostly cleared, flat to gently undulating slopes.

Figure 1-1: Map showing the location of the Addendum study area.

1.3 REFERENCE TO OZARK 2023

OzArk 2023 provides the legislative and archaeological context for the Addendum study area and should be referred to for further information on these subjects.

OzArk 2023 also includes the results of the survey of the Development Footprint that includes the amendments for the BESS design amendments, the realignment of the Development Footprint, the relocation of solar arrays, the increased width of internal access roads, and the installation of a transmission tower and should be referred to for survey data.

OzArk 2023 also documents the survey of Ringwood and Wollar Roads (but not the intersection with the Golden Highway). This data is repeated in this Addendum ACHAR as it applies to the Addendum study area.

1.4 DESCRIPTION OF THE AMENDED PROJECT

Proposed amendments to the Project following public exhibition of the EIS and additional design refinements are summarised below.

1. Transport route amendments and upgrade of the intersection of the Golden Highway and Ringwood Road.
2. Upgrades to additional parts of Wollara Road and Ringwood Road.
3. Increased BESS capacity and option of a decentralised BESS and the choice to host both centralised and decentralised BESS units.
4. Minor modifications to the Development Footprint and internal layout including:
    - Removal of travelling stock route (TSR) 4481 from within the Project Area although site access will remain through the TSR with no access upgrades.
    - Relocation and/or removal of solar arrays within the Development Footprint to avoid Regent Honeyeater Habitat, scattered trees and Box Gum Woodland.
    - Increased width of selected internal access roads to accommodate subterranean power cables
5. Construction of an additional transmission tower adjacent the BESS/substation.

As a result of these modifications the Development Footprint is approximately 792 hectares (ha), a reduction of approximately 7 ha from the EIS.

In terms of Aboriginal cultural heritage, these amendments did not require additional field survey. The reasons for this are set out below.

- Upgrades to the intersection of the Golden Highway and Ringwood Road (Amendment 1) include additional areas that were not previously surveyed. Assessment of the intersection of the Golden Highway with Ringwood Road was able to be completed at a desktop level using knowledge gained from the survey of identical and contiguous landforms as part of the previous survey of Ringwood Road (August 2022), as well as photographs and information provided by Umwelt ecologists who inspected the intersection study area on

foot. Previous survey effort comprised the relevant landforms and as such, no further field survey was required or undertaken.

- Upgrades to Wollara and Ringwood Road (Amendment 2) include areas that were part of the original survey completed by OzArk in August 2022 (termed the Access Route). The August 2022 survey included the road corridor of Ringwood and Wollara Roads from the Golden Highway to the Development Footprint (**Figure 1-1**). This survey included the waterway crossings associated with the Bow River and Killoe Creek, as well as several unnamed waterway crossings. In addition, several spot checks were undertaken in landforms along the road corridor that are more distant to waterways. Previous survey effort covers this amendment and as such, no further field survey was required or undertaken.

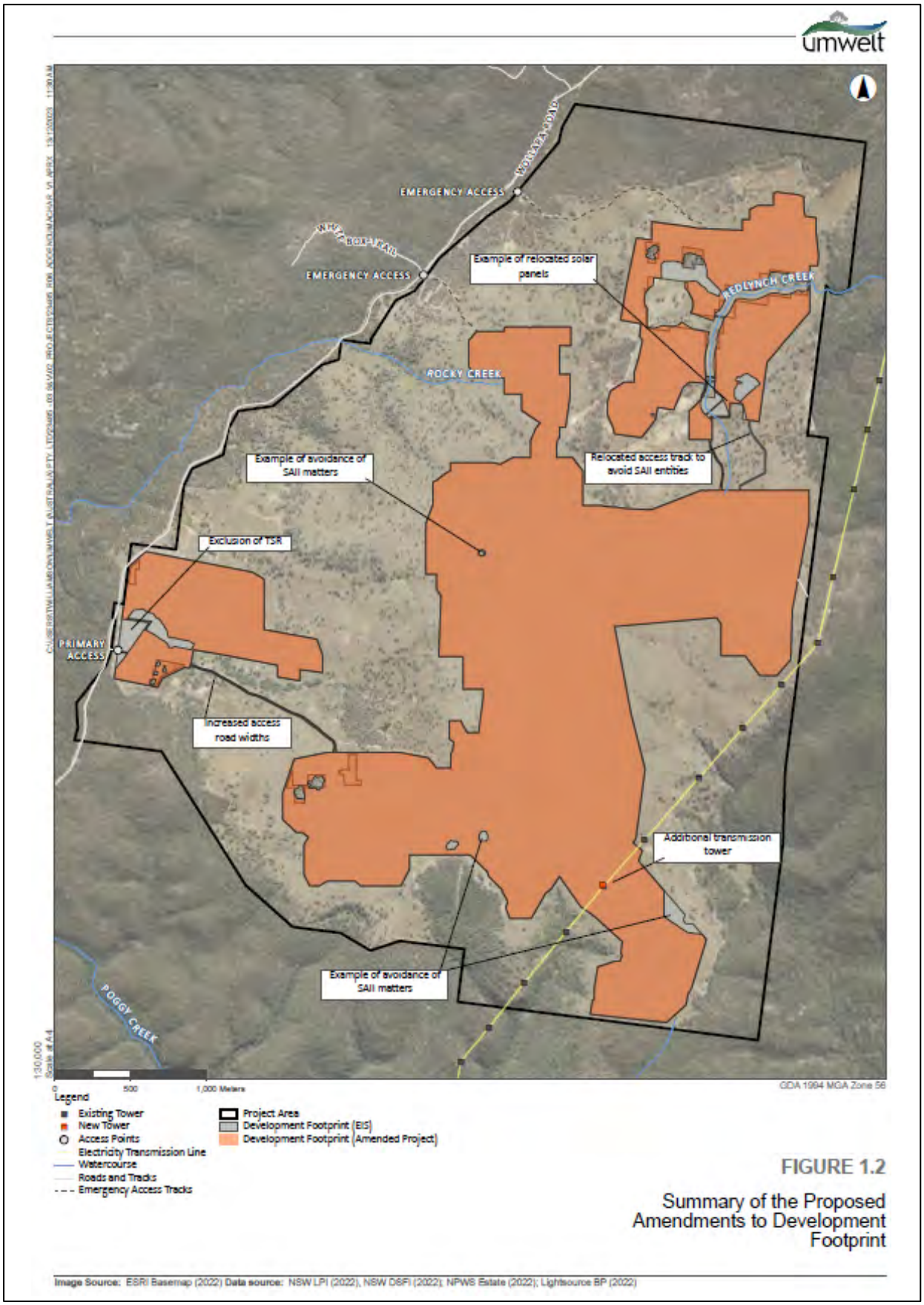
- Amendments 3 to 5 are located within the Development Footprint that was fully assessed by pedestrian survey during August 2022. As no unsurveyed landforms are impacted by these amendments, no further survey was required or undertaken.

OzArk assessed the Access Route from the Golden Highway to the Development Footprint, as well as the Development Footprint itself in the ACHAR (OzArk 2023).

The Addendum ACHAR specifically addresses the amendments to the Project, but the survey results will remain unchanged. Recommendations contained in the ACHAR have been altered to account for the fact that the realigned Development Footprint and is able to avoid 37-1-1027 (Redlynch Creek IF1) and this site will no longer be harmed by the Amended Project. In addition, a new recommendation is made based on the Heritage NSW submission on the ACHAR made during the consultation period that further recording and investigation by a suitably qualified archaeologist of the grinding groove site 37-1-1033 (Killoe Creek GG1) takes place prior to construction activities.

Details of each of the key changes associated with the Amended Project are described below and a summary of the amendments are shown on **Figure 1-2**.

Figure 1-2: Summary of proposed amendments.

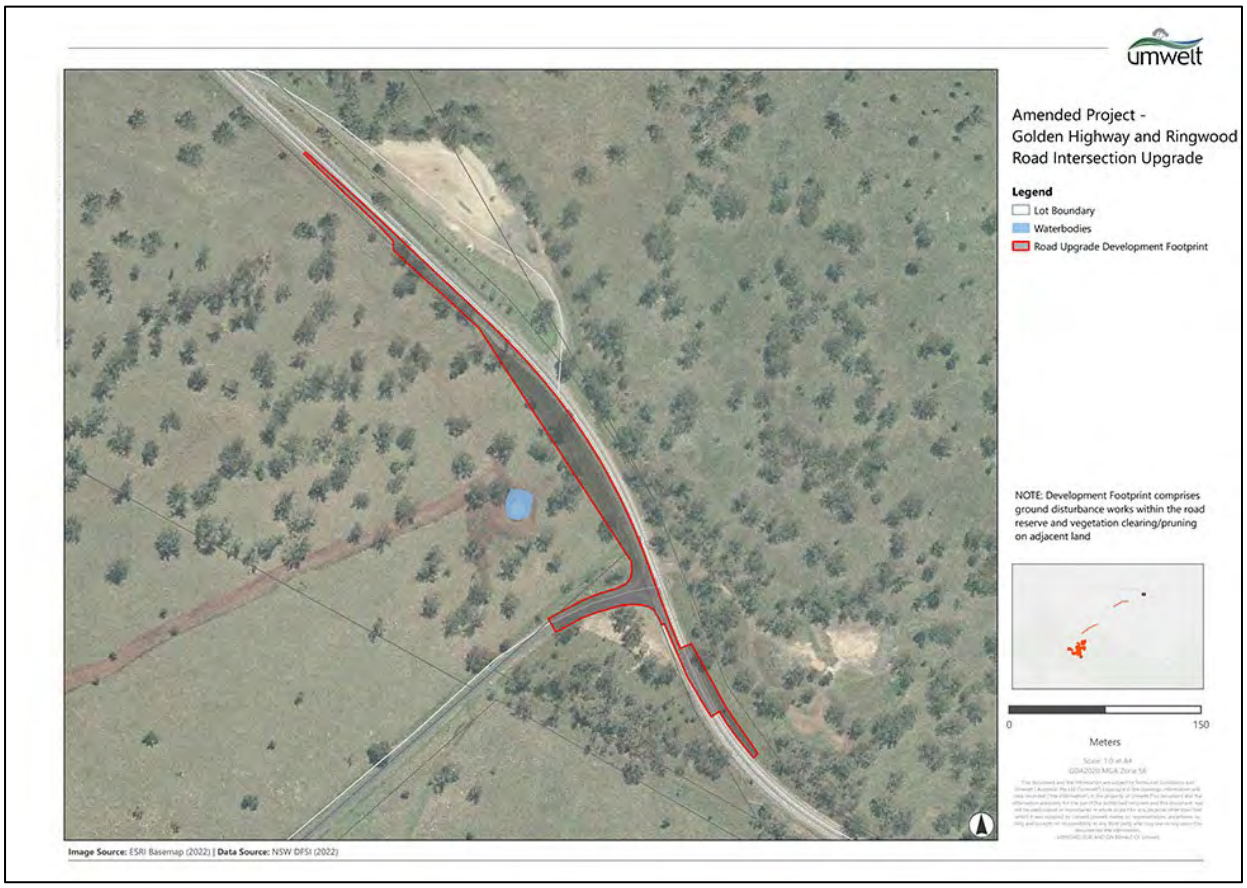


1.4.1 Golden Highway and Ringwood Road intersection upgrade

The proponent proposes an upgrade to the intersection of the Golden Highway and Ringwood Road in line with Austroads Safe Intersection Site Distance (SISD) standards. These upgrades would include (**Figure 1-3**):

- Pruning and removal of vegetation and select trees on the western side of the intersection on Lot 1 DP34496. Currently estimated at six established trees
- The construction of a 325 m acceleration/merge lane to allow vehicles to safely turn left onto the Golden Highway from Ringwood Road (Lot 1 DP34496)
- Realignment of the existing low voltage power line to provide clearance to the acceleration lane (if required and subject to detailed design)
- Extension of the existing Golden Highway westbound and Ringwood Road left-in deceleration lane taper to 30 m and widening of the intersection
- Pruning of vegetation on the eastern side of the intersection wholly within the road reserve
- Formalisation of the informal bus stop on Ringwood Road at the intersection with Golden Highway (Lot 7303 / DP 1146691).

Figure 1-3: Indicative Golden Highway and Ringwood Road intersection upgrade.



1.4.2 Wollara and Ringwood Roads upgrades

The proponent is proposing additional road upgrades as community benefits under the Voluntary Planning Agreement with the Upper Hunter Shire Council. These works would also facilitate further improvements to enable the safe movement of heavy vehicles associated with the Project. The proposed upgrades include:

- Realignment, widening and sealing an additional 1.6 km section of Ringwood Road between Killoe Creek and Binks Road
- Realignment, widening and sealing a 4.7 km unpaved section of Wollara Road between the Goulburn River National Park boundary and 1621 Wollara Road. No upgrades are proposed in the portion of Wollara Road within the Goulburn River National Park.

The proposed road upgrades are shown on **Figure 1-4** and **Figure 1-5**.

The existing condition of these roads comprise:

- Ringwood Road – a local road that is sealed and generally flat with low vertical grades and varying road width and a maximum road width of approximately 5 m along the alignment
- Wollara Road – a local road that comprises a combination of sealed and unsealed sections north of the site and unsealed sections south of the site. The road width varies along the length of the road.

These upgrades will include 8 m bitumen-sealed formation with a minimum of 500 millimetre (mm) unsealed shoulders. The horizontal and vertical alignment of the proposed road will ensure safe sight distance and an improved road network for the users.

Figure 1-4: Proposed additional upgrade works along Wollara and Ringwood Roads.

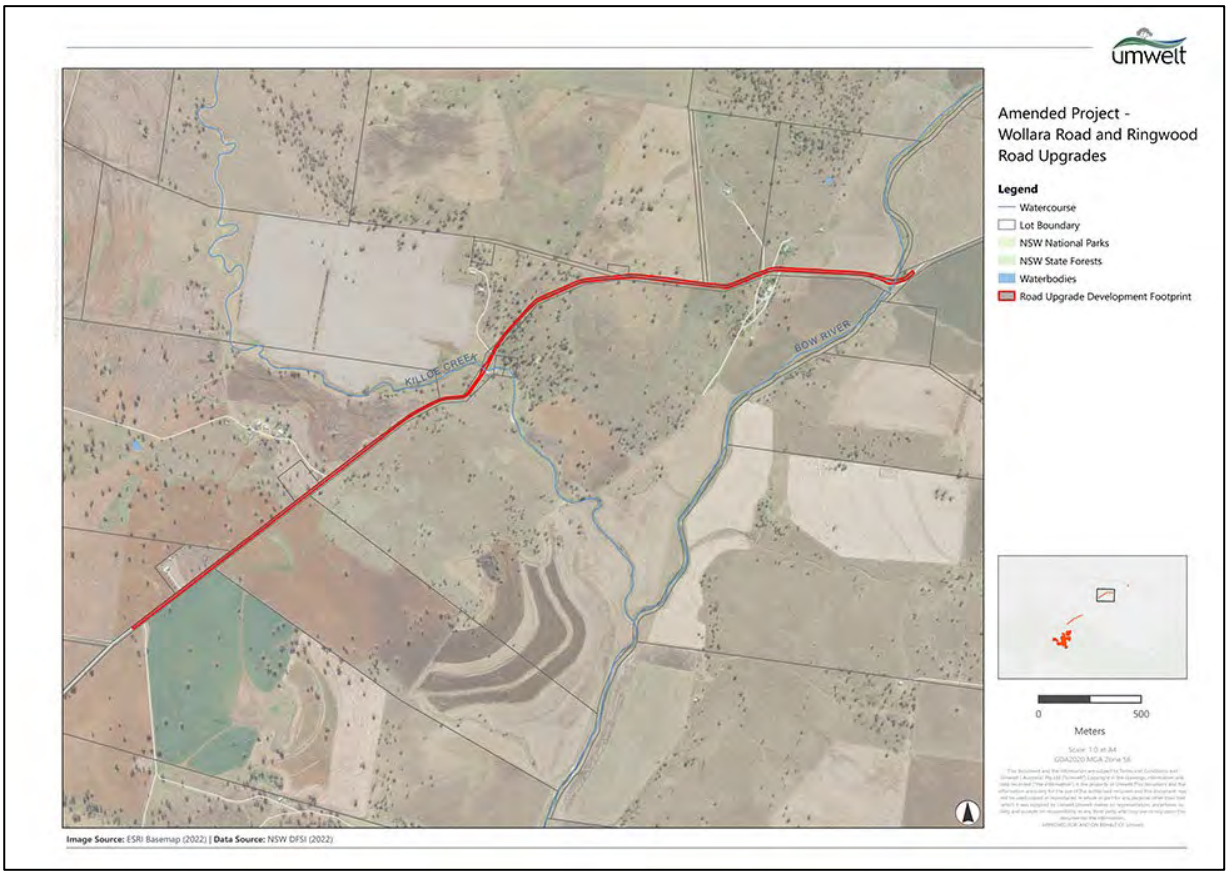
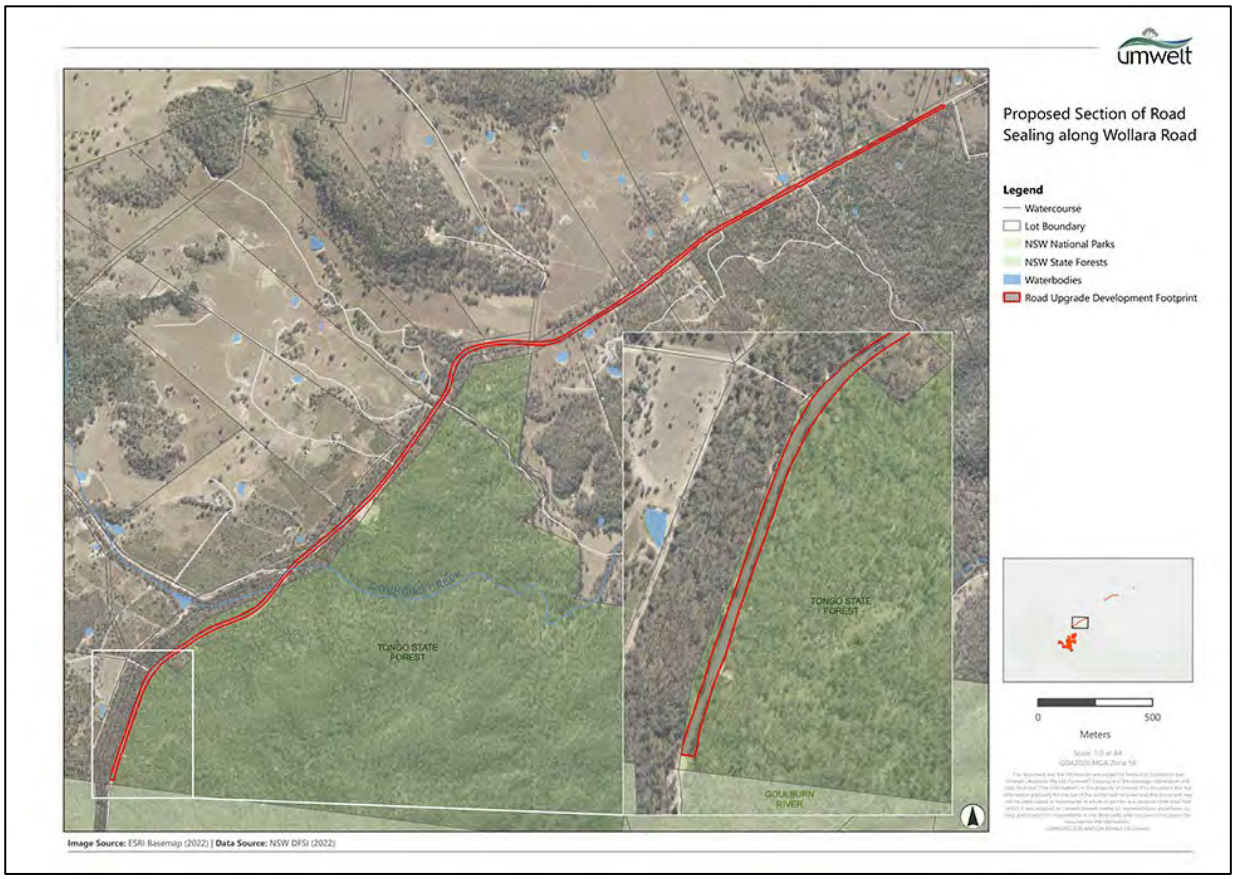


Figure 1-5: Proposed section of road sealing along Wollara Road.



1.4.3 BESS design amendments

The proponent is proposing to amend the centralised BESS design as documented in the EIS to allow for increased capacity. The capacity of the centralised BESS is proposed to increase to 450MWp / 900MWh from 280MWp / 570MWh (as per the Project EIS) to allow for greater energy storage capacity, required to safely and cost effectively decarbonise Australia's energy network.

The proponent is also seeking to amend the Project EIS to include the option of a decentralised BESS, to allow for greater flexibility in the design of the final BESS facility. The decentralised BESS option involves 560 individual 6.1 m battery containers and DC-DC converters, and associated infrastructure being situated next to the photovoltaic (PV) inverter stations located throughout the solar arrays, rather than in a centralised location as proposed in the EIS.

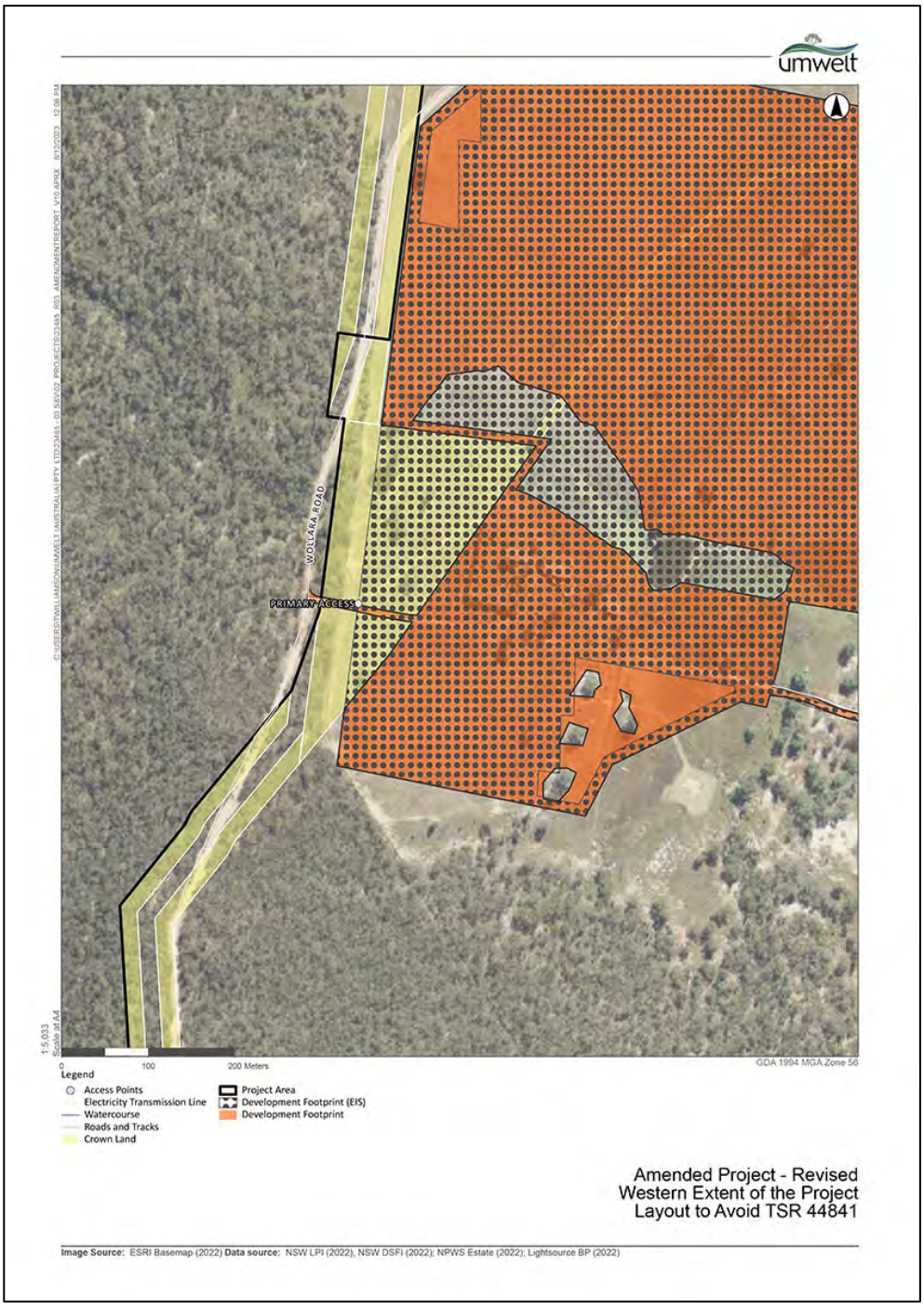
All infrastructure is proposed to reside entirely within the existing Project Area and the Development Footprint as assessed under the EIS. As this amendment does not include land that was not surveyed for the ACHAR (OzArk 2023), it is not discussed further in this Addendum ACHAR.

1.4.4 Development Footprint Realignment

Following further consultation with the Department of Planning and Environment (DPE) and Crown Lands following public exhibition of the Project EIS, a minor realignment of the Development Footprint is proposed to avoid overlapping with the Traveling Stock Reserve (TSR) 44841. The western extent of the Development Footprint is now proposed to extend towards the east and will avoid TSR 44841 (**Figure 1-6**).

This realignment involves a reduction of the Development Footprint and is wholly within land surveyed as part of OzArk 2023 for the EIS.

Figure 1-6: Aerial showing the realignment of the southwest of the Development Footprint.



1.4.5 Relocated solar panels

Following consultation with NSW Biodiversity and Conservation Division (BCD) during the Response to Submissions phase, additional areas of solar panels throughout the Development Footprint are proposed to be relocated to previously unused areas within the Project Area or removed, to increase avoidance of Plant Community Types and threatened species habitat and particularly, on Serious and Irreversible Impacts (SAII) entities.

As this amendment is wholly within land surveyed as part of the ACHAR (OzArk 2023), additional survey was not required.

Because of the realignment of the Development Footprint, 37-1-1027 (Redlynch Creek IF1) will no longer be harmed by the Amended Project (**Figure 1-7**).

As a result, a total of four recorded sites will now not be harmed by the Amended Project as they are located outside the Development Footprint: 37-1-1027 (Redlynch Creek IF1), 37-1-1032 (Ringwood Gully IF6), 37-1-1033 (Killoe Creek GG1), and 37-1-1037 (Rocky Creek Gully OS4).

Seven Aboriginal sites, 37-1-1028 (Rocky Creek Slope IF2), 37-1-1029 (Wollara Road IF3), 37-1-1030 (Monaghans Creek IF4), 37-1-1031 (Rocky Creek Gully IF5), 37-1-1034 (Redlynch Creek OS2), 37-1-1035 (Redlynch Creek OS1), and 37-1-1036 (Redlynch Creek OS3) will be harmed by the Amended Project and will be appropriately managed.

1.4.6 Increased width of selected internal access roads

An increase in the width of the internal access road corridors is also proposed to accommodate the revised design of the internal reticulation work. It is now proposed that subterranean transmission corridors would be used as part of the internal reticulation network, which are proposed to travel adjacent to the internal access roads, in turn increasing the width of the internal access road corridors.

As this amendment only includes land that was surveyed for the ACHAR (OzArk 2023), and does not result in additional impacts, it is not discussed further in this Addendum ACHAR.

1.4.7 Additional transmission tower

An additional transmission tower may be required on the current transmission line near the proposed substation to accommodate the connection of the Project to the national electricity market. Further consultation undertaken with Transgrid during exhibition of the Project EIS has determined that the additional tower would now form part of the Project.

The transmission tower is proposed to be located within land that was surveyed for the ACHAR (OzArk 2023) and does not result in additional impacts, it is not discussed further in this Addendum ACHAR.

Figure 1-7: Recorded sites in relation to the realigned Development Footprint.

2 ABORIGINAL COMMUNITY CONSULTATION

The Aboriginal cultural heritage assessment of the Goulburn River Solar Farm has followed the ACHCRs (DECCW 2010b). The consultation log, copies of correspondence with Aboriginal community stakeholders and its results are presented in Section 3 of the ACHAR (OzArk 2023). Further consultation undertaken for the finalisation of OzArk 2023 is shown in **Appendix 1 Figure 1**.

An update letter was sent to all RAPs on 29 August 2023 summarising the status of the Project and providing notification that further assessment for an Addendum study area would be undertaken. The update letter is included as **Appendix 1 Figure 2**.

2.1 CULTURAL VALUES IDENTIFIED THROUGHOUT THE ACHCR PROCESS

No specific cultural values were identified by the RAPs regarding the Addendum study area, however, the strong cultural values of Aboriginal communities towards landscapes and cultural heritage sites are recognised.

3 LANDSCAPE CONTEXT

An understanding of the environmental context of a study area is requisite in any Aboriginal archaeological investigation (DECCW 2010). It is a particularly important consideration in the development and implementation of survey strategies for the detection of archaeological sites. In addition, natural geomorphic processes of erosion and/or deposition, as well as human-activated landscape processes, influence the degree to which the remains of material culture are retained in the landscape as archaeological sites; and the degree to which they are preserved, revealed and/or conserved in present environmental settings.

3.1 TOPOGRAPHY AND HYDROLOGY

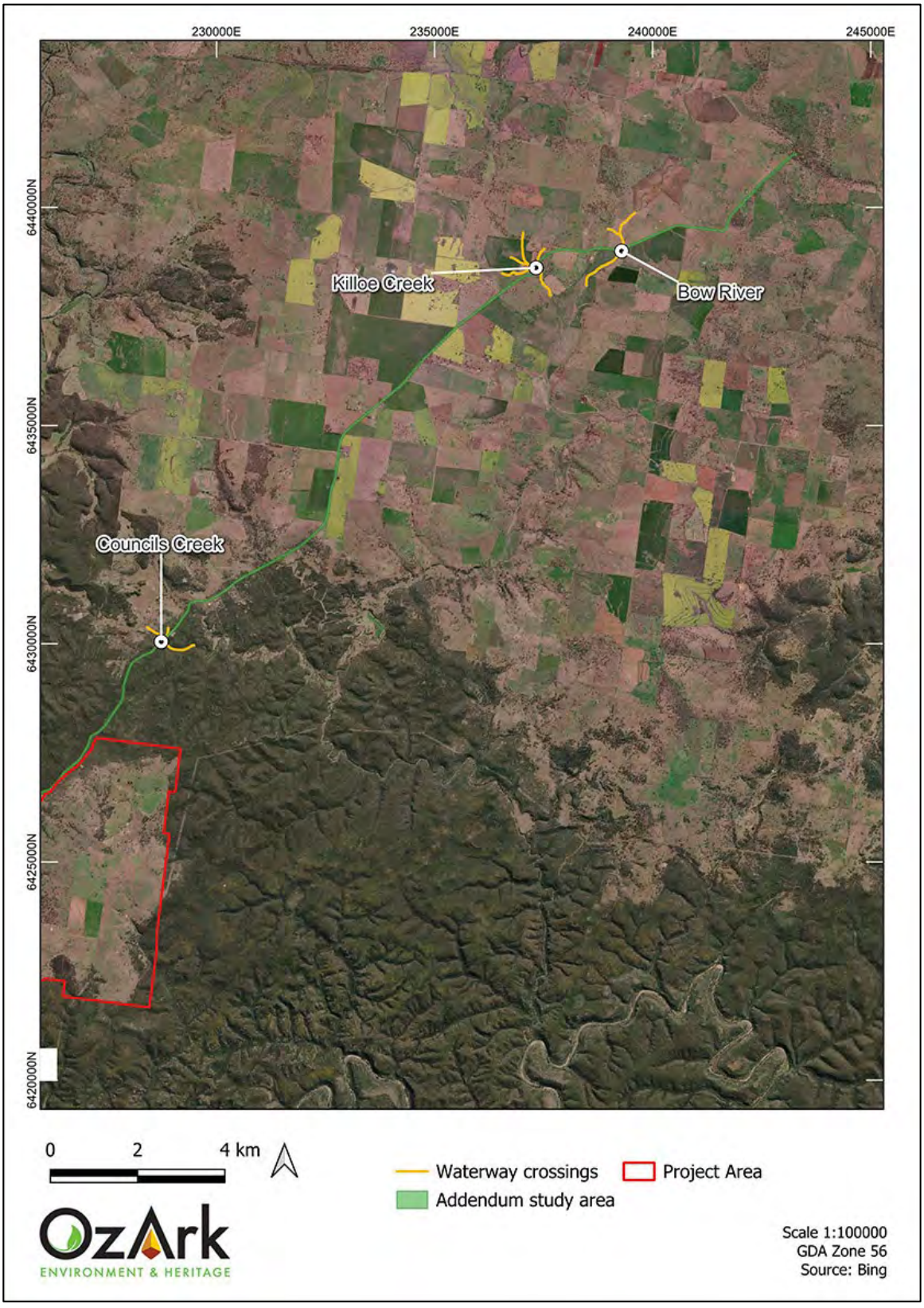
The topography of the Addendum study area is generally flat, cleared agricultural land and road reserves with some moderate gradient undulating hills (**Figure 3-1**).

Figure 3-1: Topography of the Addendum study area.

<table>
<tr><td> </td><td> </td></tr>
<tr><td>1. View of Bow River from Ringwood Road.</td><td>2. View of causeway over Killoe Creek, Ringwood Road.</td></tr>
<tr><td> </td><td> </td></tr>
<tr><td>3. Vegetation along western end of road corridor, Wollara Road.</td><td>4. View towards causeway over Councils Creek, Wollara Road.</td></tr>
</table>

The waterways of Bow River (approximately 4.5 km from the Golden Highway intersection), Killoe Creek (approximately 6.5 km from the Golden Highway intersection) and Councils Creek (approximately 17.5 km from the Golden Highway intersection), traverse the road corridor of the Addendum study area (**Figure 3-2**).

Figure 3-2: Hydrology of Addendum study area.



3.2 GEOLOGY AND SOILS

The Addendum study area is located within the Brigalow Belt South Bioregion. The geology and geomorphology of the region is layered sedimentary rock that has weather to produce a dissected landscape consisting of gently sloping foothills that grade into sandstone escarpments and ridge tops surrounding the lower-lying river flats of the permanently flowing Goulburn and Munmurra Rivers (Cumberland Ecology 2013).

3.3 VEGETATION

The Addendum study area supports exotic and native vegetation; however, this has been heavily disturbed due to agricultural activity and road construction. Ringwood and Wollara Roads are mostly bordered by open agricultural fields with few remaining native trees. The roadside vegetation becomes denser in the southwestern portion of the Addendum study area, towards the boundary with Tongo State Forest.

Prior to agricultural land clearing the Addendum study area would have supported a woodland of rough-barked apple (*Angophora floribunda*), Blakely's red gum (*Eucalyptus blakelyi*), narrow-leaved red ironbark (*Eucalyptus crebra*), grey box (*Eucalyptus microcarpa*), Yellow box (*Eucalyptus melliodora*), white box (*Eucalyptus albens*) and blackbutt (*Eucalyptus pilularis*). Sandstone gullies included narrow-leaved stringybark (*Eucalyptus sparsifolia*), broad-leaved ironbark (*Eucalyptus fibrosa* ssp. *fibrosa*), currawang (*Acacia doratoxylon*), forest phebalium *(Phebalium ambiens*), Australian boxthorn (*Bursaria spinosa*), hopbush (*Dodonaea* sp.), and River oak (*Casuarina cunninghamiana*). In the creeks on northern aspects Belah (*Casuarina cristata*) was also likely to be present with fern understorey along creek lines at the eastern end of the range (Kovac and Lawrie 1991 and Mitchell 2002).

3.4 LAND USE HISTORY AND EXISTING LEVELS OF DISTURBANCE

The Addendum study area consists of road corridors through grazing land, most of which has been subjected to extensive vegetation clearing.

3.5 CONCLUSION

The review of the environmental factors associated with the Addendum study area allows the following conclusions to be drawn in terms of past Aboriginal occupation:

- Topography and hydrology: The flat to gently undulating landforms which dominate the Addendum study area would have been hospitable to Aboriginal people. The semi-permanent watercourses would have provided limited freshwater and subsistence requirements to support occupation of the area, however this occupation was probably short-term or sporadic.

- Geology and soils: The predominate geology of the Addendum study area is sandstone, which was frequently used as a surface for sharpening axes when in close association

with water. Thus, areas with outcropping sandstone could contain evidence of past Aboriginal activity. The fertile soils of the region would have supported various resources that attracted the traditional Aboriginal people to the area. However, colonial use of the fertile soil has resulted in long-term impacts to the environment, including the clearing of vegetation to provide open spaces for intensive grazing. These impacts could have removed certain site types (such as culturally modified trees) or the disturbed artefact sites through soil loss, ploughing, and stock trampling. Gully and sheetwash erosion, particularly along the drainage and gully landforms, indicate preservation of artefacts in their original depositional context is unlikely.

- Vegetation: The Addendum study area would have once supported an open woodland which would have provided some resources for Aboriginal subsistence in the past and the evidence suggests that this was a managed landscape, possibly to use the plateau as a hunting ground. These vegetation types had several utilitarian, medicinal, and subsistence uses. Wood from Eucalypts were used for dish and bowl manufacture, bark used to make shelters and canoes, oil to sooth colds, aches, and fevers and as a general antiseptic and honey, nectar, and manna from some species for food (Stewart & Percival 1997). However, resources likely to have supported a large population of people would have been present closer to the banks of more permanent water sources including the Bow and Goulburn Rivers. The broad-scale vegetation clearance which has taken place across the Addendum study area for agricultural purposes and road construction reduces the likelihood that any culturally modified trees remain present, however, should mature native vegetation remain, particularly along the ephemeral drainages, culturally modified trees may be present.

- Land use: Activities such as vegetation clearance, grazing, and cultivation are the dominant types of disturbance to have taken place across the Addendum study area. These activities are likely to have displaced Aboriginal objects or sites or removed them entirely i.e. modified trees. Further, cultivation reduces the potential for intact subsurface archaeological material to remain. In areas where farming and agriculture is less intensive, Aboriginal objects are likely to be in a secondary context due to slope wash.

4 ARCHAEOLOGICAL CONTEXT

4.1 DESKTOP DATABASE SEARCHES CONDUCTED

The Aboriginal Heritage Information Management System (AHIMS) was searched on 1 June 2022 for OzArk 2023. As this search is over 12 months old, an additional search was conducted for the Addendum study area on 16 October 2023 covering the same coordinates as the 2022 search. The search results are shown in **Appendix 2**.

The results of the search are displayed on **Figure 4-1**. The 2022 AHIMS search returned 106 entries whereas the 2023 search includes 117 entries. This is explained by the fact that the 2023 search includes the 11 sites recorded in the 2022 survey for the Project (37-1-1033 [Killoe Creek GG1], 37-1-1035 [Redlynch Creek OS1], 37-1-1034 [Redlynch Creek OS2], 37-1-1036 [Redlynch Creek OS3], 37-1-1037 [Rocky Creek Gully OS4], 37-1-1027 [Redlynch Creek IF1], 37-1-1028 [Rocky Creek Slope IF2], 37-1-1029 [Wollara Road IF3], 37-1-1030 [Monaghans Creek IF4], 37-1-1031 [Rocky Creek Gully IF5], and 37-1-1032 [Ringwood Gully IF6]). Other than these 11 sites, no new sites have been registered in the AHIMS search area and no new sites have been recorded within or near the Project area that are not discussed in OzArk 2023.

It is noted that the Addendum study area includes land currently subject to a Native Title claim (NC2011/006, NSD37/2019, Gomeroi People) (**Figure 4-2**).

4.2 REGIONAL AND LOCAL CONTEXT: CONCLUSION

A review of the studies conducted in the broader region of the Addendum study area is presented in OzArk 2023. The results of these investigations provide the following regional synthesis:

- Archaeological sites, even where surface evidence is not present, occur on most landforms
- Site frequency and density are dependent on their location in the landscape. This theme is consistent throughout NSW and is influenced by a range of factors, the most relevant of which is the existing level of disturbance. More specifically, the potential for undisturbed *in situ* deposits remaining in the upper Hunter Valley is generally low
- The highest concentration of Aboriginal sites on the valley floor surrounds creeks and waterways. Sites located away from water sources tend to have a low artefact density and site complexity
- Few scarred trees are recorded reflecting the high degree of tree clearing in the region
- The most frequently recorded raw material is indurated mudstone/tuff (a fine-grained siliceous material) associated with Hunter River gravels. Other frequently recorded materials include locally sourced silcrete, quartz, chert, and volcanic stone.

Figure 4-1: Location of previously recorded AHIMS sites in relation to the Addendum study area (2023 data).

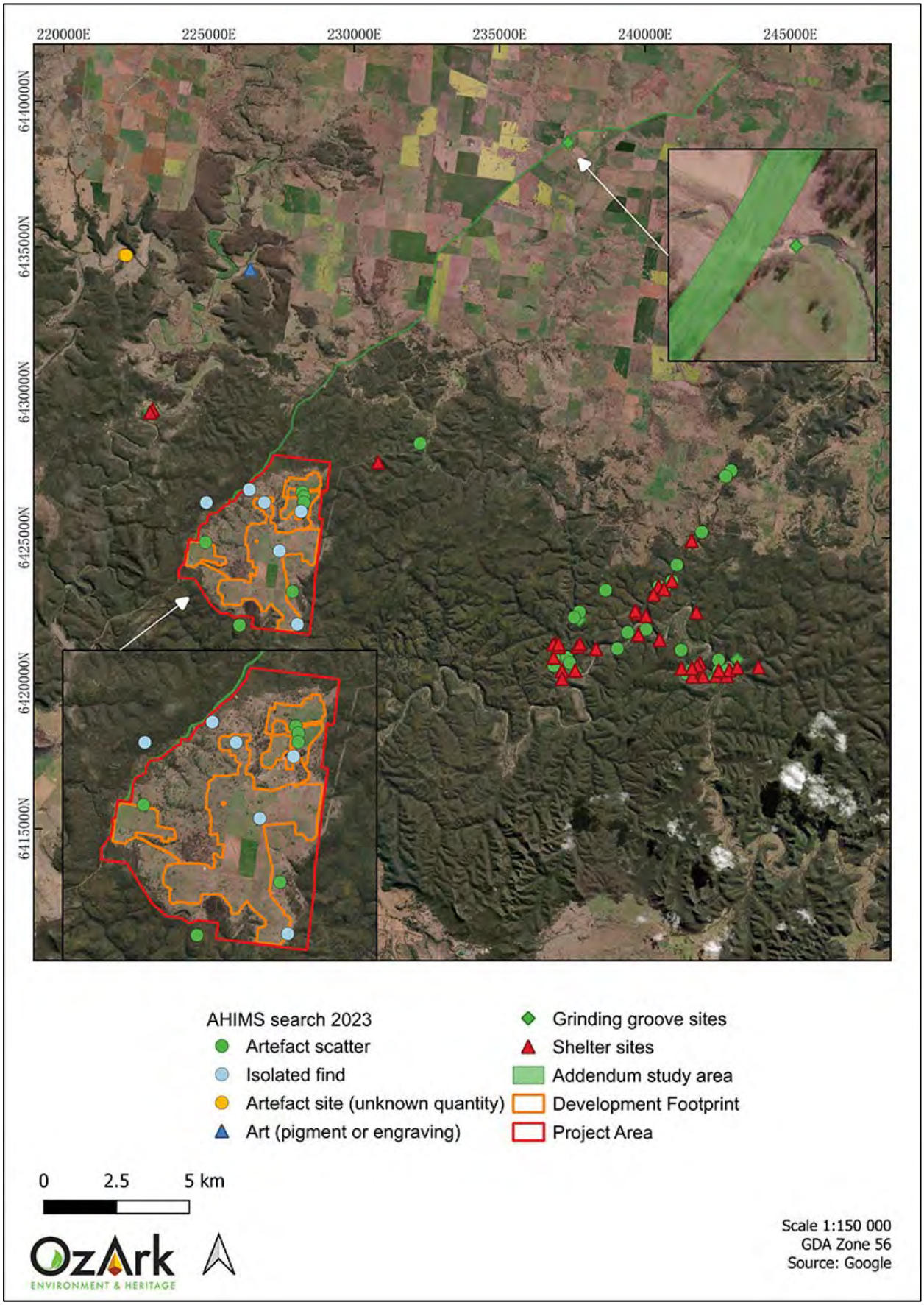


Figure 4-2: The Project Area in relation to Gomeroi People Native Title claim (NC2011/006, NSD37/2019).

5 RESULTS OF ABORIGINAL ARCHAEOLOGICAL ASSESSMENT

5.1 SAMPLING STRATEGY AND FIELD METHODS

OzArk 2023 records the survey of the Development Footprint and the Access Route. The Access Route assessment aligns with the Ringwood and Wollara Roads upgrades proposed in the Amended Project. The results of this survey will be repeated here for consistency with other specialist reports for the amendment.

The field survey for OzArk 2023 was undertaken by OzArk over one week from 15 August to 19 August 2022.

The survey strategy in 2022 for Ringwood and Wollar Roads involved sample surveys along the edges of the road corridor within the Addendum study area with care taken to inspect all waterway crossings.

The intersection of Ringwood Road and the Golden Highway was not specifically surveyed in 2022, although identical and contiguous landforms along Ringwood Road were surveyed. Information on the topography and the levels of disturbance at the intersection study area was supplied to OzArk by ecologists who visited the study area. As such, additional field survey was not required or undertaken.

5.2 PROPOSAL CONSTRAINTS

As most of the Addendum study area along Ringwood and Wollara Roads has been previously disturbed by road construction including roadside drainage features, survey involved only targeted pedestrian inspection of creek crossings and sections determined to have elevated archaeological potential or minimal evidence of previous disturbances. The remainder of the road corridor was inspected from a vehicle.

5.3 INTERSECTION OF RINGWOOD ROAD AND THE GOLDEN HIGHWAY

The impact footprint for the intersection study area was inspected on foot by ecologists who were instructed to note items such as topography and previous disturbances to allow an appraisal of the area's archaeological potential.

The intersection study area is within slopes with a moderate gradient. To the east of the Golden Highway are the remains of a bitumen road, cuttings, and steel bins (**Figure 5-1**). All tree vegetation is immature regrowth.

The sloping terrain and widespread disturbances indicates that Aboriginal sites are unlikely to be recorded within the intersection study area. The lack of mature trees indicates that culturally modified trees will not be present.

The assessment of the intersection study area as having low archaeological potential is supported by the survey results along Ringwood Road that also concluded that landforms in this area have a low archaeological potential.

Figure 5-1: Views of the intersection study area.

<table>
<tr><td> </td><td> </td></tr>
<tr><td>1. View of the Golden Highway to the north of Ringwood Road.</td><td>2. View to the Golden Highway from the eastern side of the road.</td></tr>
<tr><td> </td><td> </td></tr>
<tr><td>3. View of a disused bitumen road to the east of the Golden Highway.</td><td>4. View of steel bins and cuttings to the east of the Golden Highway.</td></tr>
</table>

5.4 ABORIGINAL SITES RECORDED

Table 5-1 summarises the Aboriginal cultural heritage sites recorded during the August 2022 survey.

One site is within the Addendum study area, 37-1-1033 (Killoe Creek GG1), and further details on the site follows.

Table 5-1: Aboriginal cultural heritage site recorded during the survey.

AHIMS ID	Site name	Site type	Coordinates (GDA Zone 56) East	Coordinates (GDA Zone 56) North	Within Addendum study area?	Within Development Footprint?
37-1-1033	Killoe Creek GG1	Grinding Grooves	237357	6438576	Yes	No
37-1-1035	Redlynch Creek OS1	Artefact Scatter	228219	6426563	No	Yes
37-1-1034	Redlynch Creek OS2	Artefact Scatter	228274	6426411	No	Yes
37-1-1036	Redlynch Creek OS3	Artefact Scatter	228272	6426217	No	Yes
37-1-1037	Rocky Creek Gully OS4	Artefact Scatter	224888	6424844	No	No
37-1-1027	Redlynch Creek IF1	Isolated Find	228173	6425902	No	No
37-1-1028	Rocky Creek Slope IF2	Isolated Find	226913	6426210	No	Yes
37-1-1029	Wollara Road IF3	Isolated Find	226394	6426654	No	Yes
37-1-1030	Monaghans Creek IF4	Isolated Find	227432	6424546	No	Yes
37-1-1031	Rocky Creek Gully IF5	Isolated Find	224916	6426210	No	Yes
37-1-1032	Ringwood Gully IF6	Isolated Find	228045	6422023	No	No

37-1-1033 (Killoe Creek GG1)

Site type: Grinding grooves

GPS coordinates: GDA 2020 Zone 56 237357 E, 6438576 N

Location of site: Located 7.1 km south along Ringwood Road from the intersection of the road and Golden Highway. Situated on the southern bank of Killoe Creek, approximately 50 m east of Ringwood Road.

Description of site: The site is on the southern creek bank of Killoe Creek, approximately 50 m east of the creek crossing on Ringwood Road (**Figure 5-2**). The site consists of at least 20 very weathered grooves on a flat sandstone slab next to the creek. Four of the better-preserved grooves measure 27 x 7 millimetres (mm), 26 x 5 mm, 28 x 7 mm, and 21 x 5 mm (**Figure 5-3**).

Figure 5-2: Location of Killoe Creek GG1.

Figure 5-3: Killoe Creek GG1. View of site and selection of grinding grooves.

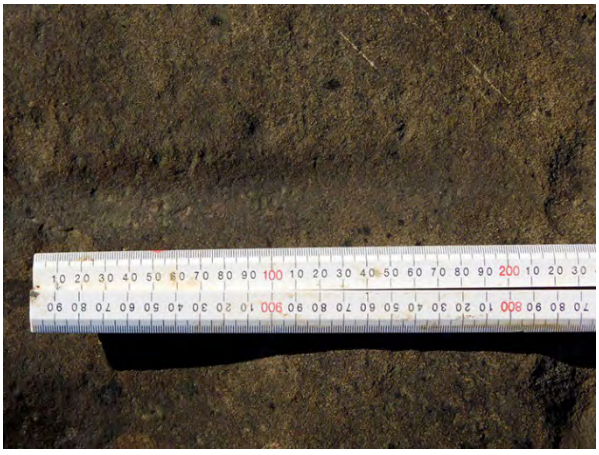
1. View north of Killoe Creek GG1. Range pole marks recorded location of site.

2. View west from Killoe Creek GG1 towards Killoe Creek crossing on Ringwood Road.

3. View of some of the better preserved grooves at Killoe Creek GG1.

4. View of some of the better preserved grooves at Killoe Creek GG1.

5. Detail of a group of grooves at Killoe Creek GG1.



6. Detail of a worn groove at Killoe Creek GG1.

5.5 SUMMARY OF SURVEY RESULTS

One grinding groove site was identified during the survey. The grinding groove site is located approximately 50 m from the creek crossing and is outside the Development Footprint of the Addendum study area. Therefore, it will not be harmed during the proposed upgrade of Ringwood Road.

Consistent with previous studies within the broader region, the grinding grooves were near a waterway with sandstone outcropping. This is expected as these areas, near watercourses, are generally associated with increased levels of past resource and camping activities. The grinding grooves indicate that hatchet manufacture/curation is occurring within the broader area. Hatchets would likely have been utilised for the purpose of removing wood and bark from trees for the purposes of construction of shelters, shields, canoes, and coolamons.

5.6 ASSESSED SIGNIFICANCE OF THE RECORDED SITE

Table 5-2 presents a summary of the significance assessment of Aboriginal cultural heritage site recorded near the Addendum study area. Further details of each of the assessment criteria are provided below.

Social or Cultural Value

Cultural and social values can only be determined by the local Aboriginal people.

Generally, however, all sites hold cultural value to the Aboriginal community. Wonnarua man, Victor Perry (2001), notes that: '*the Wonnarua people consider that all sites within their traditional homeland (to be) of high importance and …in need of proper care and protection'*. Further, Perry 2001 notes: '*the Wonnarua wish to protect their history and culture wherever possible,and maintain a connection with the land by providing recommendations in regards to Wonnarua Koori Heritage. The land and its stories were passed down from father to son over 200 generations before the arrival of Cook from England.*'

For these reasons, the Aboriginal objects recorded during the survey have high cultural value and the conservation of these objects is a central aspect of Aboriginal tribal lore.

No further cultural values were identified following the RAP review of OzArk 2023.

Archaeological/Scientific Value

The grinding grooves site (Killoe Creek GG1) located outside the Development Footprint of the Amended Project has limited scientific research potential and the significance of the grooves primarily relates to their educational value. The grinding groove site type is less common in the local and regional areas in terms of representativeness, and this raises its scientific significance to a moderate value.

Aesthetic Value

The grinding grooves site at Killoe Creek GG1 has moderate aesthetic values as the site remains interpretable by the layperson and the grooves maintain their association with the flowing waters of Killoe Creek.

Historic Value

None of the archaeological sites recorded during the survey have historic values associated with important persons, places, or events.

Table 5-2: Significance assessment of sites in the Addendum study area.

AHIMS ID	Site Name	Social or Cultural Value	Archaeological / Scientific Value	Aesthetic Value	Historic Value
37-1-1033	Killoe Creek GG1	High	Moderate	Moderate	Nil

5.6.1 Statement of significance

The Addendum study area holds cultural significance to the local Aboriginal community as Aboriginal people value their heritage as tangible links with the lifestyles and values of their ancestors (Perry 2001:13).

Perry 2001 notes that the land and the water running through it are the '*lifeblood*' of Aboriginal culture and that the forest and mountains of the region provided the resources needed to survive. Perry 2001 records that tribal lore requires that Aboriginal people are obliged to care for the environment and that this includes the aesthetic values of the land. Therefore, the land itself has aesthetic significance and its care and maintenance are core aspects of Aboriginal culture.

37-1-1033 (Killoe Creek GG1) has aesthetic significance as the grinding grooves are visible to the layperson and the grooves maintain their association with Killoe Creek. Thus, the association of running water and visible grooves have a strong aesthetic significance.

6 ASSESSING HARM

6.1 AVOIDING AND MINIMISING HARM

6.1.1 Conserving significant Aboriginal cultural heritage

An object of the NPW Act is the '*conservation of objects places and features… of cultural value within the landscape, including… places, objects and features of significance to Aboriginal people*' (s.2A(1(b)(i)).

As heritage professionals, OzArk, strives for good conservation outcomes. In particular, OzArk is primarily concerned with the conservation and protection of Aboriginal cultural heritage that is of significance to Aboriginal people.

Two primary objectives when managing harm to an Aboriginal object are:

- Impacts to significant Aboriginal objects and places should always be avoided wherever possible
- Where impacts to Aboriginal objects and places cannot be avoided, proposals should be amended to reduce the extent and severity of impacts to significant Aboriginal objects and places using reasonable and feasible measures.

6.1.2 Opportunities to conserve Aboriginal cultural heritage values

The grinding groove site, 37-1-1033 (Killoe Creek GG1) was recorded approximately 50 m east of the Killoe Creek crossing and is therefore outside the Development Footprint of the Amended Project. There are no further known Aboriginal sites or cultural values associated with the Addendum study area.

Outside of the Addendum study area, but as a result of the Amended Project, an additional Aboriginal site, 37-1-1027 (Redlynch Creek IF1), will no longer be harmed because of the realignment of the Development Footprint. As a result, four recorded sites will not be harmed by the Amended Project as they are located outside the Development Footprint: 37-1-1027 (Redlynch Creek IF1), 37-1-1032 (Ringwood Gully IF6), 37-1-1033 (Killoe Creek GG1), and 37-1-1037 (Rocky Creek Gully OS4).

6.2 LIKELY IMPACTS TO ABORIGINAL HERITAGE FROM THE AMENDED PROJECT

Table 6-1 presents a summary of potential impacts to Aboriginal cultural heritage associated with the proposal.

Table 6-1: Impact assessment of sites in the Addendum study area.

AHIMS ID	Site Name	Type of Harm (Direct/Indirect / None)	Degree of Harm (Total/Partial / None)	Consequence of Harm (Total/Partial/No Loss of Value)
37-1-1033	Killoe Creek GG1	None	None	None

7 MANAGEMENT OF ABORIGINAL CULTURAL HERITAGE SITES

7.1 MANAGEMENT OF THE RECORDED ABORIGINAL SITES

Management strategies recommended for the recorded sites are included in **Table 7-1**.

Table 7-1: Management strategies for recorded sites.

AHIMS ID	Site name	Site type	Degree of harm	Management strategy
37-1-1033	Killoe Creek GG1	Grinding Grooves	Will not be harmed	Outside of the Development Footprint. Should works need to take place at the Killoe Creek crossing on Ringwood Road, the site should be included on all applicable construction plans and the location made known to all work crews working in the vicinity of the site to ensure the site is not inadvertently harmed. Given the cultural, scientific, and aesthetic significance of the site the Aboriginal Cultural Heritage Management Plan (ACHMP) for the Project will include a methodology for additional documentation of the site prior to construction activities. This will include further photography and accurate planning of the site by a suitably qualified archaeologist.
37-1-1035	Redlynch Creek OS1	Artefact Scatter	Total	Mapping, description, and collection of surface artefacts prior to commencement of construction.
37-1-1034	Redlynch Creek OS2	Artefact Scatter	Total	Mapping, description, and collection of surface artefacts prior to commencement of construction.
37-1-1036	Redlynch Creek OS3	Artefact Scatter	Total	Mapping, description, and collection of surface artefacts prior to commencement of construction.
37-1-1037	Rocky Creek Gully OS4	Artefact Scatter	Will not be harmed	Outside of the Development Footprint. To be included on all applicable construction plans and the location made known to all work crews working in the vicinity of the site to ensure the site is not inadvertently harmed.
37-1-1027	Redlynch Creek IF1	Isolated Find	Will not be harmed	Because of the realignment of the Development Footprint, 37-1-1027 (Redlynch Creek IF1) will no longer be harmed by the Amended Project. To be included on all applicable construction plans and the location made known to all work crews working in the vicinity of the site to ensure the site is not inadvertently harmed.
37-1-1028	Rocky Creek Slope IF2	Isolated Find	Total	Mapping, description, and collection of the surface artefact prior to commencement of construction.
37-1-1029	Wollara Road IF3	Isolated Find	Total	Mapping, description, and collection of the surface artefact prior to commencement of construction.
37-1-1030	Monaghans Creek IF4	Isolated Find	Total	Mapping, description, and collection of the surface artefact prior to commencement of construction.
37-1-1031	Rocky Creek Gully IF5	Isolated Find	Total	Mapping, description, and collection of the surface artefact prior to commencement of construction.
37-1-1032	Ringwood Gully IF6	Isolated Find	Will not be harmed	Outside of the Development Footprint. To be included on all applicable construction plans and the location made known to all work crews working in the vicinity of the site to ensure the site is not inadvertently harmed.

8 RECOMMENDATIONS

Under Section 89A of the NPW Act it is mandatory that all newly recorded Aboriginal sites be registered with AHIMS. As a professional in the field of cultural heritage management it is the responsibility of OzArk to ensure this process is undertaken and the site has been registered with the AHIMS register.

The following recommendations are made based on these impacts and with regard to:

- Legal requirements under the terms of the NPW Act whereby it is illegal to damage, deface or destroy an Aboriginal place or object without an approved ACHMP
- The findings of the current investigations undertaken within the Addendum study area
- The interests of the Aboriginal community.

The survey in 2022 identified eight Aboriginal sites within the Development Footprint (OzArk 2023). The Amended Project has realigned the Development Footprint and is able to avoid 37-1-1027 (Redlynch Creek IF1) and this site will no longer be harmed by the Amended Project. This changes Recommendations 2 and 3 in the ACHAR to read:

> ACHAR Recommendation 2 now reads: 37-1-1027 (Redlynch Creek IF1), 37-1-1032 (Ringwood Gully IF6), 37-1-1033 (Killoe Creek GG1), and 37-1-1037 (Rocky Creek Gully OS4) will not be harmed by the Project as they are located outside the Development Footprint.
>
> ACHAR Recommendation 3 now reads: Seven Aboriginal sites, 37-1-1028 (Rocky Creek Slope IF2), 37-1-1029 (Wollara Road IF3), 37-1-1030 (Monaghans Creek IF4), 37-1-1031 (Rocky Creek Gully IF5), 37-1-1034 (Redlynch Creek OS2), 37-1-1035 (Redlynch Creek OS1), and 37-1-1036 (Redlynch Creek OS3) will be salvaged by a surface collection of visible artefacts. The recommended methodology for the salvage will be set out in the ACHMP and will include the measures outlined in Section 9.2.1 of the ACHAR.

The additional recommendations concerning Aboriginal cultural values associated with the Amended Project build upon those provided in OzArk 2023:

1. 37-1-1027 (Redlynch Creek IF1) and 37-1-1033 (Killoe Creek GG1) will not be harmed by the Amended Project as they are located outside the Development Footprint. The location of these sites must be shown on all applicable Project plans to ensure that they are not inadvertently harmed.
2. Further recording and investigation of the grinding groove site (Killoe Creek GG1) prior to construction activities will be conducted. The methodology of this investigation will be set

out in the ACHMP that will be developed following Project approval but will include detailed mapping and photography of the site by a suitably qualified archaeologist.

3. All land-disturbing activities must be confined to within the Development Footprint. Should the parameters of the proposed work extend beyond this, then further archaeological assessment will be required.

REFERENCES

Burra Charter 2013 — International Council on Monuments and Sites 2013. *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance*.

Cumberland Ecology 2013 — Cumberland Ecology 2013. *Warkworth Biodiversity Areas – Baseline Fauna Investigations.* Report prepared for Rio Tinto Coal Australia Pty Ltd.

DECCW 2010 — Department of Environment, Climate Change and Water, Sydney (now Heritage NSW). *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales*.

DECCW 2010b — Department of Environment, Climate Change and Water, Sydney (now Heritage NSW). *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*.

Kovac and Lawrie 1991 — Kovac M. and Lawrie J.M., 1991. *Soil Landscapes of the Singleton 1:250,000 Sheet* map and report, Soil Conservation Service of NSW, Sydney.

Mitchell 2002 — Mitchell, P. *Descriptions for NSW (Mitchell) Landscapes* Version 2 (2002). Department of Environment and Climate Change.

OEH 2011 — Office of Environment and Heritage 2011. *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW.*

OzArk 2023 — OzArk Environment & Heritage. *Aboriginal Cultural Heritage Assessment Report. Goulburn River Solar Farm*. Report for Lightsource bp.

Perry 2001 — Victor Perry (Upper Hunter Wonnarua Council). *Aboriginal Cultural Heritage Assessment for "POGGY" via Merriwa. Lot 58 Sandstone, Quarry*.

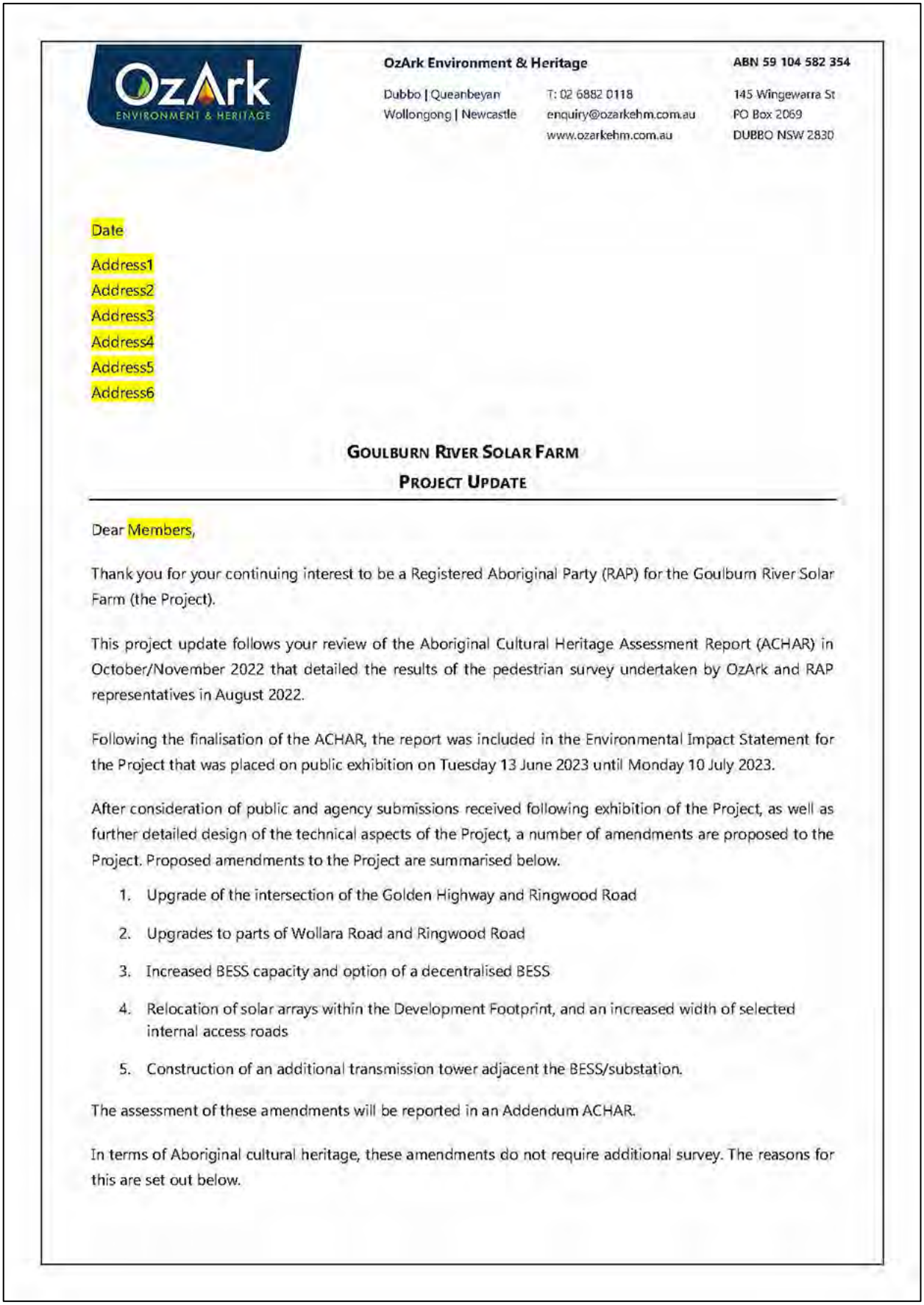
Umwelt 2021 — Umwelt (Australia) Pty Limited, 2021. *Goulburn River Solar Farm Scoping Report*. Report to Lightsource bp.

APPENDIX 1: ABORIGINAL COMMUNITY CONSULTATION

Appendix 1 Figure 1: Aboriginal consultation Log (continued from OzArk 2023).

Date	Organisation	Comment	Method
29.8.23	Didge Ngunawal Clan	Project update letter sent	Email
29.8.23	Corroboree Aboriginal Corporation	Project update letter sent	Email
29.8.23	Widescope Indigenous Group	Project update letter sent	Email
29.8.23	Walhallow Local Aboriginal Land Council	Project update letter sent	Email
29.8.23	Rose Nean	Project update letter sent	Email
29.8.23	Ungooroo Aboriginal Corporation	Project update letter sent	Email
29.8.23	Gomeroi People	Project update letter sent	Email
29.8.23	Hunters & Collectors	Project update letter sent	Email
29.8.23	Wanaruah Local Aboriginal Land Council	Project update letter sent	Email
29.8.23	Murra Bidgee Mullangari Aboriginal Corporation	Project update letter sent	Email
29.8.23	Merrigarn	Project update letter sent	Email
29.8.23	Hunter Traditional Owner	Project update letter sent	Email
29.8.23	A1 Indigenous group	Project update letter sent	Email
29.8.23	Junburra Aboriginal Consultancy Services	Project update letter sent	Email
30.8.23	Hunters & Collectors	Catherine Burrowes received email response - *I have read the project information and amendment to the ACHA for the above project, I endorse the recommendations made.*	Email

Appendix 1 Figure 2: Project update letter.



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Date

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Address3
Address4
Address5
Address6

GOULBURN RIVER SOLAR FARM
PROJECT UPDATE

Dear Members,

Thank you for your continuing interest to be a Registered Aboriginal Party (RAP) for the Goulburn River Solar Farm (the Project).

This project update follows your review of the Aboriginal Cultural Heritage Assessment Report (ACHAR) in October/November 2022 that detailed the results of the pedestrian survey undertaken by OzArk and RAP representatives in August 2022.

Following the finalisation of the ACHAR, the report was included in the Environmental Impact Statement for the Project that was placed on public exhibition on Tuesday 13 June 2023 until Monday 10 July 2023.

After consideration of public and agency submissions received following exhibition of the Project, as well as further detailed design of the technical aspects of the Project, a number of amendments are proposed to the Project. Proposed amendments to the Project are summarised below.

1. Upgrade of the intersection of the Golden Highway and Ringwood Road
2. Upgrades to parts of Wollara Road and Ringwood Road
3. Increased BESS capacity and option of a decentralised BESS
4. Relocation of solar arrays within the Development Footprint, and an increased width of selected internal access roads
5. Construction of an additional transmission tower adjacent the BESS/substation.

The assessment of these amendments will be reported in an Addendum ACHAR.

In terms of Aboriginal cultural heritage, these amendments do not require additional survey. The reasons for this are set out below.

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- Amendments 1 and 2 were part of the original survey area completed by OzArk in August 2022 (termed the Access Route). The August 2022 survey included the road corridor of Ringwood and Wollara Roads from the Golden Highway to the Development Footprint (**Figure 1**). This survey included the waterway crossings associated with the Bow River and Killoe Creek, as well as a number of unnamed waterway crossings. In addition, a number of spot checks were undertaken in landforms along the road corridor that are more distant to waterways. As a result of the Access Route assessment, one Aboriginal site was recorded: an axe grinding groove site located on Killoe Creek (Killoe Creek GG1). The site consists of several indistinct grooves on a rock slab that is outside of the proposed disturbance corridor.
- Amendments 3 to 5 are located within the Development Footprint that was fully assessed by pedestrian survey during the main survey in August 2022. As no unsurveyed landforms are impacted by these amendments, further survey is not required.

OzArk included the assessment of the Access Route from the Golden Highway to the Development Footprint in the ACHAR you have received. OzArk will develop an Amendment ACHAR to specifically address the amendments to the Project but the survey results in the current ACHAR will remain unchanged and the Amendment ACHAR will not alter the recommendations contained in the ACHAR you have reviewed, apart from recommending a new initiative: the further recording and investigation of the grinding groove site Killoe Creek GG1 as has been recommended in the Heritage NSW response to the ACHAR.

This Amendment ACHAR will be sent to you for your information when a draft is ready.

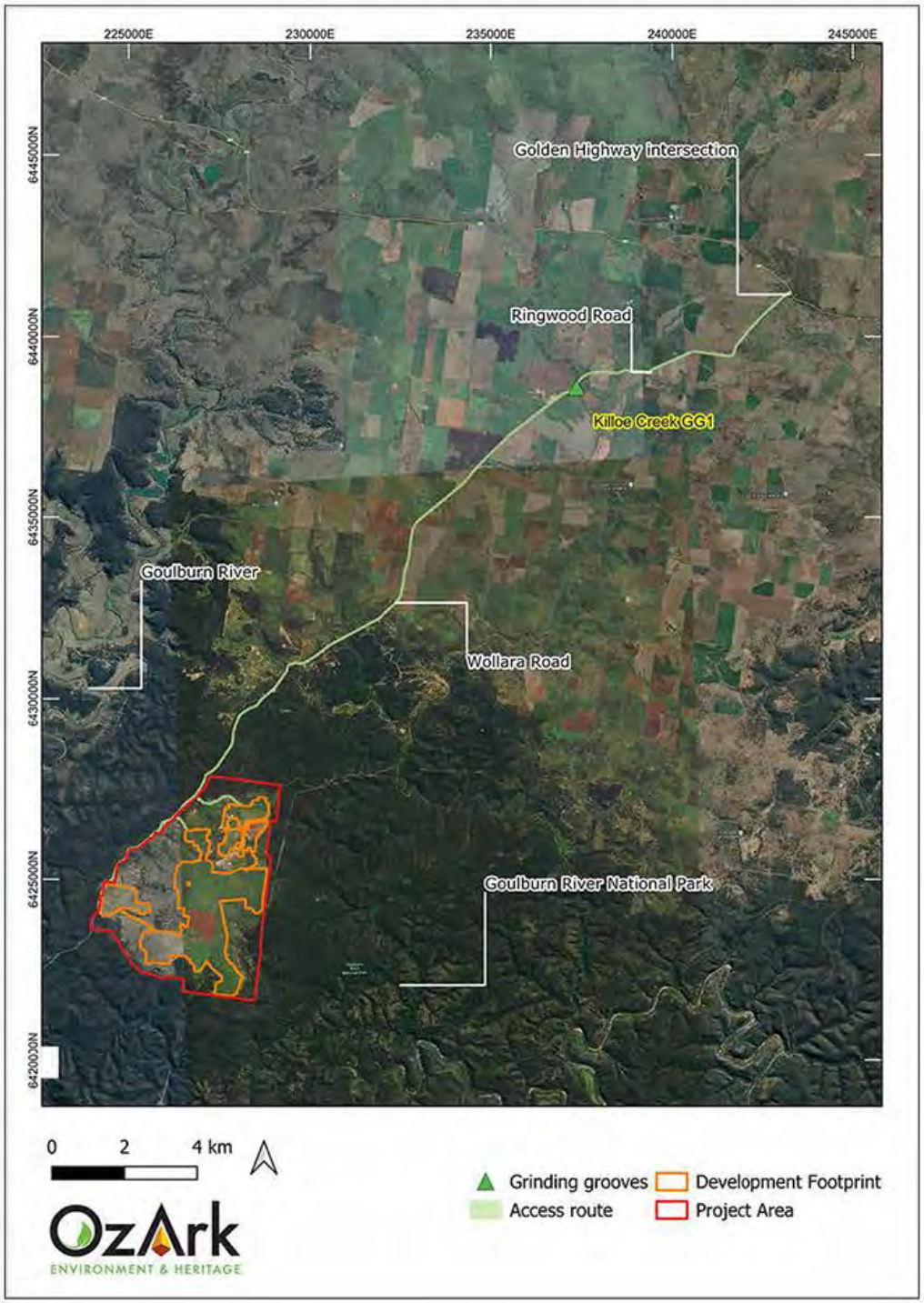
OzArk welcomes any comments you may have at this stage and invites you to contact Catherine Burrowes, OzArk's Consultation Officer (catherine@ozarkehm.com.au) with any questions or responses.

With thanks,

Ben Churcher
OzArk Principal Archaeologist

OzArk Environment & Heritage

Figure 1: Location of the Access Route.



APPENDIX 2: AHIMS SEARCH RESULTS

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 4098
Client Service ID : 828837

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
37-1-0369	Inniscarra;	AGD	56	240369	6423130	Closed site	Valid	Artefact : -	Shelter with Deposit	
	Contact	Recorders	Unknown Author					Permits		
37-1-0370	Inniscarra;	AGD	56	240369	6423130	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	Unknown Author					Permits		
37-1-0363	Inniscarra;	AGD	56	240554	6423042	Closed site	Valid	Artefact : -	Shelter with Deposit	
	Contact	Recorders	Unknown Author					Permits		
37-1-0357	Inniscarra;	AGD	56	240823	6423321	Closed site	Valid	Artefact : -	Shelter with Deposit	
	Contact	Recorders	Unknown Author					Permits		
37-1-0185	Parsons Gully;	AGD	56	241790	6420503	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0196	Parsons Gully;	AGD	56	242348	6420856	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0212	Parsons Gully;	AGD	56	242714	6420063	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0213	Goulburn River;	AGD	56	242714	6420063	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0216	Goulburn River;	AGD	56	242802	6420247	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0108	Bow River;	AGD	56	237043	6419957	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Ms Laila Haglund					Permits		
37-1-0052	Goulburn River N.P.;Bow River;	AGD	56	230720	6427400	Closed site	Valid	Artefact : -	Shelter with Deposit	1097
	Contact	Recorders	Laura-Jane Smith,D French					Permits		
37-1-0086	Bow River;	AGD	56	237641	6422255	Open site	Valid	Artefact : -	Open Camp Site	380
	Contact	Recorders	ASRSYS					Permits		
37-1-0116	Bow River;	AGD	56	236838	6421142	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	ASRSYS					Permits		
37-1-0198	Parsons Gully;	AGD	56	242436	6420240	Open site	Valid	Artefact : -	Open Camp Site	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0201	Goulburn River;	AGD	56	242436	6420240	Closed site	Valid	Artefact : -	Shelter with Deposit	380

Report generated by AHIMS Web Service on 16/10/2023 for Imogen Crome for the following area at Datum :GDA, Zone : 56, Eastings : 221988.0 - 244053.0, Northings : 6420122.0 - 6441749.0 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 117

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 4098
Client Service ID : 828837

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
	Contact	Recorders	Unknown Author					Permits		
37-1-1035	Redlynch Creek OS1	GDA	56	228219	6426563	Open site	Valid	Artefact : -		
	Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo,Mr.YEKUN ZHANG					Permits		
37-1-1034	Redlynch Creek OS2	GDA	56	228274	6426411	Open site	Valid	Artefact : -		
	Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo,Mr.YEKUN ZHANG					Permits		
37-1-0022	Tunbridge Creek;	AGD	56	240403	6421300	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0358	Inniscarra;	AGD	56	240369	6423130	Closed site	Valid	Artefact : -	Shelter with Deposit	
	Contact	Recorders	Unknown Author					Permits		
37-1-0361	Inniscarra;	AGD	56	240554	6423042	Closed site	Valid	Artefact : -	Shelter with Deposit	
	Contact	Recorders	Unknown Author					Permits		
37-1-0177	parsons gully;	AGD	56	241519	6420315	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Ms Laila Haglund					Permits		
37-1-0179	Parsons Gully;	AGD	56	241519	6420315	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0218	Parsons Gully;	AGD	56	242802	6420247	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0378	Tunbridge Creek;	AGD	56	238945	6420999	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	Unknown Author					Permits		
37-1-0377	Tunbridge Creek;	AGD	56	239301	6421554	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	Unknown Author					Permits		
37-1-0974	MTW/2019PP/GRBA/17	GDA	56	222161	6434705	Open site	Valid	Artefact : -		
	Contact	Recorders	Yancoal Australia Ltd,Miss Jessica Blackman					Permits		
37-1-0975	MTW/2019PP/GRBA/18	GDA	56	222183	6434695	Open site	Valid	Artefact : -		
	Contact	Recorders	Yancoal Australia Ltd,Miss Jessica Blackman					Permits		
37-1-0051	Goulburn River N.P.;Bow River;	AGD	56	232160	6428050	Open site	Valid	Artefact : -	Open Camp Site	1097
	Contact	Recorders	Margrit Koettig,R French					Permits		
37-1-1037	Rocky Creek Gully OS4	GDA	56	224888	6424844	Open site	Valid	Artefact : -		
	Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo,Mr.YEKUN ZHANG					Permits		
37-1-0023	Tunbridge Creek;	AGD	56	239939	6421658	Open site	Valid	Artefact : -	Open Camp Site	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0353	Inniscarra;KD/226;	AGD	56	241500	6424700	Closed site	Valid	Artefact : -	Shelter with Deposit	1197

Report generated by AHIMS Web Service on 16/10/2023 for Imogen Crome for the following area at Datum :GDA, Zone : 56, Eastings : 221988.0 - 244053.0, Northings : 6420122.0 - 6441749.0 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 117

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 4098
Client Service ID : 828837

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
	Contact	Recorders	Margrit Koettig					Permits		
37-1-0359	Inniscarra;	AGD	56	240554	6423042	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	Unknown Author					Permits		
37-1-0366	Inniscarra;	AGD	56	240554	6423042	Closed site	Valid	Artefact : -	Shelter with Deposit	
	Contact	Recorders	Unknown Author					Permits		
37-1-0049	MPB18/BMP18;Turnbridge Creek;	AGD	56	241860	6424990	Open site	Valid	Artefact : -	Open Camp Site	1097
	Contact	Recorders	Margrit Koettig;					Permits		
37-1-0194	Parsons Gully;	AGD	56	242258	6419963	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0211	Parsons Gully;	AGD	56	242714	6420063	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0102	Bow River;	AGD	56	237213	6420692	Open site	Valid	Artefact : -	Open Camp Site	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0099	Bow River;	AGD	56	237307	6420511	Open site	Valid	Artefact : -	Open Camp Site	380
	Contact	Recorders	Ms.Laila Haglund					Permits		
37-1-0096	Bow River;	AGD	56	237496	6420240	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0001	Lees Pinch;	AGD	56	223489	6420710	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	Contact	Recorders	Unknown Author					Permits		
37-1-0373	Goulburn River;	AGD	56	239668	6421470	Closed site	Valid	Artefact : -	Shelter with Deposit	
	Contact	Recorders	Unknown Author					Permits		
37-1-0375	Policemans Track;	AGD	56	239668	6421470	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	
	Contact	Recorders	Unknown Author					Permits		
37-1-0973	MTW/2019PP/GRBA/15	GDA	56	222098	6434717	Open site	Valid	Artefact : -		
	Contact	Recorders	Yancoal Australia Ltd,Miss Jessica Blackman					Permits		
37-1-0123	Bow River;	AGD	56	236755	6420683	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	ASRSYS					Permits		
37-1-0122	Bow River;	AGD	56	236747	6421141	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	ASRSYS					Permits		
37-1-1036	Redlynch Creek OS3	GDA	56	228272	6426217	Open site	Valid	Artefact : -		
	Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo,Mr.YEKUN ZHANG					Permits		

Report generated by AHIMS Web Service on 16/10/2023 for Imogen Crome for the following area at Datum :GDA, Zone : 56, Eastings : 221988.0 - 244053.0, Northings : 6420122.0 - 6441749.0 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 117

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 4098
Client Service ID : 828837

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
37-1-0367	Inniscarra;	AGD	56	240369	6423130	Closed site	Valid	Artefact : -	Shelter with Deposit	
	Contact	Recorders	Unknown Author					Permits		
37-1-0364	Inniscarra;	AGD	56	240554	6423042	Closed site	Valid	Artefact : -	Shelter with Deposit	
	Contact	Recorders	Unknown Author					Permits		
37-1-0181	Parsons Gully;	AGD	56	241519	6420315	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0187	Parsons Gully;	AGD	56	241890	6420047	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0217	Goulburn River;	AGD	56	242802	6420247	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0109	Bow River;	AGD	56	237038	6420231	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Ms.Laila Haglund					Permits		
37-1-0110	Bow River;	AGD	56	237038	6420231	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Ms.Laila Haglund					Permits		
37-1-0111	Bow River;	AGD	56	237038	6420231	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Ms.Laila Haglund					Permits		
37-1-0095	Bow River;	AGD	56	237496	6420240	Closed site	Valid	Artefact : -, Grinding Groove : -	Axe Grinding Groove,Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0092	Bow River;	AGD	56	237461	6422069	Open site	Valid	Artefact : -	Open Camp Site	380
	Contact	Recorders	ASRSYS					Permits		
37-1-0379	Inniscarra;	AGD	56	238542	6423004	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	Unknown Author					Permits		
37-1-0089	Bow River;	AGD	56	237646	6421981	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	380
	Contact	Recorders	ASRSYS					Permits		
37-1-0344	Inniscarra;	AGD	56	242856	6427110	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	ASRSYS					Permits		
37-1-0124	Bow River;	AGD	56	236760	6420409	Open site	Valid	Artefact : -	Open Camp Site	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0115	Bow River;	AGD	56	236847	6420685	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	380

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 4098
Client Service ID : 828837

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
	Contact	Recorders	ASRSYS					Permits		
37-1-1029	Wollara Road IF3	GDA	56	226394	6426654	Open site	Valid	Artefact : -		
	Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo,Mr.YEKUN ZHANG					Permits		
37-1-0368	Inniscarra;	AGD	56	240369	6423130	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	Unknown Author					Permits		
37-1-0356	Inniscarra;	AGD	56	240823	6423321	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	
	Contact	Recorders	Unknown Author					Permits		
37-1-0171	Goulburn River;	AGD	56	241142	6420948	Open site	Valid	Artefact : -	Open Camp Site	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0175	Goulburn River;	AGD	56	241430	6420222	Open site	Valid	Artefact : -	Open Camp Site	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0182	Parsons Gully;	AGD	56	241701	6420410	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0054	Goulburn River National Park;Mt Misery;Poggy Creek;	AGD	56	225950	6421800	Open site	Valid	Artefact : -	Open Camp Site	1097
	Contact	Recorders	Margrit Koettig					Permits		
37-1-0215	Parsons Gully;	AGD	56	242802	6420247	Open site	Valid	Artefact : -	Open Camp Site	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0113	Bow River;	AGD	56	236931	6421053	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	ASRSYS					Permits		
37-1-0094	Bow River;	AGD	56	237496	6420240	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0043	The Hulks;	AGD	56	222874	6429116	Closed site	Valid	Shell : -, Artefact : -	Shelter with Midden	
	Contact	Recorders	ASRSYS					Permits		
37-1-0044	The Hulks;	AGD	56	222874	6429116	Closed site	Valid	Shell : -, Artefact : -, Grinding Groove : -	Axe Grinding Groove,Shelter with Midden	
	Contact	Recorders	ASRSYS					Permits		
37-1-0025	Tunbridge Creek;	AGD	56	239655	6422201	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-1033	Killoe Creek GG1	GDA	56	237357	6438576	Open site	Valid	Grinding Groove : -		
	Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo,Mr.YEKUN ZHANG					Permits		
37-1-0199	Parsons Gully;	AGD	56	242436	6420240	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		

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Extensive search - Site list report

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Client Service ID : 828837

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
37-1-0200	Goulburn River;	AGD	56	242436	6420240	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-1032	Ringwood Gully IF6	GDA	56	228045	6422023	Open site	Valid	Artefact : -		
	Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo,Mr.YEKUN ZHANG					Permits		
37-1-1027	Redlynch Creek IF1	GDA	56	228173	6425902	Open site	Valid	Artefact : -		
	Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo,Mr.YEKUN ZHANG					Permits		
37-1-0365	Inniscarra;	AGD	56	240554	6423042	Closed site	Valid	Artefact : -	Shelter with Deposit	
	Contact	Recorders	Unknown Author					Permits		
37-1-0355	Inniscarra;	AGD	56	240823	6423321	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	Unknown Author					Permits		
37-1-0380	Inniscarra;	AGD	56	240823	6423321	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	Unknown Author					Permits		
37-1-0172	Goulburn River;	AGD	56	241154	6420308	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0040	Tunbridge Creek Myrtle Gully	AGD	56	241667	6422239	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0345	Inniscarra;	AGD	56	242677	6426924	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	Unknown Author					Permits		
37-1-0699	Eagles Drift Art Site	GDA	56	226425	6434233	Open site	Valid	Art (Pigment or Engraved) : 1		
	Contact	Recorders	Jumburra Aboriginal Consultancy Services					Permits		
37-1-0053	Poggy;Mt Misery;	AGD	56	227770	6422960	Open site	Valid	Artefact : -	Open Camp Site	1097
	Contact	Recorders	Margrit Koettig,D French					Permits		
37-1-0093	Bow River;	AGD	56	237496	6420240	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	ASRSYS					Permits		
37-1-0343	The Hulks;	AGD	56	222964	6429210	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	Contact	Recorders	ASRSYS					Permits		
37-1-0228	Parsons Gully;	AGD	56	243069	6420618	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	380
	Contact	Recorders	Unknown Author					Permits		
37-1-0026	Tunbridge Creek;	AGD	56	239931	6422115	Closed site	Valid	Artefact : -	Shelter with Deposit	380
	Contact	Recorders	Unknown Author					Permits		

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AHIMS Web Services (AWS)

Extensive search - Site list report

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SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
37-1-0240	Parsons Gully;	AGD	56	243806	6420358	Closed site	Valid	Artefact : -	Shelter with Deposit	380
Contact	Recorders	Unknown Author						Permits		
37-1-1028	Rocky Creek Slope IF2	GDA	56	226913	6426210	Open site	Valid	Artefact : -		
Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo,Mr.YEKUN ZHANG						Permits		
37-1-0362	Inniscarra;	AGD	56	240554	6423042	Open site	Valid	Artefact : -	Open Camp Site	
Contact	Recorders	Unknown Author						Permits		
37-1-0354	Inniscarra;	AGD	56	240996	6423873	Open site	Valid	Artefact : -	Open Camp Site	
Contact	Recorders	Unknown Author						Permits		
37-1-0178	Parsons Gully;	AGD	56	241519	6420315	Closed site	Valid	Artefact : -	Shelter with Deposit	380
Contact	Recorders	Unknown Author						Permits		
37-1-0112	Bow River;	AGD	56	236930	6421144	Closed site	Valid	Artefact : -	Shelter with Deposit	380
Contact	Recorders	ASRSYS						Permits		
37-1-0091	Bow River;	AGD	56	237572	6421065	Closed site	Valid	Artefact : -	Shelter with Deposit	380
Contact	Recorders	Unknown Author						Permits		
37-1-0374	Goulburn River;	AGD	56	239668	6421470	Closed site	Valid	Artefact : -	Shelter with Deposit	
Contact	Recorders	Unknown Author						Permits		
37-1-0976	MTW/2019PP/GRBA/16	GDA	56	222150	6434708	Open site	Valid	Artefact : -		
Contact	Recorders	Yancoal Australia Ltd,Miss Jessica Blackman						Permits		
37-1-0085	Bow River;	AGD	56	237661	6421158	Closed site	Valid	Artefact : -	Shelter with Deposit	380
Contact	Recorders	ASRSYS						Permits		
37-1-0024	Tunbridge Creek;	AGD	56	239561	6422291	Closed site	Valid	Artefact : -	Shelter with Deposit	380
Contact	Recorders	Unknown Author						Permits		
37-1-1030	Monaghans Creek IF4	GDA	56	227432	6424546	Open site	Valid	Artefact : -		
Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo,Mr.YEKUN ZHANG						Permits		
37-1-0371	Inniscarra;	AGD	56	240369	6423130	Open site	Valid	Artefact : -	Open Camp Site	
Contact	Recorders	Unknown Author						Permits		
37-1-0360	Inniscarra;	AGD	56	240554	6423042	Closed site	Valid	Artefact : -	Shelter with Deposit	
Contact	Recorders	Unknown Author						Permits		
37-1-0174	Parsons Gully;	AGD	56	241340	6420128	Open site	Valid	Artefact : -	Open Camp Site	380
Contact	Recorders	Unknown Author						Permits		
37-1-0176	Parsons Gully;	AGD	56	241525	6420040	Closed site	Valid	Artefact : -	Shelter with Deposit	380

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AHIMS Web Services (AWS)

Extensive search - Site list report

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SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
Contact	Recorders	Unknown Author						Permits		
37-1-0180	Parsons Gully;	AGD	56	241519	6420315	Closed site	Valid	Artefact : -	Shelter with Deposit	380
Contact	Recorders	Unknown Author						Permits		
37-1-0050	MPB19/BMP19;Tunbridge Creek	AGD	56	241850	6425000	Open site	Valid	Artefact : -	Open Camp Site	1097
Contact	Recorders	Margrit Koettig						Permits		
37-1-0210	Goulburn River;	AGD	56	242710	6420246	Open site	Valid	Artefact : -	Open Camp Site	380
Contact	Recorders	Unknown Author						Permits		
37-1-0105	Bow River;	AGD	56	237043	6419957	Closed site	Valid	Artefact : -	Shelter with Deposit	380
Contact	Recorders	Ms.Laila Haglund						Permits		
37-1-0107	Bow River;	AGD	56	237043	6419957	Closed site	Valid	Artefact : -	Shelter with Deposit	380
Contact	Recorders	Unknown Author						Permits		
37-1-1031	Rocky Creek Gully IF5	GDA	56	224916	6426210	Open site	Valid	Artefact : -		
Contact	Recorders	OzArk Environmental and Heritage Management - Dubbo,Mr.YEKUN ZHANG						Permits		
37-1-0068	Tunbridge Creek;	AGD	56	239213	6420985	Closed site	Valid	Artefact : -	Shelter with Deposit	380
Contact	Recorders	K Pratt						Permits		
37-1-0229	Parsons Gully;	AGD	56	243074	6420344	Closed site	Valid	Artefact : -	Shelter with Deposit	380
Contact	Recorders	Unknown Author						Permits		
37-1-0372	Inniscarra;	AGD	56	240191	6422852	Closed site	Valid	Artefact : -	Shelter with Deposit	
Contact	Recorders	Unknown Author						Permits		
37-1-0202	Parsons Gully;	AGD	56	242429	6420606	Open site	Valid	Artefact : -	Open Camp Site	380
Contact	Recorders	Unknown Author						Permits		

** Site Status

Valid - The site has been recorded and accepted onto the system as valid

Destroyed - The site has been completely impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There is nothing left of the site on the ground but proponents should proceed with caution

Partially Destroyed - The site has been only partially impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There might be parts or sections of the original site still present on the ground

Not a site - The site has been originally entered and accepted onto AHIMS as a valid site but after further investigations it was decided it is NOT an aboriginal site. Impact of this type of site does not require permit but Heritage NSW should be notified

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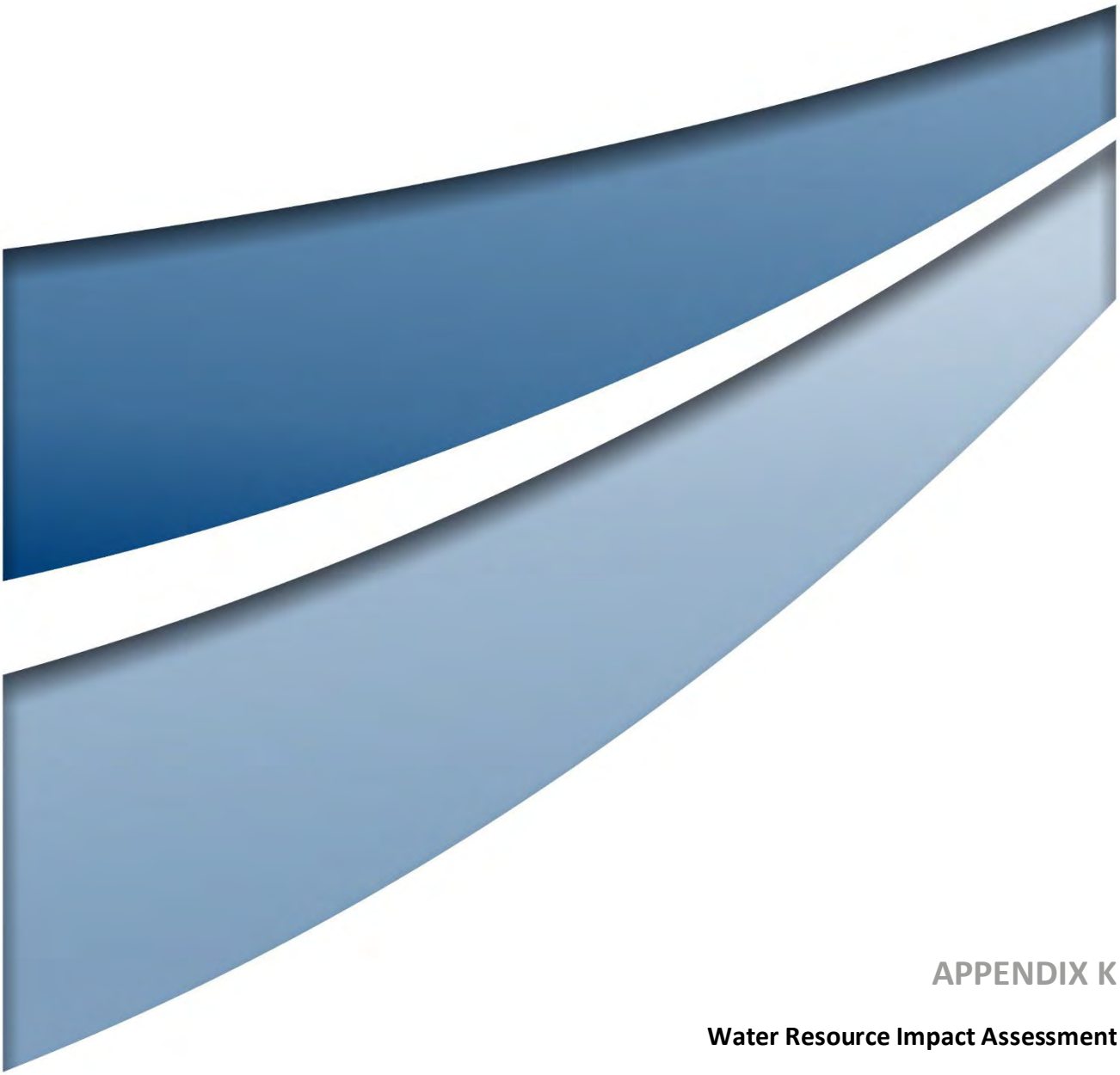

APPENDIX K

Water Resource Impact Assessment

umwelt
Environmental & Social Consultants

lightsource bp

GOULBURN RIVER SOLAR FARM

Amended Water Resources Impact Assessment

FINAL

December 2023

GOULBURN RIVER SOLAR FARM

Amended Water Resources Impact Assessment

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Lightsource bp

Project Director: Malinda Facey
Project Manager: Jessica Henderson Wilson
Technical Manager: Melissa Swan
Report No. 23485/R09
Date: December 2023

Environmental & Social Consultants

This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Acknowledgement of Country

Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.

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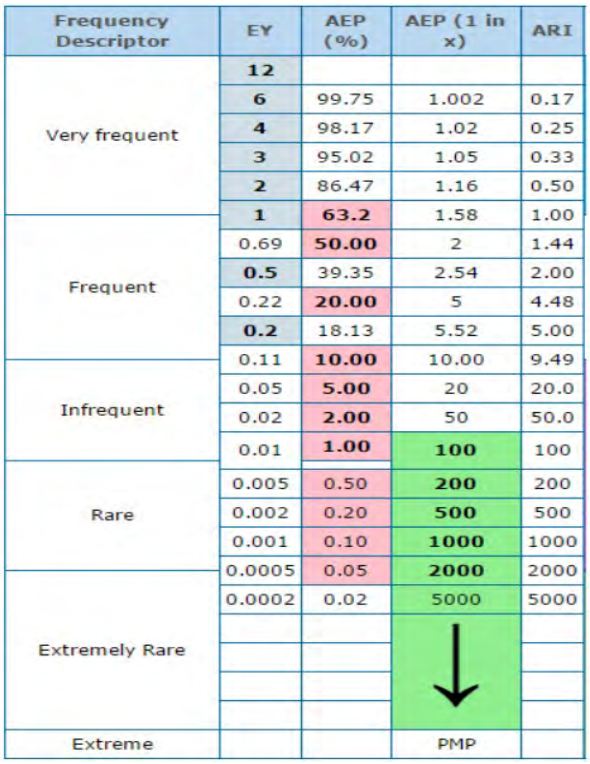
Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
V0	J Henderson-Wilson	04/12/2023	M Facey	05/12/2023
V1	J Henderson-Wilson	11/12/2023	M Facey	11/12/2023

Glossary and Abbreviations

Term/Abbreviation	Definition
AEP (Annual Exceedance Probability)	Annual Exceedance Probability. The chance of a flood of a given or large size occurring in any one year, usually expressed as a percentage. In this study AEP has been used consistently to define the probability of occurrence of flooding. The following relationships between AEP and ARI applies to this study (ARR, 2019). 
AHD	Australian Height Datum. A common national surface level datum approximately corresponding to mean sea level.
Amended Project	The Amended Project includes the elements of the Project as described in the EIS as well as changes which have been made largely in response to submissions on the EIS. These include: Project site access/egress amendments, upgrades to additional sections of Wollara Road and Ringwood Road, increased BESS capacity and an option of a decentralised BESS, minor Project layout modifications, construction of an additional transmission tower and additional assessment and revised approach for workforce accommodation.
ARR	Australian Rainfall and Runoff. Guidelines prepared by the Institute of Engineers Australia for the estimation of design floods.
ASS / PASS	Acid Sulfate Soils / Potential Acid Sulfate Soils.
BESS	Battery Energy Storage System.
CEMP	Construction Environmental Management Plan.
Development footprint	The maximum extent of ground disturbance associated with the construction and operation of the Project. The development footprint would cover an area of approximately 792.19 ha within the Project Area.

Frequency Descriptor	EY	AEP (%)	AEP (1 in x)	ARI
Very frequent	**12**			
	6	99.75	1.002	0.17
	4	98.17	1.02	0.25
	3	95.02	1.05	0.33
	2	86.47	1.16	0.50
	1	**63.2**	1.58	1.00
Frequent	0.69	**50.00**	2	1.44
	0.5	39.35	2.54	2.00
	0.22	**20.00**	5	4.48
	0.2	18.13	5.52	5.00
	0.11	**10.00**	10.00	9.49
Infrequent	0.05	**5.00**	20	20.0
	0.02	**2.00**	50	50.0
	0.01	**1.00**	**100**	100
Rare	0.005	0.50	**200**	200
	0.002	0.20	**500**	500
	0.001	0.10	**1000**	1000
	0.0005	0.05	**2000**	2000
Extremely Rare	0.0002	0.02	5000	5000
			↓	
Extreme			PMP	

Term/Abbreviation	Definition
Discharge	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m^3/s). Discharge is different from speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second (m/s).
Environmental Impact Statement (EIS) Project	The proposed Goulburn River Solar Farm. The Project includes the construction, operation and decommissioning of a solar farm with capacity of up to 550 MW, BESS and associated infrastructure. Including the various road repairs and upgrades to Ringwood Road.
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
Flood risk	Potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk in this manual is divided into 3 types, existing, future and continuing risks. They are described below: • Existing flood risk: the risk a community is exposed to as a result of its location on the floodplain. • Future flood risk: the risk a community may be exposed to as a result of new development on the floodplain. • Continuing flood risk: the risk a community is exposed to after floodplain risk management measures have been implemented. For a town protected by levees, the continuing flood risk is the consequences of the levees being overtopped. For an area without any floodplain risk management measures, the continuing flood risk is simply the existence of its flood exposure.
Flood storage areas	Those parts of the floodplain that are important for the temporary storage of floodwaters during passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. Hence, it is necessary to investigate a range of flood sizes before defining flood storage areas.
Floodplain	Area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is flood prone land.
GW	Gigawatt.
GWh	Gigawatt-hour.
Hazard	A source of potential harm or situation with a potential to cause loss. In relation to this manual the hazard is flooding which has the potential to cause damage to the community.
Hydrology	The study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.
ICNIRP	International Commission on Non-Ionizing Radiation Protection.
Involved Dwelling	Dwelling located on land owned by landholders involved in the Project.
Involved landholder	A landholder whose property would have Project infrastructure located on it.
kL	Kilolitre, one thousand litres.
km	Kilometres.
kV	Kilovolt.

Term/Abbreviation	Definition
m AHD	Metres Australian Height Datum (AHD).
m/s	Metres per second. Unit used to describe the velocity of floodwaters.
m^3/s	Cubic metres per second or "cumecs". A unit of measurement of creek or river flows or discharges. It is the rate of flow of water measured in terms of volume per unit time.
MDBA	Murray-Darling Basin Authority.
MHRDC	Maximum Harvestable Right Dam Capacity.
ML	Megalitre, one million litres.
MNES	Matter of National Environmental Significance.
MW	Megawatt.
Non-involved dwelling	Dwelling located on land owned by landholders not involved in the Project.
Non-involved landholder	A landholder whose property is located in proximity to the Project Area but would not have Project infrastructure located on it. Potential impacts to non-involved landholders are investigated in the EIS.
NVR Map	Native Vegetation Regulatory Map.
PMF (Probable maximum flood)	The largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The probable maximum flood defines the extent of flood prone land, that is, the floodplain.
Project Area	The total area in which the Project would be developed. The Project Area covers approximately 2,000 ha.
Risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. In the context of the manual, it is the likelihood of consequences arising from the interaction of floods, communities, and the environment.
Runoff	The amount of rainfall which ends up as a streamflow, also known as rainfall excess.
Scour	Erosion by mechanical action of water, typically of soil.
Sensitive receiver	Non-involved dwellings in proximity to the Project Area that may be sensitive to noise, visual, traffic and other impacts. Potential impacts to sensitive receivers are investigated in the EIS.
TUFLOW	TUFLOW is a computer program which is used to simulate free-surface flow for flood and tidal wave propagation. It provides coupled 1D and 2D hydraulic solutions using a powerful and robust computation. The engine has seamless interfacing with GIS and is widely used across Australia.
WAL	Water Access Licence.
WSP	Water Sharing Plan.

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1.0 Introduction

1.1 Project Overview

Lightsource Development Services Australia Pty Ltd (Lightsource bp) is seeking to develop the proposed Goulburn River Solar Farm in New South Wales (NSW) (the Project), approximately 28 kilometres (km) southwest of Merriwa within the Upper Hunter Shire Local Government Area (LGA) (refer to **Figure 1.1**). An Environmental Impact Statement (EIS), including a Water Resources Impact Assessment, was submitted to the Department of Planning and Environment (DPE) and publicly exhibited for 28 days over June and July 2023.

The Project, as exhibited in the EIS, included the construction, operation, maintenance and decommissioning of approximately 550 megawatt peak (MWp) of solar photovoltaic (PV) generation along with a Battery Energy Storage System (BESS) with 280 MWp and 570 megawatt hour (MWh) capacity. The Project also comprised supporting infrastructure including a substation and connection to an existing 500 kilovolt (kV) transmission line and road upgrades to parts of Ringwood Road including two culverts at Bow River and Killoe Creek.

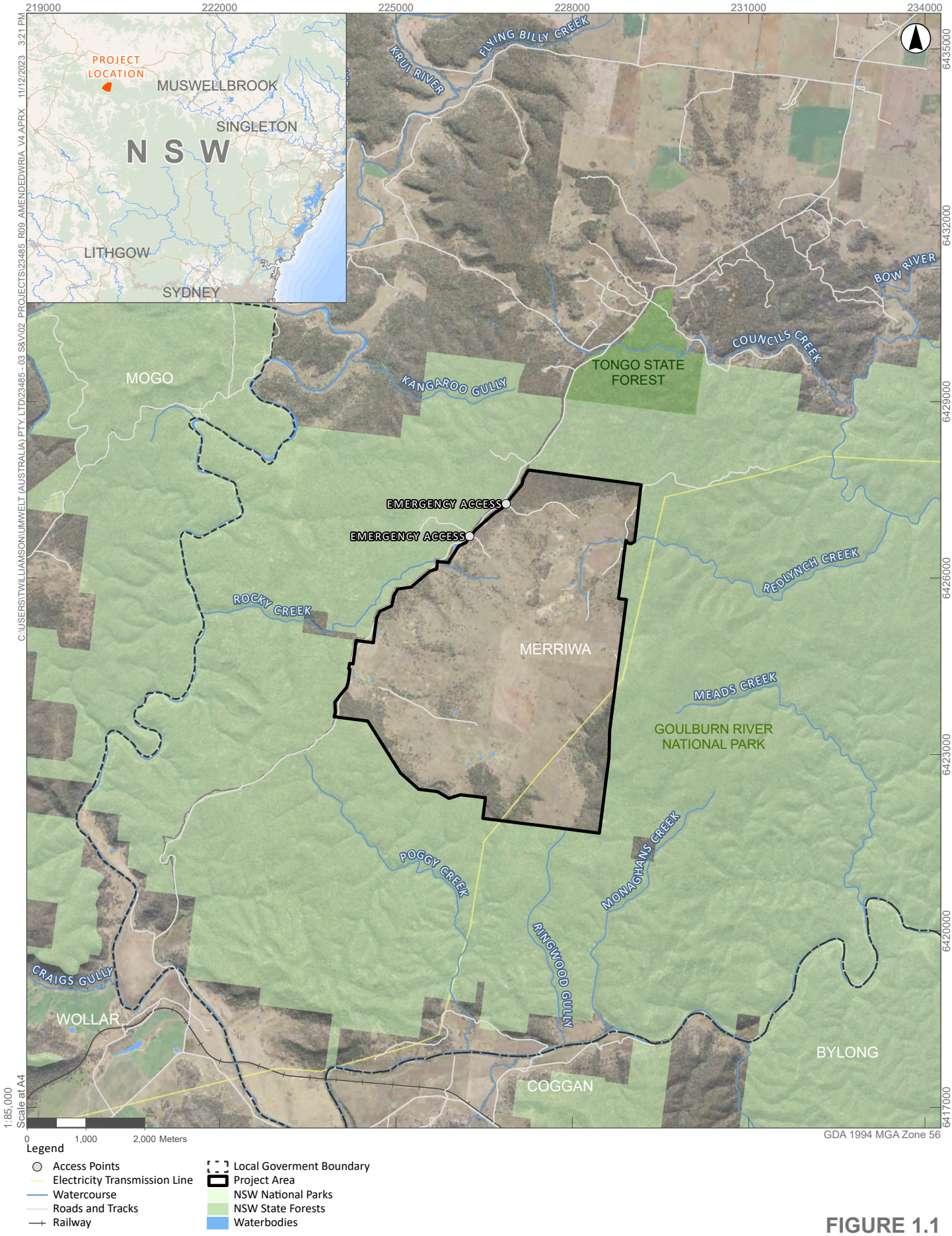
Following public exhibition of the EIS, LSbp has continued to consult with landholders and stakeholders. Ongoing consultation and consideration of the submissions received has resulted in a number of proposed changes to the Project.

Amendments to the Project (hereafter referred to as the Amended Project) are described and assessed within the Amendment Report (Umwelt, 2023a) which should be read in conjunction with the Response to Submissions Report (RtS) (Umwelt, 2023b) prepared for the Project. The conceptual layout for the Amended Project is shown in **Figure 2.2**.

The Project Area is situated on two freehold properties and sections of Crown Land, covering an area of approximately 2,000 hectares (ha), currently primarily used for grazing and cropping activities. The Development Footprint for the Amended Project is approximately 792.19 ha.

The Project is expected to operate for 40 years following an approximately 27-month construction period. After the initial 40-year operating period, the solar farm would either be decommissioned, removing all infrastructure and returning the site to its existing land capability, or repurposed with new equipment subject to technical feasibility and planning consents.

The Project is a State Significant Development (SSD) under the State Environmental Planning Policy (Planning Systems) 2021 (Planning Systems SEPP) as the capital value of the Project is over $30 million. An EIS for the Project was submitted to DPE in May 2023. Public exhibition of the EIS took place between 13 June 2023 and 10 July 2023, with 56 unique submissions made by the public (including one from Mid-Western Regional Council) as well as submissions from the two local councils the Project Site is located within and 11 government agencies.



Legend

- Access Points
- Electricity Transmission Line
- Watercourse
- Roads and Tracks
- Railway
- Local Goverment Boundary
- Project Area
- NSW National Parks
- NSW State Forests
- Waterbodies

FIGURE 1.1

Location and Regional Context

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)

1.2 Description of Amendments to this Assessment

This Water Resources Impact Assessment has been updated in response to the community and stakeholder submissions received on the EIS and subsequent amendments as part of the Amended Project.

- **Section 1.1** has been updated to reflect the details of the Amended Project and the approvals process to date.
- **Section 1.2** (this section) has been added to provide a summary of the updates to the document.
- **Section 1.3** has been updated to reference the Amended Project.
- **Section 2.0** has been updated to include the description of the Amended Project.
- **Section 3.5** has been updated to present the number of Water Access Licences for the 2023/2024 year.
- **Section 7.1.1** has been updated to include reference to the additional road upgrades proposed.
- **Section 7.2** has been updated to include a reference to the Amended Project.
- **Section 8.0** has been updated to include reference to the additional road upgrades proposed.
- **Section 10.0** has been updated to include additional References.

1.3 Purpose and Scope of this Report

This Amended Water Resources Impact Assessment (WRIA) has been prepared by Umwelt in accordance with the Secretary's Environmental Assessment Requirements (SEARs) (amended on 1 February 2022) issued by the DPE and as presented in **Section 1.4** and with consideration of the submissions relating to the public exhibition of the EIS (addressed within the Response to Submissions Report (Umwelt, 2023b)) and associated Project Amendment Report (Umwelt, 2023a)**.**

This report considers the potential impacts of the Project on water resources in the vicinity of the Amended Project Area, and the scope of this report includes:

- Assessments on the following:
    - flooding (including modelling for 10%, 1%, 0.5%, 0.2% Annual Exceedance Probability (AEP) and the Probable Maximum Flood (PMF))
    - groundwater levels
    - potential impacts and mitigation measures for erosion and sedimentation
    - surface and groundwater quality
    - water users
    - water sourcing and licensing.
- Identification of any mitigation and management measures to minimise potential impacts of the Project on water and soil resources.

1.4 Statutory Context, Policy and Guidelines

This report has been prepared in accordance with the following guidelines and legislative requirements:

- NSW *Water Management Act 2000* (WM Act).
- NSW *Water Act 1912* (Water Act).
- Relevant Water Sharing Plans within the Project Area.
- Groundwater:
    - NSW State Groundwater Policy Framework Document and component policies (DPIE).
    - NSW Aquifer Interference Policy 2012 (DPIE).
    - National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC).
- Flooding:
    - Floodplain Development Manual (OEH).
    - Floodplain Risk Management Guideline (OEH).
    - Australian Rainfall and Runoff Guidelines 2019.
- Surface Water:
    - NSW State Rivers and Estuary Policy (DPIE Water).
    - NSW Government Water Quality and River Flow Objectives at [http://www.environment.nsw.gov.au/ieo/].
    - Using the ANZECC Guideline and Water Quality Objectives in NSW (DEC, 2006).
    - National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ).
    - Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (DECC, 2008).
    - Managing Urban Stormwater: Soils and construction (Landcom).
    - Technical Guidelines: Bunding and Spill Management (EPA).
    - NSW Guidelines for Controlled Activities (Various) (DPIE).
    - NSW Water Quality Objectives (DECCW, 2006).
    - ANZECC (2000) Guidelines for Fresh and Marine Water Quality.
    - Approved Methods for the Sampling and Analysis of Water Pollutant in NSW (DECC, 2004).

- Guidelines for Controlled Activities on Waterfront Land: There a number of guidelines for Controlled Activities under the WM Act, developed by the former NSW Office of Water (now DPE – Water).
    - *Guidelines for riparian corridors on waterfront land.*
    - *Guidelines for instream works on waterfront land.*
    - *Guidelines for vegetation management plans on waterfront land.*
    - *Guidelines for watercourse crossings on waterfront land.*
    - *Controlled Activities on Waterfront Land: Controlled activity exemptions on waterfront land.*

Note that there has been no specific engagement with the community or government stakeholders as part of this assessment due to the minor impacts. Broader engagement has been undertaken with the community and government stakeholders as part of the EIS and preparation of the Response to Submissions and Amendment Report.

1.5 Summary of SEARS

The SEARs identify matters that must be addressed in the Environmental Impact Statement (EIS). **Table 1.1** references the relevant requirements for water and where the SEARs have been addressed in this report.

Table 1.1 SEARs Items and Responses

Requirement	Section Where Addressed
Water – including: an assessment of the likely impacts of the development (including flooding) on surface water and groundwater resources and measures proposed to monitor, reduce and mitigate these impacts;	**Section 7.0** and **Section 8.0**
details of water requirements and supply arrangements for construction and operation; and	**Section 3.5**, **Section 4.1**, **Section 7.4**and **Section 8.0**
where the project involves works within 40 metres of any river, lake or wetlands (collectively waterfront land), identify likely impacts to the waterfront land, and how the activities are to be designed and implemented in accordance with the DPI *Guidelines for Controlled Activities on Waterfront Land* (2018) and (if necessary) *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (DPI 2003), and *Policy & Guidelines for Fish Habitat Conservation & Management* (DPE, 2013); and	**Section 3.1**, **Section 7.1**, **Section 7.2** and **Section 8.0**
a description of the erosion and sediment control measures that would be implemented to mitigate any impacts in accordance with Managing Urban Stormwater: Soils & Construction (Landcom 2004);	**Section 8.0**

The Agency Advice and where in the WRIA it has been addressed is included in **Appendix A**.

1.6 Submissions on the EIS

An EIS for the Project was submitted to DPE in May 2023. Public exhibition of the EIS took place between 13 June 2023 and 10 July 2023. A total of 12 submissions relating to water were received. A Response to Submissions (RtS) report was prepared to provide a summary of the actions since exhibition, detail the comments provided in the public submissions phase of the EIS, analyse the submissions and offer a detailed response to each submission. Where required, the submissions relating to water have been addressed within this Amended WRIA. A summary of the submissions as relating to water and how they have been addressed is presented in **Appendix A**.

2.0 Project Description

2.1 EIS Project

The Project as exhibited within the EIS (the EIS Project) (and as displayed on **Figure 2.1**) included the construction, operation and decommissioning of a photovoltaic (PV) solar farm with a capacity of approximately 550 MWp, which will supply electricity to the national electricity grid. The Project also included a BESS with a proposed capacity of about 570 MWh and an electrical substation to connect the solar farm to the existing 500 kV transmission line that runs through the Project Area. Road upgrades were proposed to the north of the Project Area on Ringwood Road.

Subject to the final design process, the key components of the EIS Project include:

- Approximately 1 million bifacial solar PV modules in an east-west single-axis tracking arrangement with an average height of approximately 3.1 m at full tilt, with a maximum of 4 m in some areas due to undulating site topography.
- A BESS with an approximate 570 MWh capacity.
- Onsite 500 kV switchyard and substation, with underground electrical conduits and cabling leading into the yard and overhead lines reaching above to the existing transmission line.
- A 30 m Communications tower, providing communications, radio and cellular services to the site and the wider region.
- Perimeter and internal gravel access roads allowing for site maintenance.
- Temporary construction facilities and a site office and operations and maintenance building with parking for the operations team.
- Primary access point from existing driveway off Wollara Road, and two access points strictly for emergency access along the north-western boundary of the Project Area (**Figure 2.1**).
- Drainage line crossings, if and where required, to manage existing surface water flows.
- Perimeter security fencing around the solar modules, crossing gates, water tanks and/ or dams, and internal access points around the Project boundary.
- Ringwood Road would include a 1.8 km section to be widened and resealed between Bow River and Killoe Creek. These repairs will include 8 m bitumen-sealed formation with a minimum of 500 mm unsealed shoulders. The horizontal and vertical alignment of the proposed road will ensure safe sight distance, safe movement of longer vehicles, and an improved road network for the users.
- Culvert Upgrades: Two locations on Ringwood Road have been identified for upgrade to the water crossings at Bow River and Killoe Creek. The culvert upgrades will include:
    - installing culverts designed to accommodate B doubles and various farm machinery
    - culvert width 7 m (3.5 m lane width) sealed carriageway with suitable guardrail and signage

- associated drainage works
- stockpile site to be located on disturbed land within the road reserve in consultation with Upper Hunter Council
- temporary side track at both locations to facilitate access during construction.

2.2 The Amended Project

Proposed amendments to the Project are summarised below and addressed further in the Amendment Report (Umwelt, 2023a) which should be read in conjunction with this assessment. **Figure 2.2** displays the Amended Project and **Figure 2.3** highlights the differences between the Amended Project and the EIS Project. The Amended Project includes:

- Amendments to the transport route, including:
  - A revised transport access/egress route, including the diversion of construction vehicles egress west at the Golden Highway and Ringwood Road intersection to a vehicle turning area on Barnett Street, Merriwa.
  - An upgrade of the intersection of the Golden Highway and Ringwood Road to support these movements.
- Upgrades to additional sections of Wollara Road and Ringwood Road.
- Increased BESS capacity and option of a decentralised BESS including the option to host both centralised and decentralised BESS units.
- Minor modifications to the Development Footprint and internal layout, including:
  - A re-alignment of the Development Footprint to avoid Travelling Stock Route (TSR) 44841 although maintaining existing access through TSR 44841.
  - Relocation or removal of solar arrays within the Development Footprint to further avoid serious and irreversible impacts (SAII) to important habitat for the Regent Honeyeater and Box Gum Woodland.
  - Relocation of the access road connecting the northern portions of the site to further avoid biodiversity impacts.
  - An increase in the width of two (2) internal access roads which connect the western and northern portions of the site from 6 m (as originally proposed in the Project EIS) to 10 m, to allow for underground transmission corridors as part of the internal reticulation network, rather than overhead transmission cables.
  - Reduction of the development footprint to 792.19 ha as a result of the above modifications.
- Construction of an additional transmission tower within the existing easement of the 500 kV transmission line adjacent the BESS/substation.
- Additional assessment and revised approach for workforce accommodation.

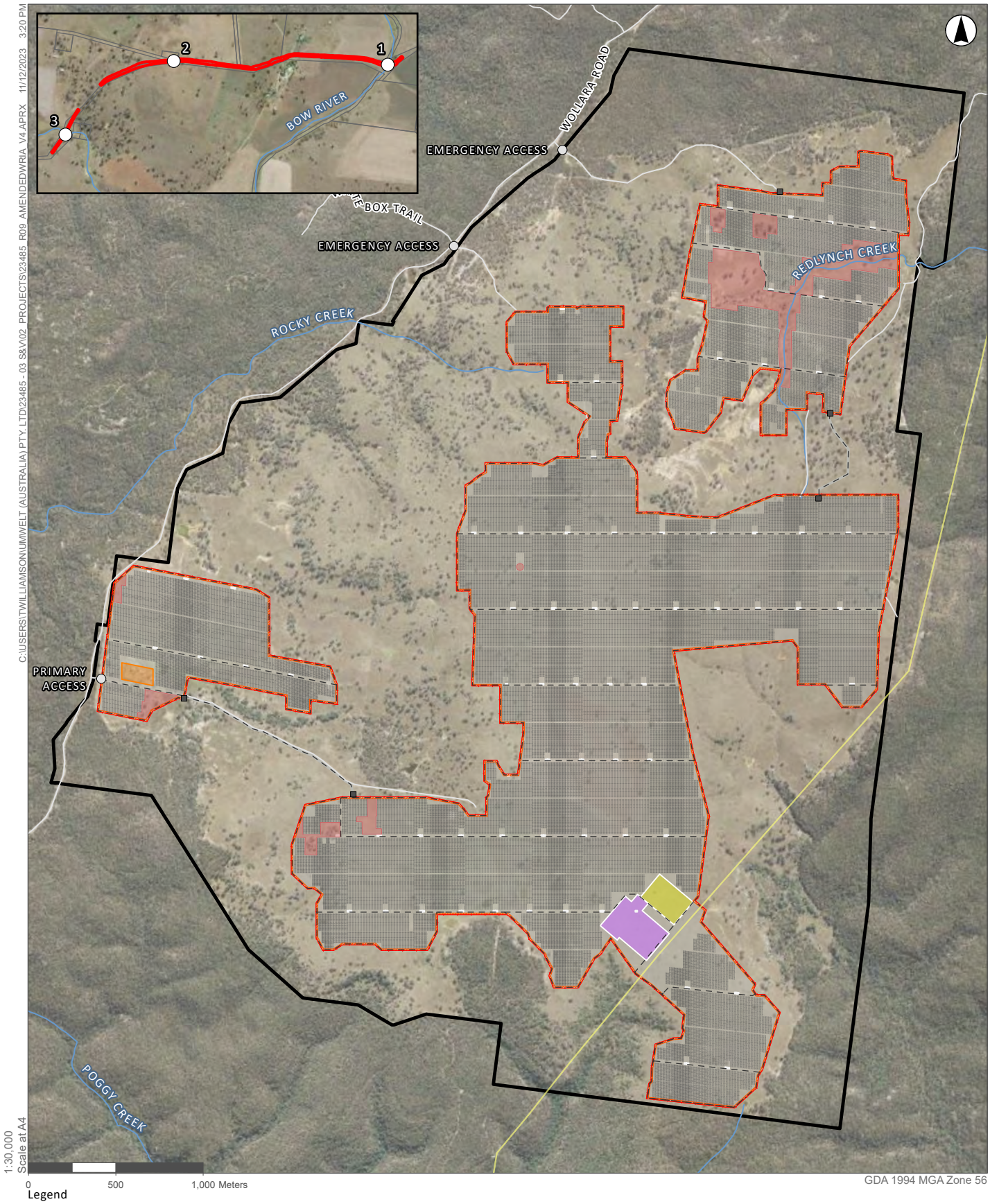


FIGURE 2.1

EIS Project Development Footprint

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)

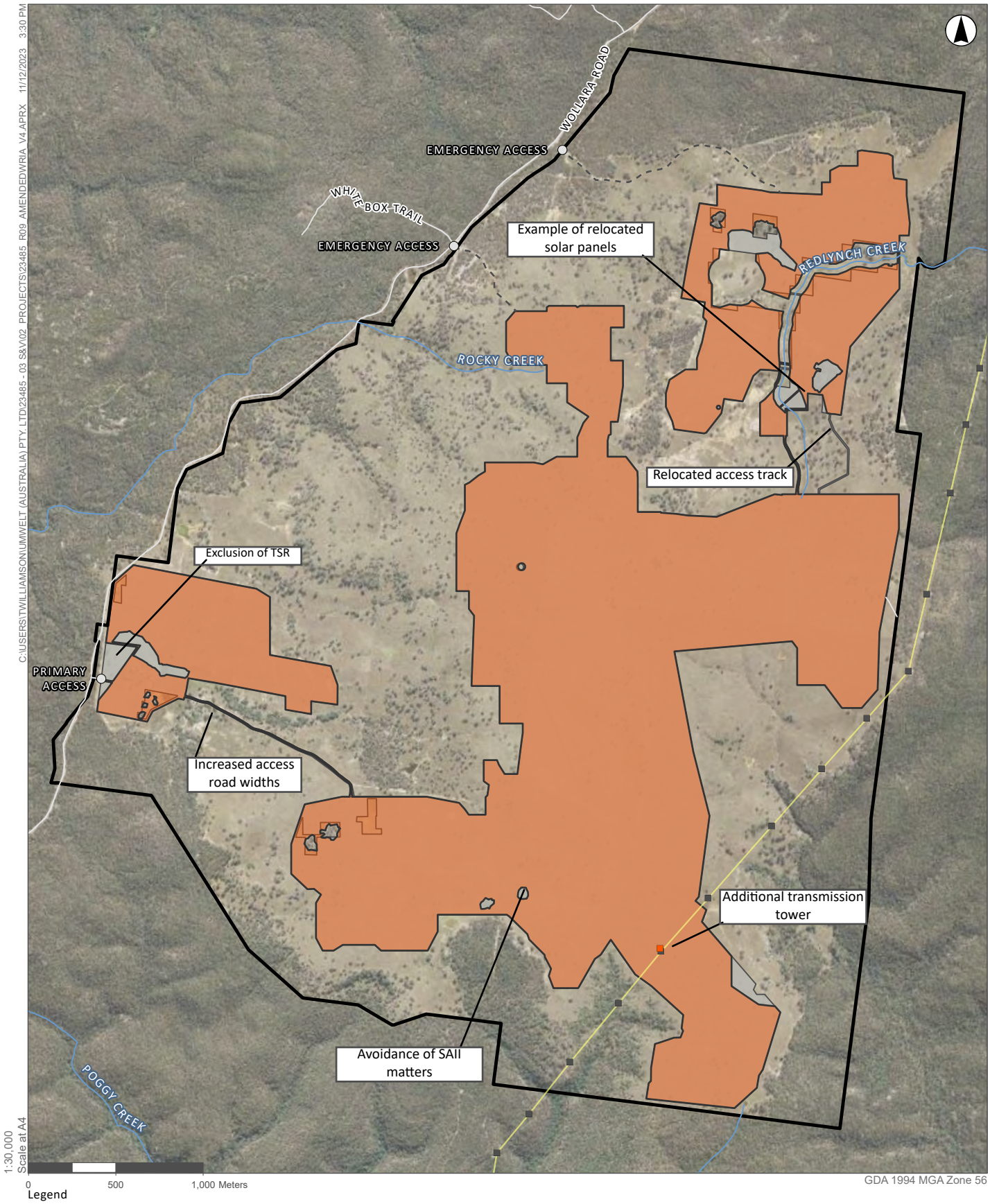


FIGURE 1.4

Summary of the Proposed Amendments to Development Footprint

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)

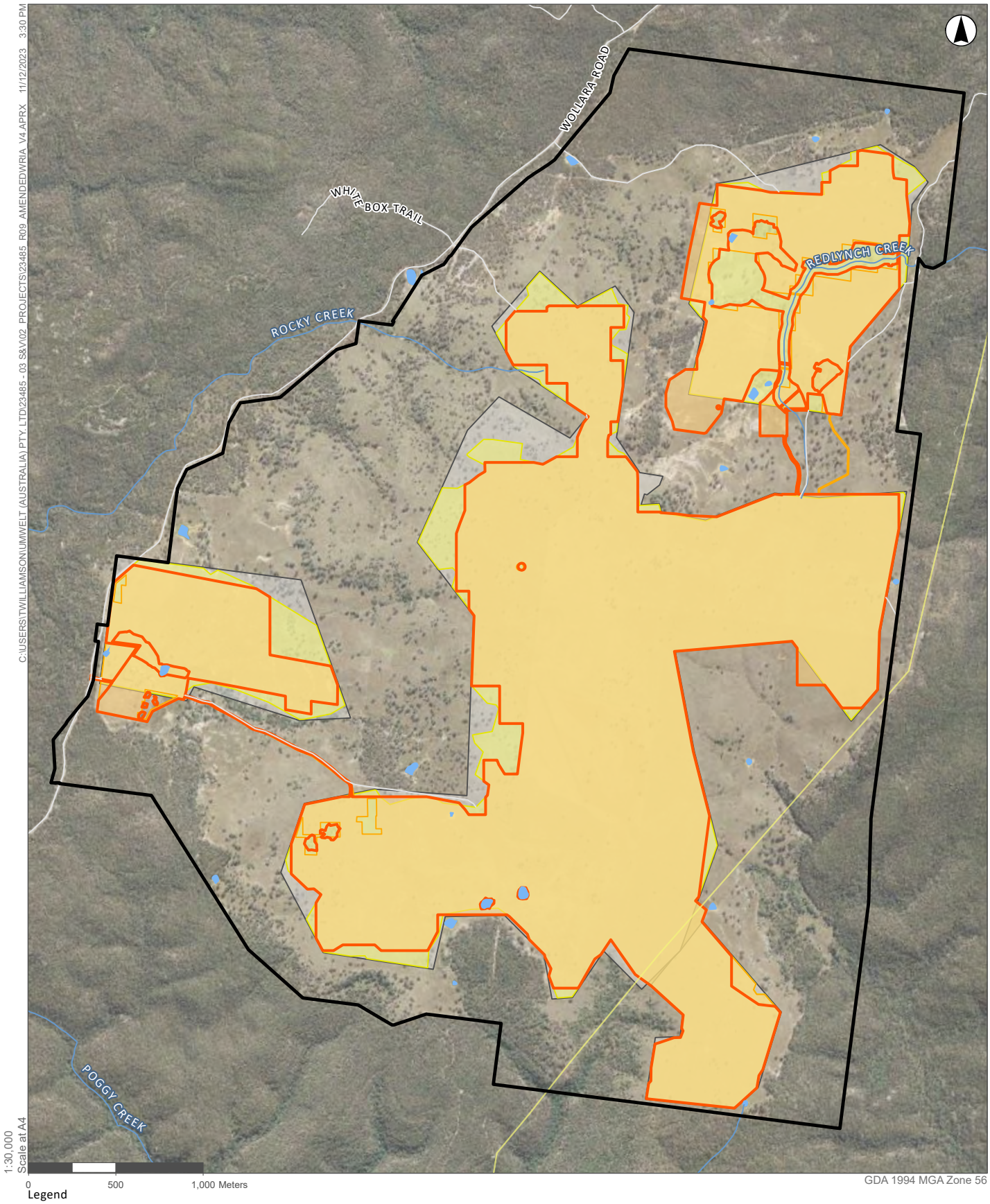


FIGURE 2.3

Summary of the Proposed Amendments to the Development Footprint

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022); Lightsource BP (2022)

3.0 Existing Environment

3.1 Hydrology

The Project Area is located within the Hunter River catchment, within the Goulburn River sub-catchment. In the surrounding area of the Project, Redlynch Creek is located to the northeast, Rocky Creek to the northwest, Poggy Creek to the southwest and Ringwood Gully to the south. Goulburn River is located approximately 3 km to the south and to the west of the Project Area (refer to **Figure 3.1**).

The topography of the Project Area varies, with the majority of the Project Area between 400 mAHD and 440 mAHD, with elevation between 350 mAHD and 390 mAHD in the north and southwest of the Project Area (refer to **Figure 5.1**). The identified watercourse alignments with their corresponding Strahler stream order are shown in **Figure 3.1**. As the Project Area is located on top of a ridge, watercourses and unnamed flow paths within the Project Area are located towards the boundary.

The majority of the watercourses in the Project Area are only 1st and 2nd order watercourses with sections of Redlynch Creek, Rocky Creek and Monaghans Creek also becoming 3rd order watercourses within the Project Area. All watercourses within the Project Area eventually flow into the Goulburn River.

There are approximately 20 to 30 small man-made farm dams present within the Project Area where water pooling occurs for extended periods, as shown in **Figure 3.1**.

The Road Upgrade Area includes two watercourses, Bow River a 6th order watercourse and Killoe Creek a 4th order watercourse. The identified watercourse alignments with their corresponding Strahler stream order are shown in **Figure 3.1A**.

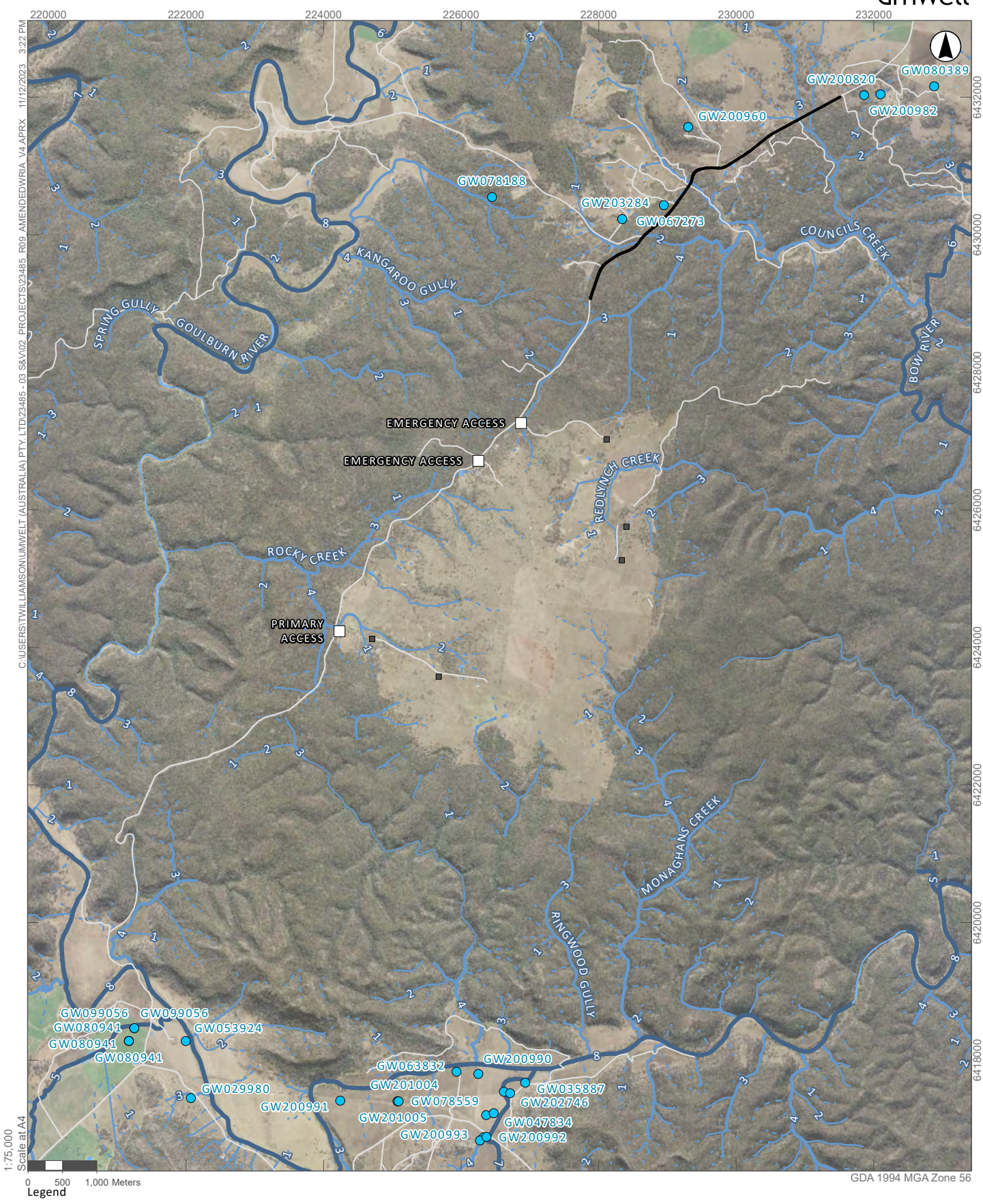


FIGURE 3.1

Hydrological Context

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)

FIGURE 3.1A
Hydrological Context in Road Upgrade Areas

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022)

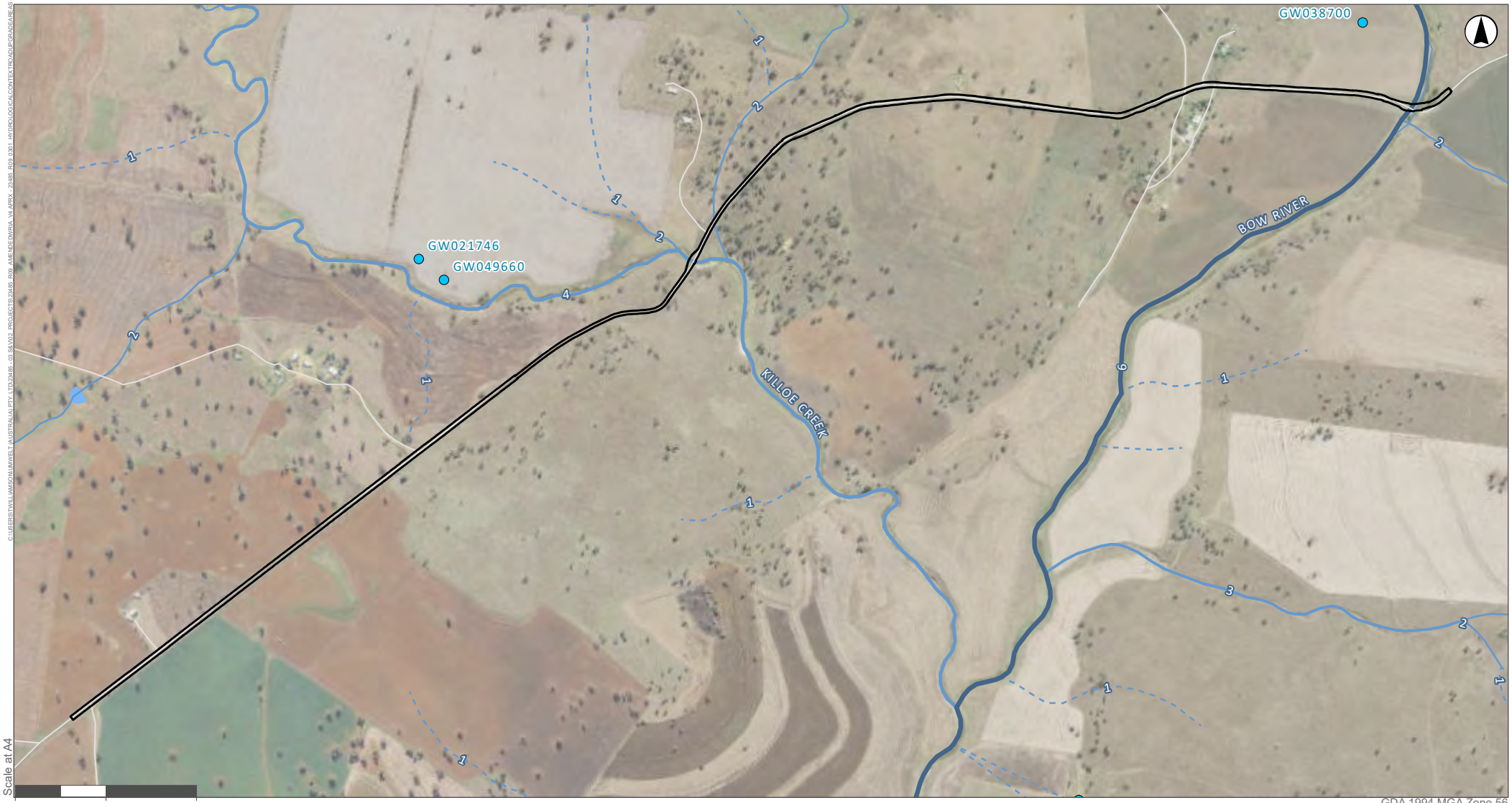


FIGURE 3.1B
Hydrological Context in Road Upgrade Areas

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022)

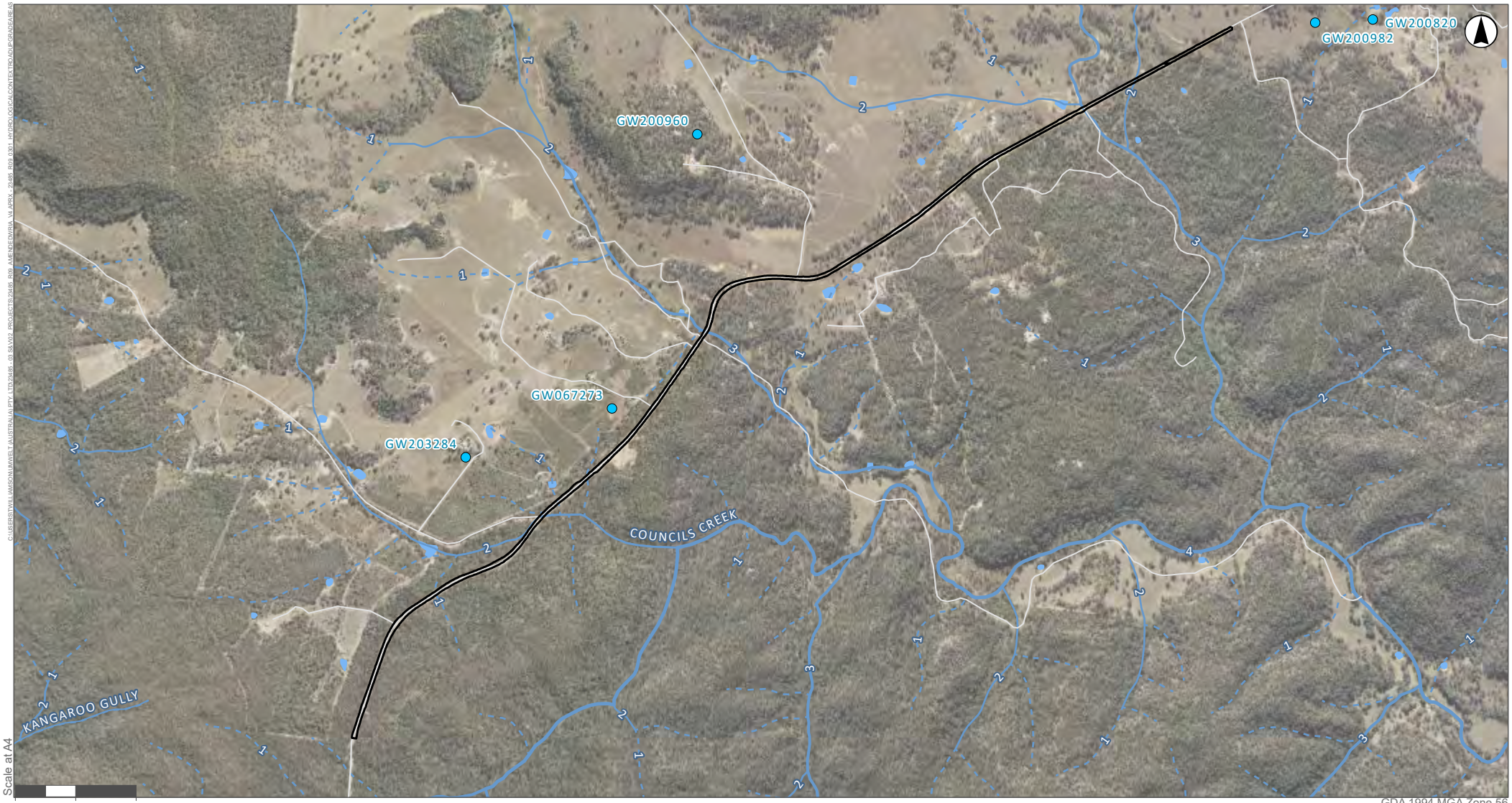


FIGURE 3.1C
Hydrological Context in Road Upgrade Areas

Image Source: ESRI Basemap (2022) **Data source:** NSW LPI (2022), NSW DSFI (2022); NPWS Estate (2022)

3.2 Rainfall and Evaporation

The closest active Bureau of Meteorology (BoM) daily rainfall gauge to the Project Area is Barrigan St, Wollar (Gauge 062032), approximately 16 km to the southwest. The gauge is considered representative of the local region rainfall patterns.

Records from the Barrigan St, Wollar gauge cover a continuous period of over 121 years from 1901 to 2022. The recorded annual average rainfall over this period is 590 mm, with 1950 providing for the highest annual total of 1,205 mm.

The average monthly rainfall data from the Barrigan St, Wollar gauge is presented in **Figure 3.2**. The mean and median rainfalls are highest during spring/summer, with the highest monthly mean reaching 61.5 mm in January, and are lowest in May at 26.5 mm. The highest daily rainfall values indicate storm events are most likely to occur during February with peak daily totals exceeding 180 mm.

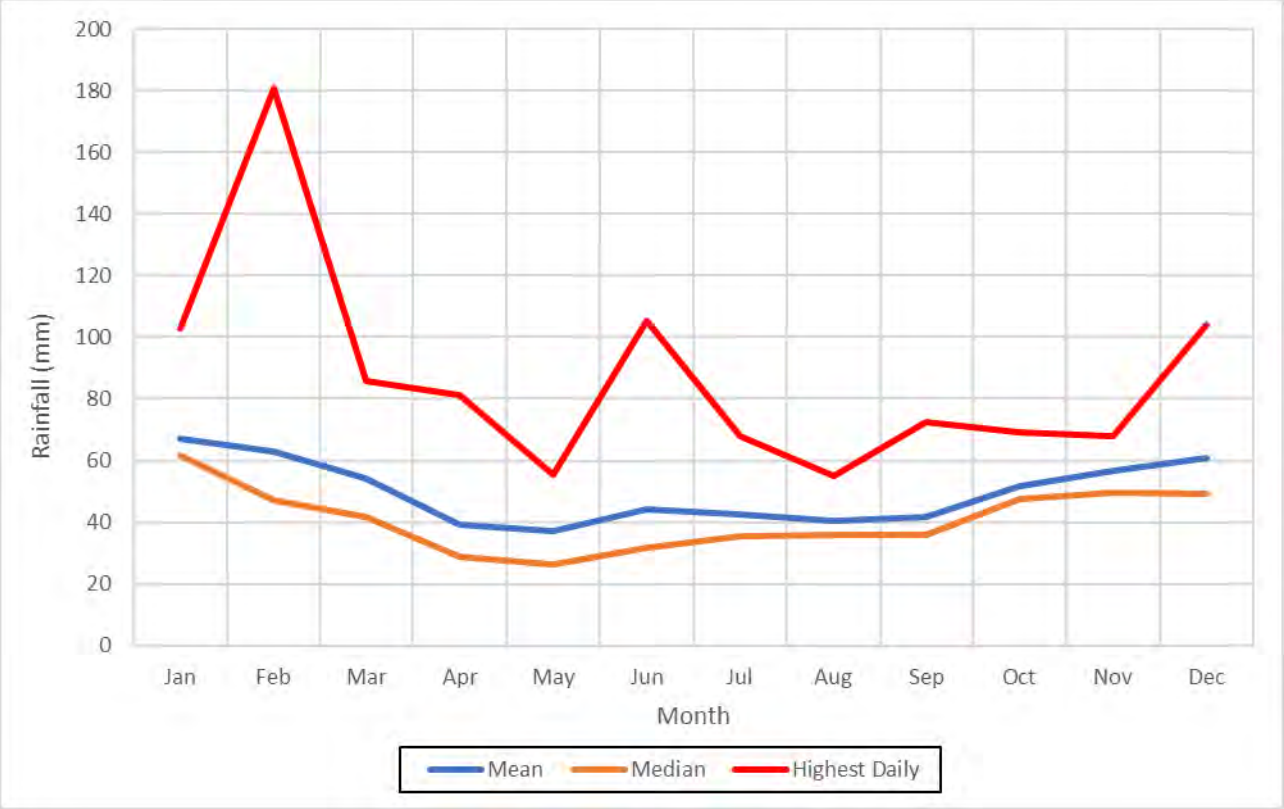


Figure 3.2 Monthly Rainfall at Barrigan St, Wollar Gauge (Gauge ID 062032)

The average annual evaporation across the Project Area is estimated to be between 1,200 and 1,600 mm/year (BoM, 2006), as shown in **Figure 3.3**.

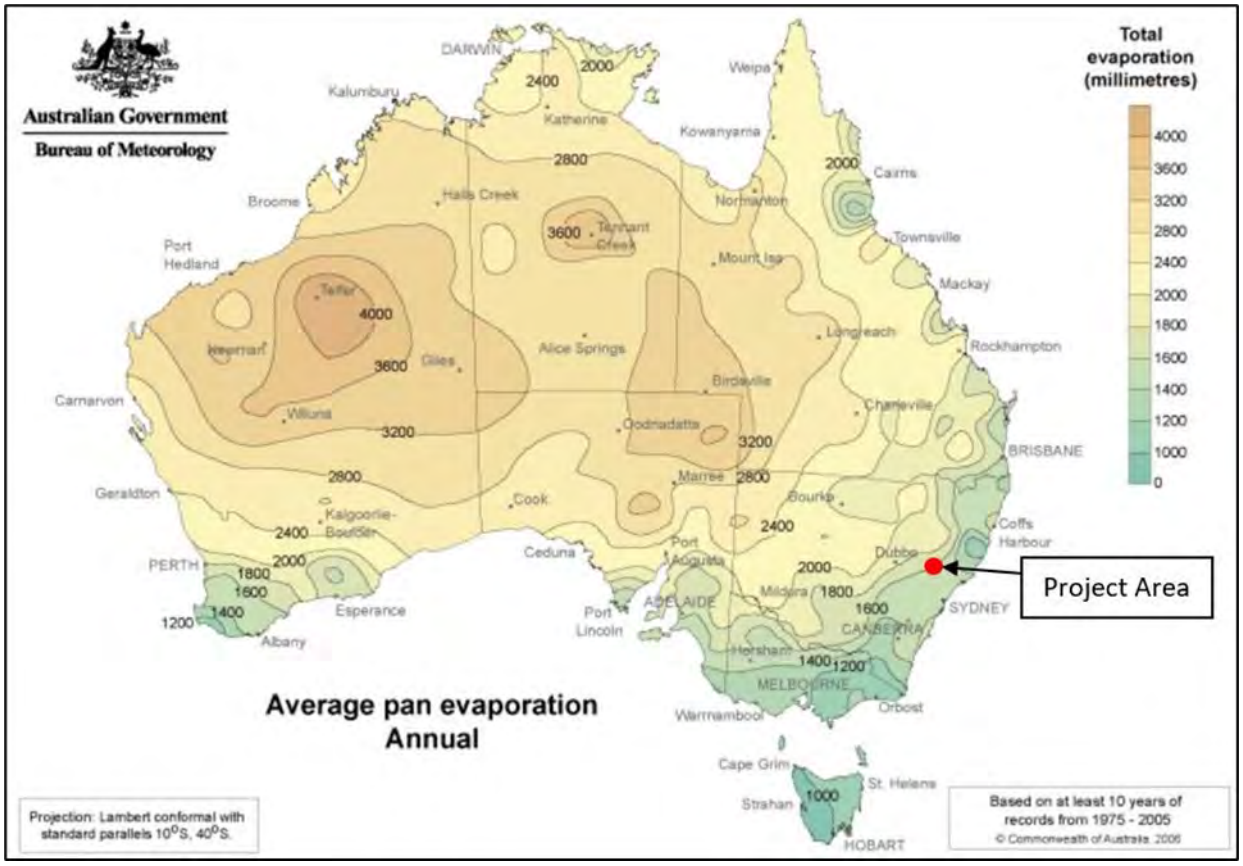


Figure 3.3 Average Annual Evaporation

3.3 Geology and Soils

The Project Area geology is generally comprised of Carboniferous granites and Cainozoic units with smaller sections of the Project Area comprised of Dungeree Volcanics and Tucklan Formation (Meakin et al, 2000). Common minerals are quartz and biotite.

There are no known occurrences of acid sulfate soils (ASS) within the Project Area (OEH, 2010),and it is highly unlikely they would exist at the site or be impacted by the Project due to the elevation of the Project Area (ASS is usually found at elevations less than 1 metre above sea level).

A review of NSW DPE soil profile and soil map information website, 'eSPADE', indicated the majority of the Project Area is located within the 'Bald Hill' soil landscape described as covering low hillocks and basalt or dolerite caps and flows to the south of Merriwa. The main soils are Euchrozem – Chocolate Soil intergrades with shallow stony loams on crests (DPE, 2022). The soil landscapes across the Project Area are shown in **Figure 3.4**. Refer to the Soil, Land and Agriculture Assessment report (Umwelt, 2023) for more information on the soils, issues identified and recommended management measures.

3.4 Groundwater

Groundwater at the Project Area is managed under the Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources (DPE, 2022).

Groundwater to the southwest and northwest of the Project Area, surrounding the Goulburn River is mapped in the *Upper Hunter Local Environmental Plan 2013* as 'Groundwater Vulnerability'. There is no identified groundwater vulnerability within the Project Area.

There are no WaterNSW registered groundwater bores within the Project Area. The closest groundwater bore (GW203284) is approximately 3 km northwest of the Project Area and is described as being drilled to 82 m in depth and for stock and domestic water supply purposes. The last recorded groundwater depth was 41 m below ground on 7 June 2014 (WaterNSW, 2021a). Bores approximately 4 km south of the Project Area (GW063832, GW200990, GW035887) located along the Goulburn River are either for monitoring or water supply purposes.

3.5 Water Extraction and Users

The *Water Management Act 2000* is the key piece of legislation for water resource management in NSW. Under the Act, Water Sharing Plans (WSPs) have been developed to protect the environmental health of water sources, whilst securing sustainable access to water for all users. The WSPs specify maximum water abstractions and allocations and provide licenced and unlicensed water users with a clear picture of when and how water will be available.

All water extraction in NSW, apart from some exemptions for basic landholder rights extractions and pollution control, must be authorised by a water access licence (WAL).

The Project Area is subject to the WSP for the *Hunter Unregulated and Alluvial Water Sources 2022* and the Project Area is located within the Upper Goulburn River Water Source.

Licensed surface water use in the Upper Goulburn River Water Source is primarily for agricultural (irrigation) use. The number of WALs and total share entitlement in the water source as well as the number and type of shares for the 2023/2024 year are presented in **Table 3.1**.

Table 3.1 Surface Water Access Licences

Number of WALs 2023/2024	Number of Shares			Total
	Aquifer	Domestic and Stock	Unregulated River	
20	102	8	1,780	1,890

3.6 Groundwater Dependent Ecosystems (GDEs)

The Goulburn River supports a number of identified moderate and low priority groundwater dependent ecosystems (GDEs) within the area surrounding the Project Area (DPIE, 2019), as shown on **Figure 3.5**.

Moderate potential aquatic GDEs were identified along significant reach lengths of the Goulburn River, west and south of the Project Area. Low potential terrestrial GDEs were identified within the Project Area, with some isolated small areas of medium and high potential terrestrial GDEs located well downstream of the Project Area along the natural surface water drainage paths (BoM, 2017).

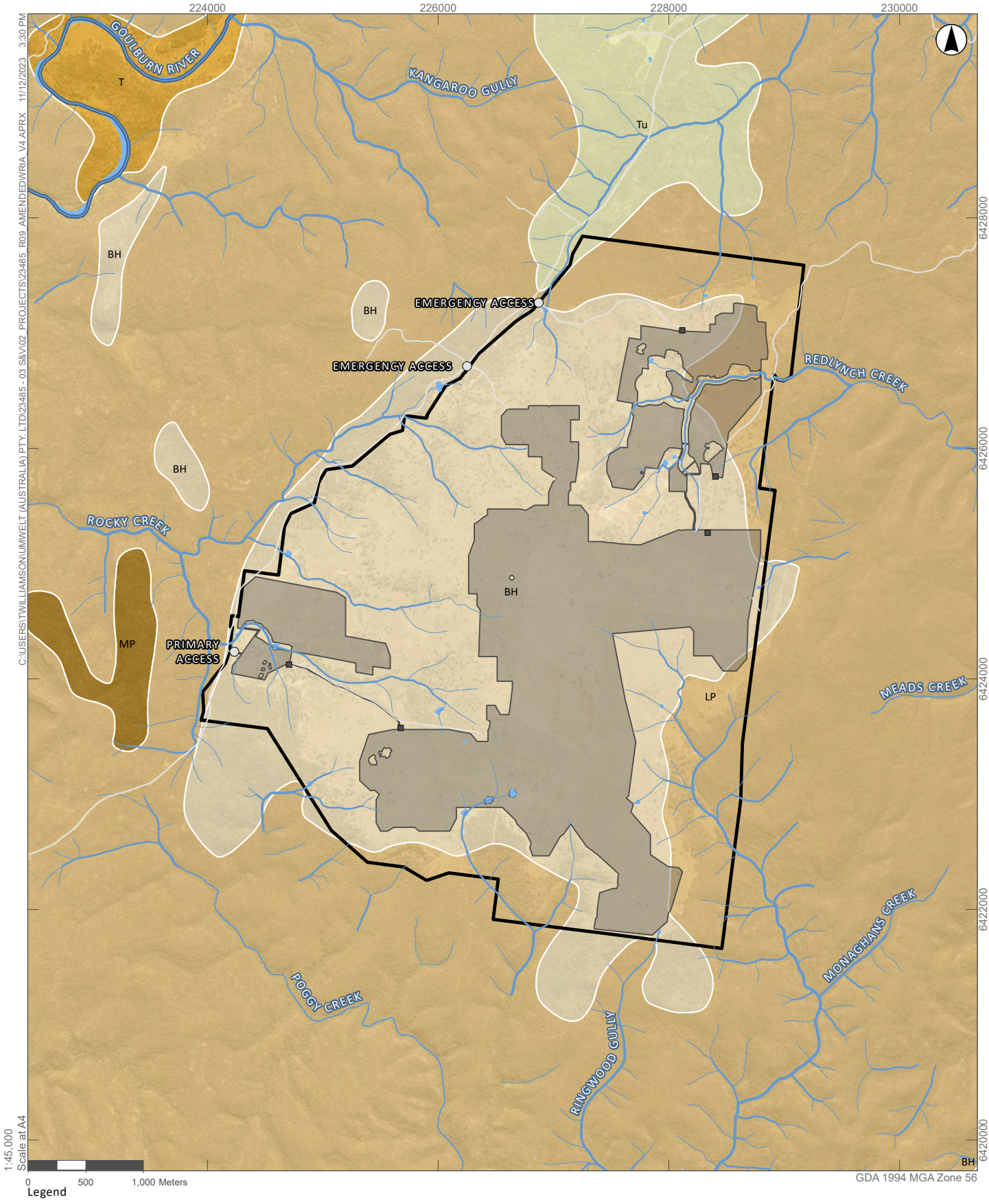
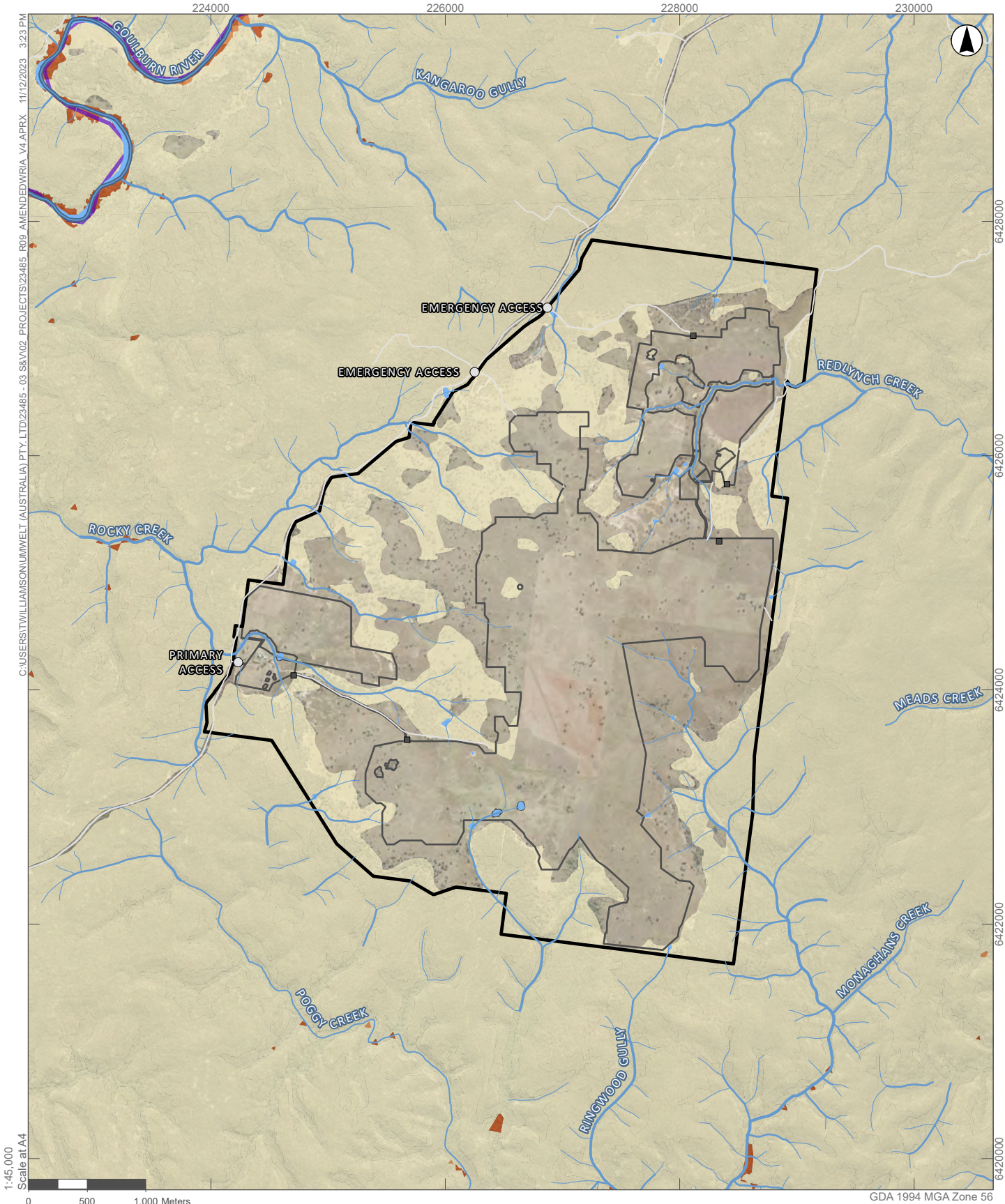


FIGURE 3.4

Soil Landscape Mapping

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)



Legend

- Gate
- Access Points
- Roads and Tracks
- Watercourse
- Waterbodies
- Study Area
- Development Footprint - Amended Project

Aquatic GDEs

- Moderate potential GDE - from national assessment

Terrestrial GDEs

- Low potential GDE - from regional studies
- Moderate potential GDE - from regional studies
- High potential GDE - from regional studies

FIGURE 3.5

Groundwater Dependent Ecosystems

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)

3.7 Surface Water Quality, Environmental Values and Water Quality Objectives

The NSW Water Quality Objectives (WQOs) have been developed to guide plans and actions to achieve healthy waterways. The WQOs are based on measurable environmental values (EVs) for protecting aquatic ecosystems, recreation, visual amenity, drinking water and agricultural water. The WQOs for the Hunter River catchment have been developed to achieve suitable water quality for the protection of:

- aquatic ecosystems
- visual amenity
- primary and secondary contact recreation
- livestock water supply
- irrigation water supply
- homestead water supply
- drinking water
- aquatic foods.

The River Flow Objectives for the Hunter River catchment have been developed to:

- protect pools in dry times
- protect natural low flows
- protect important rises in water levels
- maintain wetland and floodplain inundation
- maintain natural flow variability
- manage groundwater for ecosystems
- minimise effects of weirs and other structures.

Based on the likely construction activities and operations for the Project and the environmental values listed above, the water quality objectives presented in **Table 3.2** are considered relevant to the Project.

There is no relevant available water quality information for the existing environment. Often in modified environments, there is the potential for the current water quality to not meet the existing guidelines and trigger values for protecting environmental values. Irrespective of the current condition of waterways, the Project should not further degrade water quality. As such, the key objective of the Project is to minimise the potential impacts on downstream receiving waters, so that the Project changes the existing water regime by the smallest amount practicable.

Table 3.2 Project Relevant Water Quality Objectives

Parameter	Units	Value/Range
pH	-	6.5 to 8.0
Salinity (Electrical Conductivity)	µS/cm	30 to 350
Turbidity	NTU	2 to 25
Total Phosphorus	µg/L	20
Total Nitrogen	µg/L	250
Visual clarity and colour	-	Natural visual clarity should not be reduced by more than 20%. Natural hue of the water should not be changed by more than 10 points on the Munsell Scale. The natural reflectance of the water should not be changed by more than 50%.
Surface films and debris	-	Oils and petrochemicals should not be noticeable as a visible film on the water, nor should they be detectable by odour. Waters should be free from floating debris and litter.

4.0 Water Demand, Supply and Discharge

4.1 Proposed Water Supply and Use

The Project would require a water supply during the construction, operational and decommissioning phases.

During construction, non-potable water would primarily be used for plant establishment, dust suppression and site ablutions. The associated water demand for the 27-month construction period is estimated to peak at 11.26 ML/month.

During operations, non-potable water would be required for occasional maintenance activities such as washing of the PV solar panels, amenities and potable water would be required by operational staff as well as for stock. Washing of the panels would not require any detergent or cleaning agents. It is expected that this water demand would be minimal.

Potable water demands for both the construction and operational phases of the Project will be primarily sourced from rainfall stored in on-site water tanks at the O&M facility and augmented by water trucks if required. Potable water storages will be routinely tested to ensure water quality meets the requirements of the Australian Drinking Water Guidelines (ADWG) (National Health and Medical Research Council, 2011) and an appropriate maintenance regime will be implemented to ensure ADWG water quality standards are maintained.

Non-potable water demands to meet construction water demands will be sourced by purchasing and transporting water or treated wastewater to site by tanker from commercial suppliers in the nearby region. Other sources of non-potable water may include:

- Harvested runoff from farm dams under agreement with host or local landholders. These existing dams are unlikely to be licensed as the dams are likely to capture water under a harvestable right. The total capacity of all dams on a property allowed under the harvestable right is called the Maximum Harvestable Right Dam Capacity which has been calculated for the Project Area as 130 megalitres (based on a Project Area of 2,000 ha) (WaterNSW, 2022b). No change in licensing is expected to be required, however this should be confirmed prior to construction.
- Harvested runoff from disturbed areas captured in excavations or sediment basins/traps constructed to prevent sediment transport off-site.
- Groundwater from licensed bores in the region under agreement with host or local landholders.

Water sources would be determined in consultation with suppliers and landholders and will be subject to availability. Where further licenses are needed to access water from these sources or licence amendments are required, these will be secured by Lightsource bp prior to the water being used.

All other water sourced from either surface water or groundwater sources to meet Project construction demands will be licenced and managed, as required, in accordance with the requirements of the *Water Management Act 2000*, the Water Management (General) Regulation 2018 and relevant WSPs (i.e. the *Hunter Unregulated and Alluvial Water Sources 2022*.

4.2 Discharge

No change to the natural surface waterway outlets from the Project Area is being proposed and no water discharge is proposed as part of the Project.

5.0 Flood Assessment Methodology

5.1 Modelling Approach

The hydrological assessment was undertaken in accordance with ARR2019 and with consideration of the relevant provisions of the NSW Floodplain Development Manual (2005). The mapping within ARR2019 is consistent with the NSW Floodplain Development Manual (2005) but provides additional detail and updated recommendations on hazard category thresholds.

There are no specific floodplain risk management plans prepared by Upper Hunter Shire Council that cover the Project Area. The most recent floodplain risk management plan prepared within Upper Hunter Shire LGA is the Aberdeen Floodplain Risk Management Study and Draft Plan (2015). This document uses the NSW Government's Floodplain Development Manual (2005) to characterise and map flood hazard.

There are no Rural Floodplain Management Plans covering the Project Area, but the analysis and reporting is consistent with the expectations of a Rural Floodplain Management Plan.

A flood investigation was undertaken for 10%, 1%, 0.5% and 0.2% AEP events and the PMF. AEP is a measure of the likelihood a flood level or flow will be equalled or exceeded in any given year. The PMF is the largest flood that could be conceivably expected to occur at a particular location, usually estimated from Probable Maximum Precipitation (PMP).

Hydraulic modelling of the Project Area was completed using a two-dimensional (2D) TUFLOW flood model. TUFLOW software is one of the most widely used hydraulic modelling software packages in Australia. The software is considered an appropriate modelling tool for modelling riverine and local overland flooding. TUFLOW allows the simulation of runoff generated from local rainfall on a grid that is representative of the site topography, known as "direct rainfall" modelling. A finer resolution 2D TUFLOW model covering the Project Area catchment was used to determine the critical storm durations and temporal patterns. The TUFLOW model was run for the critical storms and temporal patterns determined using this resolution model.

The model provides estimates of flood levels, depth, velocities, and flood hazard for each of the modelled design events. The hydraulic model was run for both existing and climate change conditions. Climate change modelling was undertaken using the 0.5% and 0.2% AEP year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood-producing rainfall events due to climate change.

5.1.1 Design Rainfall Inputs

5.1.1.1 Event Duration

Design rainfall was derived for burst durations between 30 minutes and 24 hours, based on the expectation that the critical storm duration for the Project Area catchment would be relatively short.

5.1.1.2 Intensity-Frequency Duration (IFD)

Rainfall burst depths for the modelled AEP events were estimated for the centroid of the catchment using the 2016 ARR IFD analysis available from the BoM as shown in **Table 5.1**. A consistent design rainfall was adopted (i.e., no spatial variation) given the size of the local catchment.

The PMP was estimated using the Generalised Short Duration Method (GSDM) (BoM, 2003).

Table 5.1 Design Rainfall Depths (mm) for Various Event Durations and AEPs

AEP (1: Y)	30 min	1.5 hr	2.0 hr	3.0 hr	6.0 hr	9.0 hr	12.0 hr	18.0 hr	24.0 hr
2	18.0	25.3	27.4	30.7	37.6	42.7	46.8	53.2	58.1
5	23.8	33.3	36.0	40.3	49.6	56.7	62.5	71.9	79.3
10	27.9	38.8	42.0	46.9	57.9	66.4	73.5	85.3	94.7
20	32.1	44.5	48.0	53.6	66.2	76.1	84.7	98.9	111.0
50	37.9	51.9	55.9	62.4	77.7	90.1	101.0	119.0	134.0
100	42.6	57.6	62.0	69.3	86.8	101.0	114.0	136.0	154.0
200	49.2	66.6	71.6	79.9	99.8	117.0	131.0	157.0	178.0
500	58.6	79.4	85.3	95.0	118.0	138.0	156.0	186.0	212.0

5.1.2 Model Domain and Topography

The Project Area catchment was delineated using LiDAR data and is shown in **Figure 5.1**. The total modelled area is approximately 33 km^2, covering all of the Project Area catchment, and extending downstream of the Project Area boundary along the relevant watercourse alignments.

The model topography was developed from the LiDAR data available for the site. The Project Area is covered by 2 m resolution LiDAR data flown in 2017 (GA, 2017). A 4 m model grid resolution was adopted covering the Project Area. The modelled topography is shown in **Figure 5.1**.

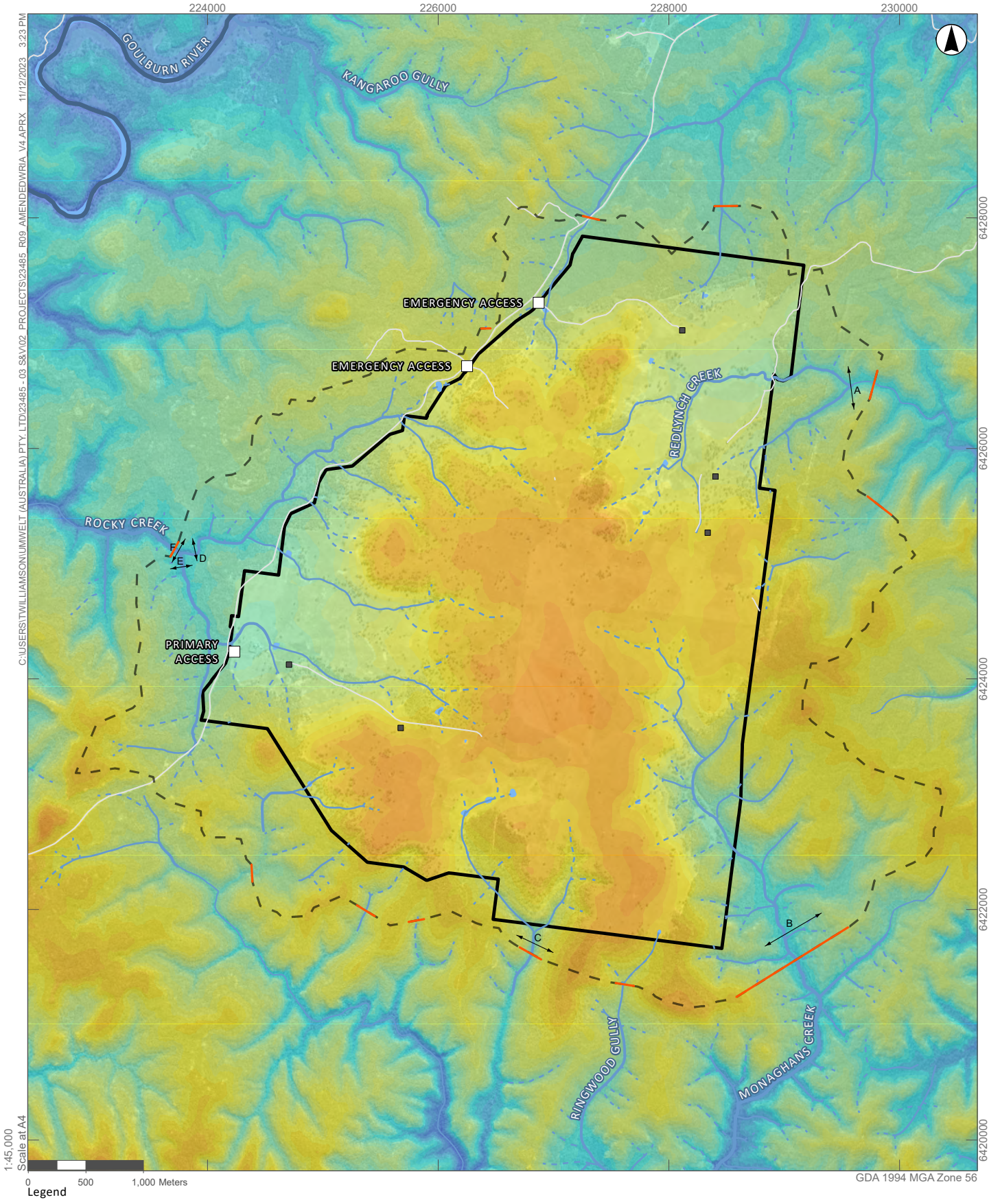


FIGURE 5.1

Model Domain and Topography

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)

5.1.3 Hydraulic Roughness and Losses

The hydraulic model used Manning's 'n' to represent the hydraulic roughness to determine the restriction caused by the range of land uses within the model area. Aerial photography was used to assign a specific Manning's 'n' roughness coefficient based on the recommendations in ARR2019, as shown in **Table 5.2**. Most of the Project Area is minimally to moderately vegetated based on aerial photography. Initial and continuing losses were also applied as per land use and the adopted values are shown in **Table 5.3**. The values used are typical and have been used in similar studies.

Losses were initially extracted from the ARR online Data Hub. The suggested losses were a 47.0 mm initial loss (IL) and a 3.8 mm/hr continuing loss (CL). As the site is in NSW, the CL was multiplied by a factor of 0.4, reducing it to a CL value of 1.52 mm/hr.

Table 5.2 Manning's Roughness used in the Developed Hydraulic Model

Manning's 'n'	Land Use
0.15	Residential – Rural (lower density)
0.3	Industrial/Commercial or large buildings on site
0.03	Minimal vegetation
0.06	Moderate vegetation
0.09	Heavy vegetation
0.06	Open water (with reedy vegetation)
0.02	Open water (with submerged vegetation)
0.02	Car park/pavement/wide driveways/roads

Table 5.3 Losses Used in the Developed Hydraulic Model

Event	Initial Loss (mm)	Continuing Loss (mm/h)
10% AEP	8.1	1.5
1% AEP	7.8	1.5
0.5% AEP	7.8	1.5
0.2% AEP	7.8	1.5
PMF	0	1

5.2 Model Scenarios

A range of storm duration and temporal patterns (as discussed in **Section 5.1.1**) were simulated (using ARR2019 inputs) to identify the rainfall profiles providing for the critical flood conditions (design peak water levels) across the Project Area. A coarse grid (10 m resolution) TUFLOW model was used to determine the critical storm duration for the 1% AEP and PMF events.

The critical storm duration and temporal pattern results providing the design peak water levels across the Project Area are presented in **Table 5.4**. The 1% AEP critical storms and temporal patterns were also adopted for the 10%, 0.5% and 0.2% AEP. These scenarios were modelled in the finer 4 m grid hydraulic model.

Table 5.4 Critical Storm and Temporal Patterns

Event	Critical Duration (hours)	Temporal Pattern[1]
10% AEP	0.5 hours	8
1% AEP	0.5 hours	5
0.5% AEP	0.5 hours	5
0.2% AEP	0.5 hours	5
PMF	0.25 hours	GSDM

*Note: [1] Refer to **Section 5.1.1.2**.*

5.3 Model Verification

There are no river flow gauges in the vicinity of the Project Area and therefore, in the absence of calibrated data, the modelled TUFLOW design flows were verified by comparison with those produced by the ARR Regional Flood Frequency Estimation (RFFE) method (**Table 5.5**). The RFFE Method is a replacement for the Probabilistic Rational Method described in the previous version of ARR. The RFFE flows were compared to the TUFLOW flows at a selection of sub-catchments, and all TUFLOW flows were within the RFFE Lower and Upper Confidence Limits. Given the general agreement between the TUFLOW and RFFE flows, the adopted model parameters values were considered fit for purpose. Additionally, the roughness values and losses adopted for this assessment (refer **Section 5.1.3**) are within ranges typically applied in studies of this nature.

Table 5.5 ARR Regional Flood Frequency Estimation Model Results

Location (Refer to Figure 5.1)	AEP (%)	TUFLOW Discharge (m^3/s)	RFFE Discharge (m^3/s)	RFFE Lower Confidence Limit (5%) (m^3/s)	RFFE Upper Confidence Limit (95%) (m^3/s)
A	10% AEP	35.5	19	8.2	43.7
	1% AEP	73.0	57.1	24	137
B	10% AEP	52	23.3	10.1	53.6
	1% AEP	98.2	70.3	29.6	168
C	10% AEP	23.6	16.2	7.1	37.3
	1% AEP	43.2	49	20.6	117
D	10% AEP	49.3	21.5	9.3	49.4
	1% AEP	99.6	64.8	27.2	155
E	10% AEP	30.9	18.3	8.0	42.2
	1% AEP	72.2	55.3	23.3	132
F	10% AEP	79.8	36.1	15.7	83.1
	1% AEP	168.4	109	45.8	260

6.0 Flood Modelling Results and Discussions

6.1 Overview and Flood Hazard Classifications

The flood model results provide the distribution of peak flood level, depth, velocity and hazard across the Project Area for each modelled design magnitude flood event. Note that areas where the modelled flood depths are less than 50 mm have been filtered from the results.

A comparison of the 1% AEP and PMF flood inundation extents is shown on **Figure 6.1** and a suite of detailed flood mapping of the simulated depth, velocity and flood hazard distributions for all modelled events is provided in **Appendix C**. Discussion of the flood conditions for each design event is provided in the following sections as outlined below:

- 10% AEP event (refer **Section 6.1.1**).
- 1% AEP event (refer **Section 6.1.2**) – representative of the principal flood planning event.
- 0.5% and 0.2% AEP events (refer **Section 6.1.3**) – representative of indicative climate change impacts.
- PMF event (refer **Section 6.1.4**).

The Project Area is typically located over the upper catchments of the minor watercourses that flow through the site. This provides for the 1% AEP flood inundation to be largely confined to narrow corridors along the watercourse alignments. The PMF inundation extents provide a significantly greater land area coverage of the Project Area, however much of this is shallow overland sheet flow with low flood hazard (Hazard Category H1). The PMF event represents the largest flood conceivable that could occur at a location.

The flood hazard of the site was assessed in accordance with ARR 2019, which defines six hazard categories as presented in **Table 6.1**. The combined flood hazard curves are presented in **Figure 6.2**. The flood hazard mapping is provided in **Appendix C**.

Table 6.1 Hazard Classification (ARR, 2019)

Hazard Vulnerability Classification	Classification Limit (D and V in combination)	Limiting Still Water Depth (D)	Limiting Velocity (V)	Description
H1	D*V ≤ 0.3	0.3	2.0	Generally safe for vehicles, people and buildings.
H2	D*V ≤ 0.6	0.5	2.0	Unsafe for small vehicles.
H3	D*V ≤ 0.6	1.2	2.0	Unsafe for vehicles, children, and the elderly.
H4	D*V ≤ 1.0	2.0	2.0	Unsafe for vehicles and people.
H5	D*V ≤ 4.0	4.0	4.0	Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
H6	D*V ≥ 4.0	-	-	Unsafe for vehicles and people. All building types considered vulnerable to failure.

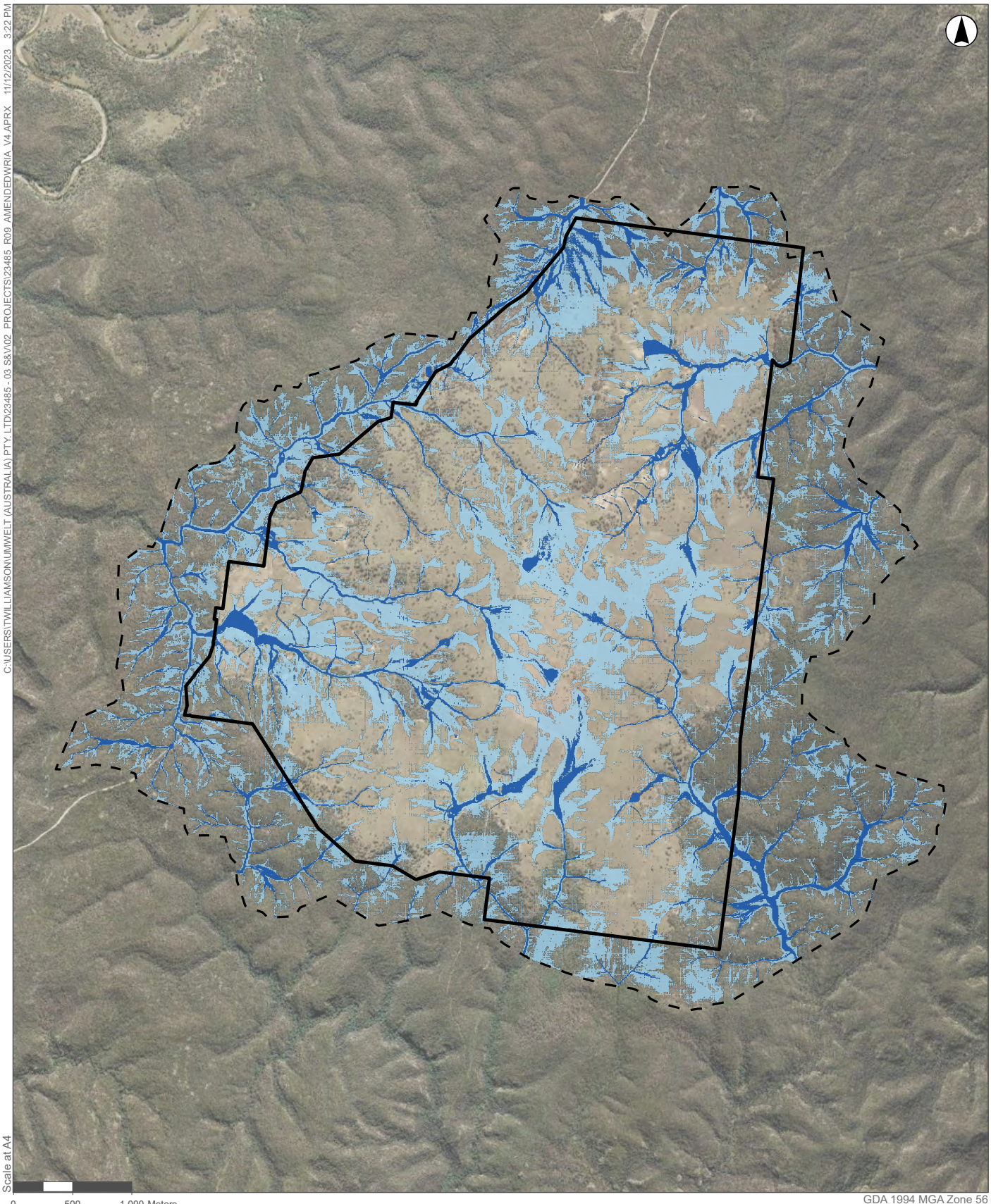


FIGURE 6.1

Flood Extents

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)

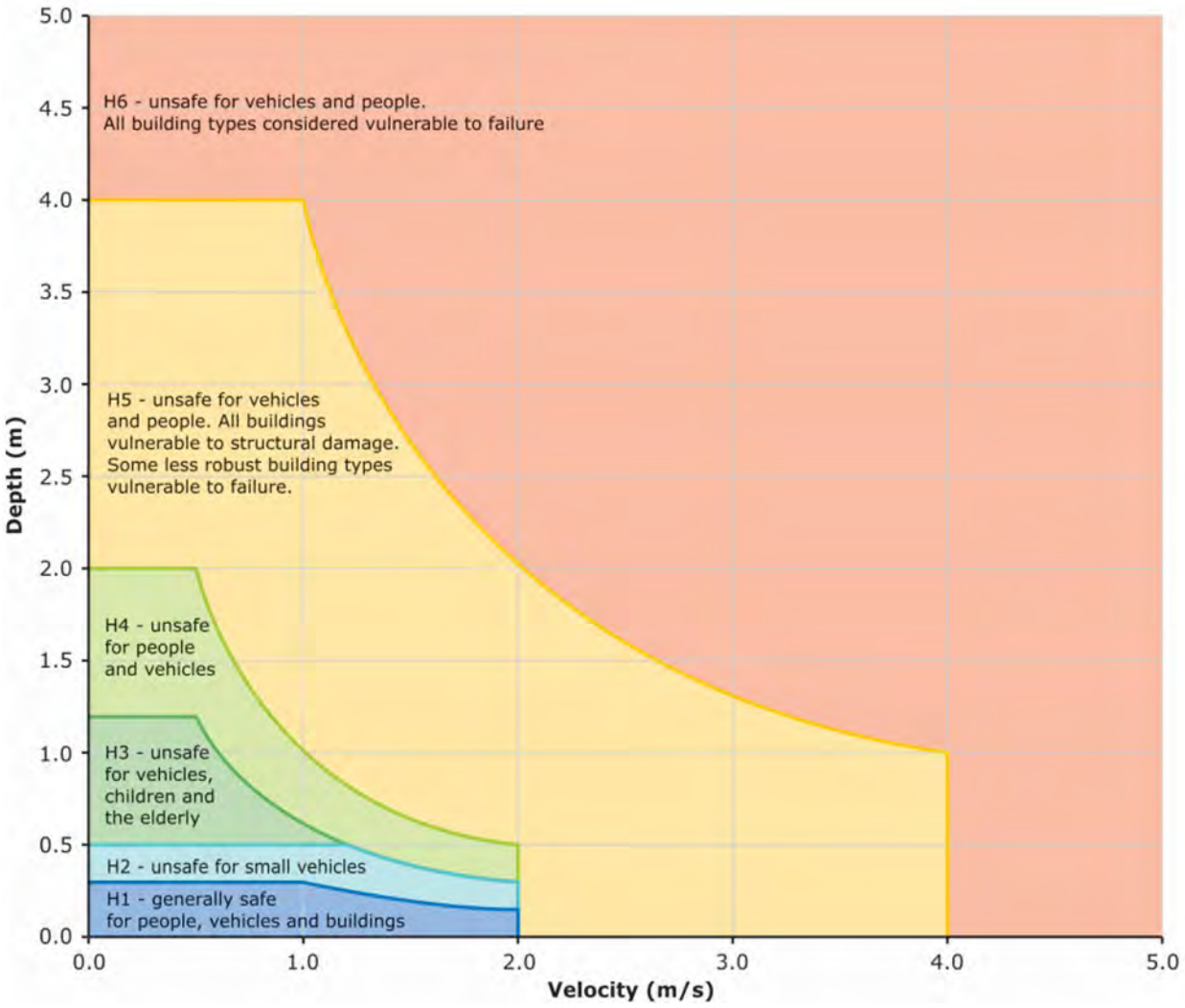


Figure 6.2 Combined Flood Hazard Curves (Smith et al. 2014)

6.1.1 10% AEP Results

Modelled 10% AEP depths, velocities and flood hazards are presented in **Appendix C**. Results show there is generally no widespread flooding within the Project Area, with active flowpaths typically confined within the watercourses and local depressions.

General overland flood flow depths outside of the main waterway alignments are typically shallow at less than 0.3 m. The minor watercourses within the Project Area have flood depths generally less than 1 m with some higher depths observed at farm dam locations. Higher flood depths exceeding 1 m are observed along the main channel alignment.

High velocities up to approximately 4.5 m/s are predicted within the northeast and western channels. Review of aerial imagery shows evidence of erosion and sedimentation (due to higher flow velocities and steeper areas).

The flood hazard within the site for this flood event is mostly characterised as H1: 'Generally safe for vehicles, people and buildings', with isolated areas of higher flood hazard (H5 and higher) predicted in the northeastern and southern areas of the site, however these areas are well confined to the waterways and defined drainage lines (which will be avoided due to slope limitations on the PV trackers).

6.1.2 1% AEP Results

Modelled 1% AEP depths, velocities and flood hazard are in **Appendix C**. The general flood inundation patterns and extents are similar to the 10% AEP event, albeit with increasing depths and velocities associated with the higher flows.

Flood depths remain generally less than 0.3 m along overland flow paths and local depressions, with depths of flow along the minor watercourses within the Project Area typically up to 1 m with some localised higher depths along the reaches. A similar flood depth range is observed for farm dams. The mainstream flooding of the creek adjacent to the Project Area is still relatively confined.

High velocities up to approximately 4.5 m/s are predicted within the northeast and western channels. Review of aerial imagery shows evidence of erosion and sedimentation (due to higher flow velocities and steeper areas).

The flood hazard within the site for this flood event is mostly characterised as H1: 'Generally safe for vehicles, people and buildings', and only reaches above this in the waterways and defined drainage lines. Within some of the watercourse alignments, flood hazard classes H5 and H6 are attained and accordingly would represent areas where infrastructure should be avoided.

6.1.3 Climate Change Modelling

The 0.5% and 0.2% AEP year flood events were used as proxies for assessing sensitivity to an increase in rainfall intensity of flood-producing rainfall events due to climate change. The 0.5% and 0.2% AEP design rainfalls for the Project Area represent general increases of 10% and 25% in rainfall respectively above the 1% AEP design rainfall. Accordingly, these are within the 10–30% range typically adopted for climate change allowance on design rainfall.

Modelled 0.5% and 0.2% AEP depths, velocities and flood hazards are presented in **Appendix C**.

The flood inundation patterns and extents are again generally similar to the 1% AEP design results (as discussed in **Section 6.1.3**). The modelling shows no activation of additional flow paths or extended inundation areas that materially impact on the development.

Flood depth remains generally less than 0.3 m for overland flow areas with flood depths up to 2 m along the well-defined mapping extents of the larger watercourses.

The 0.5% and 0.2% AEP climate change flood depths are only marginally larger than that of 1% AEP existing conditions. Higher AEP events show similar results indicating the inundation impact of climate change is not anticipated to be a significant issue for the Project. The results suggest the Project Area is able to drain effectively without a significant increase in floodplain area which could hold water at high depths for extended periods of time.

6.1.4 PMF Results

Modelled PMF depths, velocities and flood hazards are presented in **Appendix C**. There is an overall increase in mapped flood extent, although a significant proportion of this area is in overland flow areas with flow depth less than 0.3 m.

Flood extents along the defined watercourses and overland flow paths have generally increased with broader areas of overland sheet flow (up to 0.5 m depth) as a result of extreme rainfall intensity, but still typically confined to the general alignments albeit with increasing flood depth. The watercourses within the Project Area have flood depths up to 4 m in the lower reaches with a similar flood depth range observed within the Project Area's dams.

Corresponding to the increase in the flood depth distribution across the Project Area, flow velocities are increased for the PMF event. Within defined watercourses, velocities reach between 5.0 and 6.0 m/s. Review of aerial imagery shows evidence of erosion and sedimentation (due to higher flow velocities and steeper areas).

The flood hazard within the site is mostly characterised as H1: 'Generally safe for vehicles, people and buildings' and only reaches above this in the waterways and defined drainage lines. Within some of the watercourse alignments, flood hazard classes H5 and H6 are attained and accordingly would represent areas where infrastructure should be avoided as shown in Figure C-15 in **Appendix C**.

7.0 Assessment of Potential Impacts

Based on the outcomes of the flood modelling (**Section 6.0**) and the risk assessment (**Appendix B**), the Project has the potential to impact on water resources in the following manner:

- impacts to surface water quality on receiving and downstream waterways
- impacts to stream stability, riparian health and fish passage
- impacts to flooding, including flow rates, velocities and depths
- impact on water supply
- impacts to groundwater, including impacts to downstream users and GDEs.

A risk assessment was undertaken for the Project to identify and assess the potential water resources related risks associated with the Project. The risk assessment is provided in **Appendix B** and has adopted the Risk Assessment Framework set out in Australian Standard/New Zealand Standard (AS/NZS) ISO 31000:2018 Risk Management – Principles and Guidelines (2018).

7.1 Surface Water Quality

Water quality impacts are most likely to be experienced during construction and decommissioning with limited operational impact.

7.1.1 Construction and Decommissioning

During construction and decommissioning of the Project, soils would be subject to disturbance, involving minor vegetation removal, excavation works and stockpiling of materials, which can potentially lead to sediments and/or pollutants mobilising in runoff and entering local waterways. Furthermore, this could result in the deterioration of EVs and WQOs (as outlined in **Section 3.7**), damage to private property for involved landholders as well as increased turbidity and decrease in water quality to downstream waterways. Sediments and pollutants present in runoff may enter the downstream waterways or environments, such as the adjacent Goulburn River National Park, and have the potential to flow into Goulburn River and the tributaries which discharge to the Hunter River. The key factor influencing the extent of sediment runoff and stormwater pollution is likely to be weather events. The occurrence of a major storm event at a critical phase of the construction period could potentially result in higher levels of turbid runoff. With the implementation of erosion and sediment control measures (outlined in **Section 8.0**) potential construction-related erosion and sedimentation impacts would be appropriately managed and are expected to be minor. Particular emphasis will be given to erosion and sediment control measures surrounding construction works occurring at the interface of the Goulburn River National Park (particularly during establishment of the perimeter road and assets within 20 m of the boundary). In addition, the potential exists for spills (such as hydraulic oil and fuels from equipment or vehicles as well as concrete spills, building materials and chemicals) to be washed into waterways. With the implementation of the control measures outlined in **Section 8.0**, potential construction-related soil contamination would be appropriately managed and is expected to be minor.

During the construction phase, there may be a requirement to construct waterway crossings within the Project Area to allow for access tracks to be constructed. Detailed design would be undertaken in line with relevant guidelines prior to any works commencing and with consideration of the findings and recommendations of the Project Aquatic Assessment (Coast Ecology, 2023).

Road upgrades are proposed to the north of the Project Area at the Golden Highway/Ringwood Road intersection and on Wollara Road and Ringwood Road, including upgrades to culverts at the existing road crossings of Bow River and Killoe Creek. Strategic designs have been prepared and detailed design would be undertaken in line with relevant guidelines prior to any works commencing. With the implementation of erosion and sediment control measures (outlined in **Section 8.0**), and the design of appropriate erosion and scour protection, potential construction-related erosion and sedimentation impacts would be appropriately managed and are expected to be minor.

With the implementation of measures outlined in **Section 8.0**, the potential water quality impacts would be adequately managed during the Project's construction and decommissioning phases.

7.1.2 Operation

Potential water quality impacts during the operational phase would be minimal, as the day-to-day activities during this phase would be limited to routine maintenance and monitoring. There is the potential for:

- stormwater runoff from impervious surfaces, such as the base of PV panels, resulting in localised erosion
- accidental spills or discharge through use and storage of chemicals such as fuel
- use of herbicides for vegetation control (it is noted that herbicides are currently used on the site for agricultural applications).

With the implementation of operational management measures outlined in **Section 8.0**, water quality impacts during the operational phase are expected to be negligible.

7.2 Impacts on Stream Stability, Riparian Health and Fish Passage

There are a number of non-perennial and perennial streams traversing the Development Footprint refer to **Figure 3.1**). While the Amended Project design has aimed to avoid works close to or within waterways, several waterway crossings will be required for site access, internal access roads and the electrical cabling layout. Amended Project waterway crossings, including those where there is a potential for direct impacts on the adjacent national park or it's interface will be designed to minimise impacts on stream stability and fish passage and will be designed with reference to:

- Guidelines for Controlled Activities on Waterfront Land (the CAA Guidelines) (Department of Planning, Industry and Environment (DPIE) Water, 2018).
- Why Do Fish Cross the Road? Fish Passage Requirements for Waterway Crossings (NSW Department of Primary Industries (DPI) Fisheries, 2003).
- Fisheries NSW Policy and guidelines for fish habitat conservation and management, (NSW DPI, 2013).

For works on waterfront land (within 40 m of top of bank of any watercourse with a defined bed and bank, i.e. the lower reaches of Redlynch Creek andRocky Creek and road upgrade works at Bow River and Killoe Creek as described in **Figure 3.1**) the following measures will be incorporated into the design of the works and controls included in the Soil and Water Management Plan:

- a site specific erosion and sediment control plan will be prepared for all works on waterfront land
- where practicable, infrastructure will be maintained outside of the vegetated riparian zone
- utilisation of stream crossings for co-location of services to avoid the need to trench through stream beds wherever practicable
- rehabilitate disturbed areas and provide scour protection to bed and banks as required to mitigate any areas with increased potential for erosion due to changes in flow regimes associated with Project infrastructure
- where practicable, undertake works on waterfront land from April to mid-October when fish passage is unlikely to occur.

During detailed design, consultation will be undertaken with DPI Fisheries to determine if any of the proposed waterway crossings require consideration of fish passage. For any crossings that do require consideration of fish passage, the relevant DPI Fisheries guidelines will be considered during the detailed design process.

The Aquatic Assessment provides further detail and management measures to ensure that access roads and waterway crossing are design to prevent blocking of fish passage.

7.3 Flooding

The 10%, 1%, 0.5% and 0.2% AEP and PMF were assessed using flood depth, velocity, and hazard levels. Modelling has shown the Project Area to be of low flood risk (**Section 6.0**) with minimal risk to changes in internal or external waterway flows (discussed in **Appendix B**). Access points to the Project Area were also predicted to be of low flood risk. Design of waterway crossings for access points and crossings within the Project Area will be undertaken at the detailed design phase.

The results of the flood impact assessment have shown that the Project Area is located outside areas of major flood hazard. Peak stormwater discharges from the Project Area for impervious areas may increase slightly through the creation of compacted gravel roads and some small operational buildings. However, potential impacts to drainage features and downstream watercourses are considered likely to be minimal due to the relative size of the Project Area in relation to the size of the receiving catchments, and the distributed nature of minor impacts. The Proponent has assessed the risk of flood depths and flood velocities and removed infrastructure such as PV trackers and inverters from areas at risk. Low-risk infrastructure such as access roads and cable trenches remain within these areas to maintain connectivity.

Minimal changes to the land topography, impervious fraction and therefore runoff and groundwater infiltration are expected due to the nature and extent of proposed infrastructure. If the recommendations outlined in **Section 8.0** are met and a relevant set of construction and operation Management Plans (to be approved prior to construction/operation commencement) are developed, the Project is unlikely to have any residual impacts on surface or groundwater.

If there is an intent to fill or level areas of flood inundation for the construction of PV arrays and/or ancillary infrastructure, individual or collective assessments would be required. These assessments would form part of a Soil and Water Management Plan to be developed as part of the Construction Environmental Management Plan (CEMP) to be developed prior to the commencement of construction.

Farm dams covering the Project Area do not appear to hold significant volumes of water as per the 1% AEP flood depths (discussed further in **Section 6.0**). Two small farm dams are located within the Development Footprint and filling them (if required) would likely have negligible adverse impacts to flood behaviour within receiving watercourses, but may increase general day to day flows within receiving waterways due to a decrease in catchment storage. This would need to be considered further in the Soil and Water Management Plan to define the degree of potential impact.

Access tracks and cable reticulation are the only works proposed within the watercourses and no other artificial structures are planned to be installed in the creeks within the Project Area. Where waterway crossings (i.e., culvert crossings or causeways) are required, these would be designed and constructed in compliance with the DPE – Water Guidelines.

Security fencing around the perimeter of the development footprint has the potential to trap and accumulate flood debris and impede flows. This may result in minor increases in water level upstream of the blockage and potential redistribution of flow at the boundary. Given the local topography and minor nature of the identified watercourses in the Project Area, any redistribution of flow though fence blockage would be localised and the risk of any potential blockages is low and any inundation outside of the mapped flood extents would be minor. Fence maintenance and clearing of debris after each flood event will further minimise any potential impacts.

The proposed road upgrades will be designed to accommodate B- double trucks, noting only 19 m semi-trailers are proposed to be used during construction, and the safe passing of vehicles in both directions with 3.5 m lanes. Detailed design would be undertaken in line with relevant guidelines prior to any works commencing. If the upgrades are designed to minimise impacts/afflux to acceptable levels and the design of appropriate erosion and scour protection is undertaken, it is expected that any impacts as a result of the upgrades works will be negligible.

7.4 Impact on Water Supply

7.4.1 Construction and Decommissioning

The Project would require a water supply during the construction and decommissioning phases, as discussed in **Section 4.0**.

The associated water demand is estimated as 11.26 ML/month for the 27-month construction period.

Water supply for the Project is proposed to be trucked in through a commercial supplier. Existing farm dams not part of the Development Footprint may also be utilised. Water sources would be confirmed during detailed design phase and in consultation with suppliers and landholders and be subject to availability. A water sourcing strategy would be developed so that water used during the construction phase does not cause issues to adjacent landowners or other stakeholders.

The use of any farm dams during construction and decommissioning would be agreed with the landholder. The estimated Maximum Harvestable Right Dam Capacity and licensed water use would not be exceeded. Water requirements beyond existing water rights would be sourced from commercial suppliers and delivered to site by water tanker.

Based on the above, it is anticipated that the Project's proposed water use during construction and decommissioning would not have a negative impact on water supply to the Project Area and the region.

7.4.2 Operation

During operations, a minimal water demand would be required for ongoing maintenance activities such as washing of the PV solar panels, amenities, and potable purposes by operational staff as well as for stock. Potable water demands for both the construction and operational phases of the Project will be primarily sourced from rainfall stored in on-site water tanks at the O&M facility and augmented by water trucks if required.

Based on the above, it is anticipated that the Project's proposed water use during operation would not have a negative impact on water supply to the Project Area and the region.

7.5 Groundwater Impacts

7.5.1 Construction and Decommissioning

Impacts to groundwater resources, including GDEs, are not expected given the groundwater table is unlikely to be intercepted during Project construction and the relatively deep depth to groundwater at the Project Area based on available information (refer **Section 3.4**, **Section 3.5** and **Section 3.6**). This means that any hydrocarbon/chemical spills are unlikely to infiltrate to the groundwater table.

Should the final Project design identify that construction activities will result in the interception of the groundwater table, an assessment of impacts will be undertaken, and appropriate management measures be developed to mitigate any potential impacts.

7.5.2 Operation

There will be no impacts to groundwater resources including GDEs and bore users during operation given that the groundwater table will not be intercepted.

7.6 Cumulative Impacts

Cumulative impacts are considered to be negligible as the Project is located in the upper reaches of the catchment (mainly 1st and 2nd order streams) and other projects do not occur in these areas.

Potential water quality impacts and erosion and sedimentation will be controlled with the implementation of measures outlined in **Section 8.0**.

8.0 Management and Mitigation Measures

Table 8.1 presents the proposed measures to be implemented as part of the Project to manage and minimise impacts on water resources. Refer to **Appendix B** for risk assessment.

Table 8.1 Management and Mitigation Measures relating to Water Resources

ID	Management and Mitigation Measures	Timing	Relevant Impacts
WR1	Solar panels will be designed to provide a minimum of 300 mm freeboard for the lowest edge above the maximum 1% AEP flood level.	Detailed design	Flooding, Refer to **Section 7.3**.
WR2	The solar panel piles will be designed to withstand the 1% AEP flood velocities expected in the Project Area.	Detailed design	Flooding, Refer to **Section 7.3**.
WR3	No sensitive infrastructure (e.g., substation, BESS, etc.) will be placed within 20 m of any Strahler 3 or above order streams.	Detailed design	Flooding, Refer to **Section 7.3**.
WR4	All waterway crossings will be designed and constructed in compliance with the Department of Primary Industries, Office of Water, Guidelines for riparian corridors on waterfront land and Guidelines for watercourse crossings on waterfront land.	Detailed design	Fish Passage, Refer to **Section 7.2** and Flooding, Refer to **Section 7.3**.
WR5	Further investigations will be carried out where required during detailed design to confirm the flood immunity objectives and design criteria for the Project are met.	Detailed design	Flooding, Refer to **Section 7.3**.
WR6	A Construction Soil and Water Management Plan (CSWMP) will be prepared to outline measures to manage soil and water impacts associated with the construction and decommissioning works. The CSWMP will provide: • Measures to minimise/manage erosion and sediment transport both within the construction footprint and offsite including requirements for the preparation of erosion and sediment control plans (ESCP) for all progressive stages of construction. Management controls will be included to guide construction works occurring at the interface of Goulburn River National Park (during establishment of the perimeter road and assets within 20 m of the boundary). This will include vegetation removal methods, controls around excavation works, limitations on stockpiling of materials and heavy vehicle movements on the interface of the park. Works which may lead to increased mobility of sediments and contaminants on the interface of the national park, and waterways where surface water flow is directed on to the national park will be strictly controlled. • Measures to manage waste including the classification and handling of spoil. • Procedures to manage unexpected, contaminated finds. • Measures to manage stockpiles including locations, separation of waste types, sediment controls and stabilisation. • Measures to manage accidental spills including the requirement to maintain materials such as spill kits.	Prior to construction	Surface Water Quality and Groundwater, Refer to **Section 7.1** and **Section 7.5**.

ID	Management and Mitigation Measures	Timing	Relevant Impacts
	• Controls for receiving waterways which may include designation of 'no go' zones for construction plant and equipment. • Creation of catch/diversion drains and sediment fences at the downstream boundary of construction activities where practicable to support containment of sediment-laden runoff. • Erosion and sediment control measures will be implemented and maintained at all work sites in accordance with the principles and requirements in Managing Urban Stormwater – Soils and Construction, Volume 1 (Landcom 2004) and Volume 2D (NSW Department of Environment, Climate Change and Water 2008b), commonly referred to as the "Blue Book".		
WR7	Debris will be cleared from fencing following flood events.	Operation	Flooding, Refer to **Section 7.3**.
WR8	An Operational Environmental Management Plan (OEMP) will be developed for the Project to address potentially adverse impacts on the receiving environment surface water quality during the operational phase. This will include the development and appropriate maintenance of suitable ground cover around solar panels, and grassed table drains near access tracks to minimise the potential for erosion and export of sediment. Additional measures for the treatment of stormwater quality are not considered necessary.	Operation	Surface Water Quality and Groundwater, Refer to **Section 7.1** and **Section 7.5**.
WR9	Water sources would be confirmed during detailed design phase and in consultation with suppliers and landholders and be subject to availability. A water sourcing strategy will be developed so that water used during the construction phase does not cause issues to adjacent landowners or other stakeholders.	Detailed Design	Water Supply, Refer to **Section 7.4**.
WR10	Post-construction, disturbed areas will be stabilised by the establishment and maintenance of a vegetated groundcover consisting of low-growing grasses. A weed control program will be implemented for the Project Area to manage noxious weeds and reduce weed invasion. In order to reduce the potential impact of pesticide use, glyphosate-based products, or similar non-residual and non-persistent herbicides, will be used to manage vegetation and grazing on the Project Area. This groundcover is expected to both significantly reduce the incidence of impact erosion as well as provide for the additional filtering of suspended solids and biological uptake of nutrients. Consequently, the likelihood that stormwater generated from the Project Area will contain levels of suspended solids significantly greater than baseline existing conditions is low.	Operation	Surface Water Quality, Refer to **Section 7.1**.
WR11	Proposed road upgrades at Golden Highway/Ringwood Road intersection, Wollar Road and Ringwood Road including culvert upgrades as required.	Detailed Design / Construction.	Surface Water Quality and Flooding, Refer Section 7.1 and **Section 7.3**.

9.0 Conclusion

This WRIA has reviewed information and data to understand the potential impacts of the Project on water resources within the Project Area.

The potential impacts associated with the construction, operation and decommissioning phases can be appropriately managed through implementation of a range of conventional mitigation measures.
In summary:

- The potential for discharge of sediments and the resulting impact on the receiving environment surface water quality during ground disturbance activities (construction and decommissioning) can be adequately managed through appropriate construction management planning including best practice erosion and sediment control measures.
- Potentially adverse impacts on the receiving environment surface water quality during the operational phase will be addressed through development of an OEMP. This will include the development and appropriate maintenance of a suitable ground cover underneath and around solar panels, and grassed table drains near access tracks to minimise the potential for erosion and export of sediment. Additional measures for the treatment of stormwater quality are not considered necessary.
- The flood risk assessment conducted in this study assessed the flood behaviour for both the existing and climate change conditions. The 10%, 1%, 0.5% and 0.2% AEP and PMF were assessed using flood depth, velocity, and hazard levels. The Project Area was found to present a low risk of flooding for both the existing and climate change conditions.
- The results of the flood impact assessment have shown that the Project Area is located outside areas of major flood hazard. Peak stormwater discharges from the Project Area for impervious areas may increase slightly. However, potential impacts to drainage features and downstream watercourses are considered likely to be minimal due to the relative size of the Project Area in relation to the size of the receiving catchments, and the distributed nature of minor impacts.
- High velocities were predicted within the northeast and western channels. Review of aerial imagery shows evidence of erosion and sedimentation (due to higher flow velocities and steeper areas). It is recommended the erosion on site is further investigated (including site investigation) and remediation undertaken if deemed necessary prior to construction. These areas will be avoided.
- Minimum changes to the land topography, impervious fraction and therefore runoff and groundwater infiltration are expected due to the nature and extent of proposed infrastructure. If the recommendations outlined in **Section 8.0** are met and a relevant set of construction and operation management plans (to be approved prior to construction/operation commencement) are developed, the Project is likely to have nil to minor residual impacts on surface or ground water.
- The potential for adverse impacts on the receiving environment surface water quality from point sources such as chemical storage will be mitigated through design and will be operated to comply with relevant Australian Standards and local planning requirements.

No constraints were identified within the Project Area that would prevent the Project from meeting the requirements of the local and state planning requirements.

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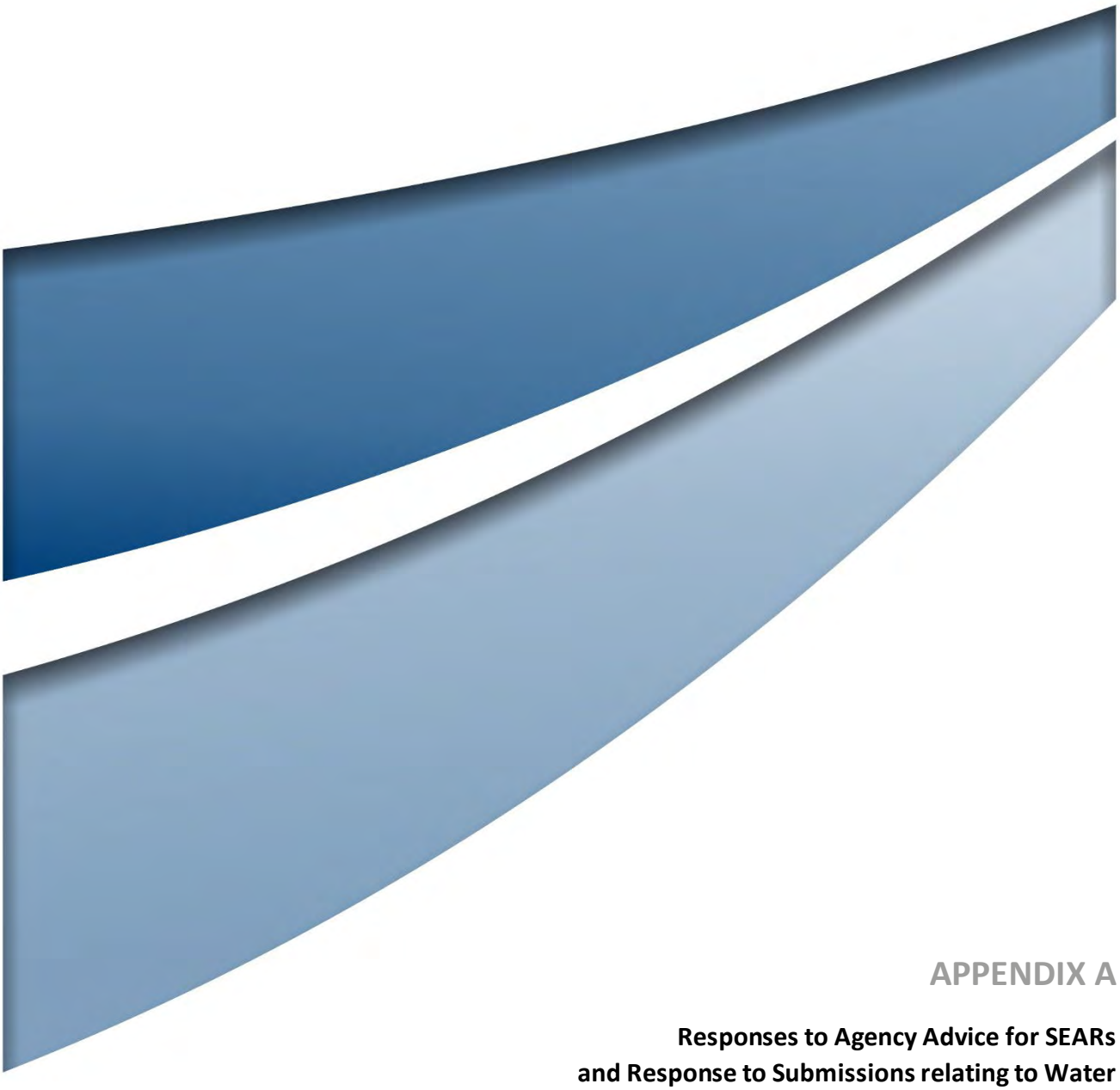


APPENDIX A

Responses to Agency Advice for SEARs
and Response to Submissions relating to Water

Agency Advice (SEARs) and Where it has Been Addressed in the WRIA		
Water and Soils		
5	The EIS must map the following features relevant to water and soils including:	
a.	Acid sulfate soils (Class 1, 2, 3 or 4 on the Acid Sulfate Soil Planning Map).	**Section 3.3**. The land is not identified as a risk area for acid sulphate soils, and it is highly unlikely they would exist at the site or be impacted by the Project.
b.	Rivers, streams, wetlands, estuaries (as described in s4.2 of the Biodiversity Assessment Method).	**Section 3.1**, **Section 5.0** and **Section 7.0**. Mapping of the rivers and wetlands has been undertaken using hydraulic modelling.
c.	Wetlands as described in s4.2 of the Biodiversity Assessment Method.	**Section 3.1**, **Section 5.0** and **Section 7.0**. Mapping of the rivers and wetlands has been undertaken using hydraulic modelling.
d.	Groundwater.	**Section 3.4** and **Section 7.0**.
e.	Groundwater dependent ecosystems.	**Section 3.6** and **Section 7.0**.
f.	Proposed intake and discharge locations.	**Section 4.1** and **Section 7.0**.
6	The EIS must describe background conditions for any water resource likely to be affected by the development, including:	
a.	Existing surface and groundwater.	**Section 2.0**, **Section 5.0** and **Section 7.0**.
b.	Hydrology, including volume, frequency and quality of discharges at proposed intake and discharge locations.	**Section 2.0** and **Section 7.0**.
c.	Water Quality Objectives (as endorsed by the NSW Government http://www.environment.nsw.gov.au/ieo/index.htm) including groundwater as appropriate that represent the community's uses and values for the receiving waters.	**Section 3.7** and **Section 7.0**.
d.	Indicators and trigger values/criteria for the environmental values identified at (c) in accordance with the ANZECC (2000) Guidelines for Fresh and Marine Water Quality and/or local objectives, criteria or targets endorsed by the NSW Government.	**Section 3.7** and **Section 7.0**.
7	The EIS must assess the impacts of the development on water quality, including:	
a.	The nature and degree of impact on receiving waters for both surface and groundwater, demonstrating how the development protects the Water Quality Objectives where they are currently being achieved, and contributes towards achievement of the Water Quality Objectives over time where they are currently not being achieved. This should include an assessment of the mitigating effects of proposed stormwater and wastewater management during and after construction.	**Section 5.0** and **Section 7.0**.
b.	Identification of proposed monitoring of water quality.	**Section 7.0**.

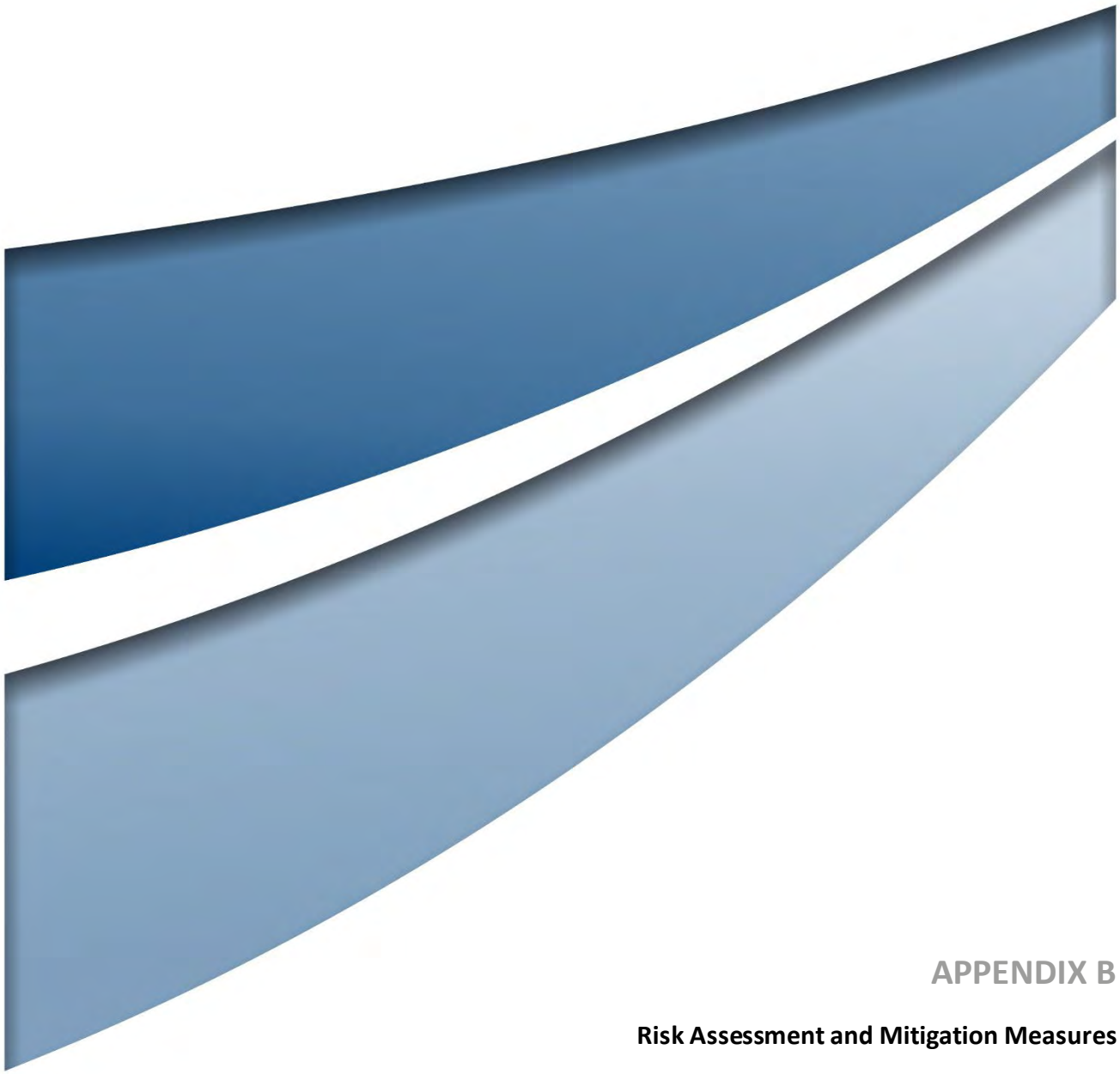
Agency Advice (SEARs) and Where it has Been Addressed in the WRIA		
8	The EIS must assess the impact of the development on hydrology, including:	
a.	Water balance including quantity, quality and source.	Proposed water supply is discussed in **Section 4.0**. Detailed water balance modelling was not undertaken as water demands are expected to be minimal during construction, operation and decommissioning. Assessment of flows from the Project Area using TUFLOW models, see **Section 5.0** and **Section 7.0**.
b.	Effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas.	Assessment flows from the Project Area using TUFLOW models, see **Section 5.0** and **Section 7.0**.
c.	Effects to downstream water-dependent fauna and flora including groundwater dependent ecosystems.	**Section 3.6**. Please refer to Biodiversity Development Assessment Report for impacts to fauna and flora.
d.	Impacts to natural processes and functions within rivers, wetlands, estuaries and floodplains that affect river system and landscape health such as nutrient flow, aquatic connectivity and access to habitat for spawning and refuge (e.g. river benches).	**Section 7.0**.
e.	Changes to environmental water availability, both regulated/licensed and unregulated/rules-based sources of such water.	**Section 4.0** and **Section 7.0**.
f.	Mitigating effects of proposed stormwater and wastewater management during and after construction on hydrological attributes such as volumes, flow rates, management methods and reuse options.	No major stormwater and wastewater infrastructure proposed for the Project Area. See **Section 7.0** for surface water impacts.
g.	Identification of proposed monitoring of hydrological attributes.	See **Section 7.0**.
Flooding		
9	The EIS must map the following features relevant to flooding as described in the Floodplain Development Manual 2005 (NSW Government 2005) including:	
a.	Flood prone land.	**Section 5.0** and **Section 7.0**.
b.	Flood planning area, the area below the flood planning level.	**Section 5.0** and **Section 7.0**.
c.	Hydraulic categorisation (floodways and flood storage areas).	**Section 5.0** and **Section 7.0**.
10	The EIS must describe flood assessment and modelling undertaken in determining the design flood levels for events, including a minimum of the 1 in 10 year, 1 in 100 year flood levels and the probable maximum flood, or an equivalent extreme event.	**Section 5.0** and **Section 7.0**.
11	The EIS must model the effect of the proposed development (including fill) on the flood behaviour under the following scenarios:	**Section 5.0** and **Section 7.0**.

Agency Advice (SEARs) and Where it has Been Addressed in the WRIA		
a.	Current flood behaviour for a range of design events as identified in 11 above. This includes the 1 in 200 and 1 in 500 year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.	**Section 5.0** and **Section 7.0**.
12	Modelling in the EIS must consider and document:	
a.	The impact on existing flood behaviour for a full range of flood events including up to the probable maximum flood.	**Section 5.0** and **Section 7.0**.
b.	Impacts of the development on flood behaviour resulting in detrimental changes in potential flood affection of other developments or land. This may include redirection of flow, flow velocities, flood levels, hazards and hydraulic categories.	**Section 5.0** and **Section 7.0**.
c.	Relevant provisions of the NSW Floodplain Development Manual 2005.	**Section 5.0** and **Section 7.0**.
13	The EIS must assess the impacts on the proposed development on flood behaviour, including:	
a.	Whether there will be detrimental increases in the potential flood affectation of other properties, assets and infrastructure.	**Section 5.0** and **Section 7.0**.
b.	Consistency with Council floodplain risk management plans.	**Section 5.0** and **Section 7.0**.
c.	Compatibility with the flood hazard of the land.	**Section 5.0** and **Section 7.0**.
d.	Compatibility with the hydraulic functions of flow conveyance in floodways and storage in flood storage areas of the land.	**Section 5.0** and **Section 7.0**.
e.	Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site.	**Section 5.0** and **Section 7.0**.
f.	Whether there will be direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.	**Section 5.0** and **Section 7.0**.
g.	Any impacts the development may have upon existing community emergency management arrangements for flooding. These matters are to be discussed with the SES and Council.	**Section 5.0** and **Section 7.0**.
h.	Whether the proposal incorporates specific measures to manage risk to life from flood. These matters are to be discussed with the SES and Council.	**Section 5.0** and **Section 7.0**.
i.	Emergency management, evacuation and access, and contingency measures for the development considering the full range or flood risk (based upon the probable maximum flood or an equivalent extreme flood event). These matters are to be discussed with and have the support of Council and the SES.	**Section 5.0** and **Section 7.0**.
j.	Any impacts the development may have on the social and economic costs to the community as consequence of flooding.	**Section 5.0** and **Section 7.0**.

Response to Submissions on EIS as related to Water		
Item	**Submission**	**Response**
NSW RFS		
1	A 10,000 litre water supply (tank) fitted with a 65 mm storz fitting shall be located adjoining the internal property access road within the required APZ.	The Project EIS has committed to an appropriate dedicated water supply for bushfire protection being provided in accordance with the requirements of the NSW Rural Fire Service. This measure has been amended to include the additional detail suggested by RFS above. This updated measure has been included in Appendix B of the Amendment Report.
National Parks and Wildlife		
2	15. b. ensure waterway crossings designs, or standards applied where direct impacts on the national park or its interface are identified are provided as part of the EIS. Ensure selected designs minimise impacts on stream stability, riparian quality and any fish passage. Provide either the reference to the design standards utilised or engineer reports as necessary.	Impacts on stream stability, riparian health and fish passage are addressed in **Section 7.2**.
3	15. c. provide the draft mitigation measures to be applied under the Soil and Water Management Plan to avoid or minimise direct impacts to waterways, water quality and riparian areas, especially for Redlynch Creek, Rocky Creek, Monaghans Creek, Bow River and Killoe Creeks	Mitigation measures to avoid or minimise direct impacts to waterways, water quality and riparian areas will be incorporated within the project CSWMP as addressed in **Section 7.2** and **Table 8.1**.
4	15. e. ensure the preparation of the future Construction Environmental Management Plan (CEMP), and any relevant subplans such as the: i. Soil and Water Management Subplan – manages surface water resulting from the projects increased volume and velocity of runoff due to increase impervious surfaces, address the risk of mobilisation of contaminants generated during construction and operation of the protect/facility. ii. Erosion Sediment Control Subplan – to manage water quality impacts affecting the park interface and waterways during construction, upgrade of roads and the transmission line. Providing clear management controls to guide construction works occurring at the interface of national park (during establishment of the perimeter road and assets within 20 m of the boundary). This should include vegetation removal methods, controls around excavation works, limitations on stockpiling of materials and heavy vehicle movements on the interface of the park.	Refer to **Table 8.1**.

Response to Submissions on EIS as related to Water		
	NPWS advises on limiting or strictly controlling works which lead to increased mobility of sediments and contaminants on the interface, and waterways where surface water flow is directed on to the national park.	
5	15. f. ensure the preparation of the future Operational Environmental Management Plan (OEMP) and any relevant subplans such as the: ii. Soil and Water Management Plan, to address surface water management during the long-term operation of the facility to ensure protection and rehabilitation of waterways adjoining park to improve filtration of flows from the project area. Reducing risk of adverse water quality impacts and threats to aquatic threatened biodiversity values. Ensure this is supported by a water quality monitoring program to demonstrate sustained or improved water quality outcomes.	Refer to **Table 8.1**.
6	8. Offsite impacts of herbicide use require assessment Section 7.1.2 'Operation' of the Water Resources Impact Assessment (Appendix 16 of the EIS) describes the potential use of herbicides for vegetation control. BCD notes that the site of the solar farm has many ephemeral watercourses on it, all of which flow into the adjacent Goulburn River National Park. Further information is required from the proponent to describe any direct, indirect and prescribed impacts that the use of herbicide may have on the adjacent National Park Estate. <u>Recommendation 8</u> The proponent should ensure that any direct, indirect or prescribed impacts to vegetation on the Goulburn River National Park from herbicide used on the project area are assessed in accordance with the BAM.	Refer to the Solar Farm Biodiversity Development Assessment Report which is contained in Part B of the Amendment Report.
DPI Fisheries		
7	Waterway crossings should be designed and constructed in accordance with the national guidelines entitled 'Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings' (Fairfull and Witheridge , 2003). This document can be access via the website at this link: https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/633505/Whydo-fish-need-to-cross-the-road_booklet.pdf.	This comment from DPI Fisheries is noted and has been incorporated into the development of the Project. **Table 8.1** in this assessment directly addresses this requirement. The Project design has aimed to avoid works close to or within waterways. The EIS identifies that several waterway crossings will be required for site access, internal access roads and the electrical cabling layout.

Response to Submissions on EIS as related to Water		
		Waterway crossings will be designed to minimise impacts on stream stability and fish passage and will be designed with reference to: • Guidelines for Controlled Activities on Waterfront Land (DPE, 2018). • Why Do Fish Cross the Road? Fish Passage Requirements for Waterway Crossings (DPI, 2003). • Fisheries NSW Policy and guidelines for fish habitat conservation and management, (NSW DPI, 2013).
8	Environmental safeguards (silt curtains, booms etc) are to be used during the works to ensure that there is no escape of turbid plumes into the adjacent aquatic environment;	This assessment addresses the requirement from DPI Fisheries to safeguard adjacent aquatic environments and notes the development of a Construction Soil and Water Management Plan (CSWMP) prior to construction. The CSWMP will be prepared to outline measures to manage soil and water impacts associated with the construction and decommissioning works as detailed in **Section 8.0**.
DPE Water		
9	The proponent should confirm that works are setback from the mapped watercourses in accordance with the Guidelines for Controlled Activities on Waterfront Land – Riparian Corridors (DPE, 2022).	The RtS and Amendment Report including amended Aquatic Assessment addresses this submission.
10	Works within waterfront land must consider the Guidelines for Controlled Activities on Waterfront Land – Vegetation management Plans (DPE, 2022).	The RtS and Amendment Report including amended Aquatic Assessment addresses this submission.
11	The proponent prepares a Soil and Water Management Plan and an Erosion and Sediment Control Plan in accordance with industry standards including the guideline, Managing Urban Stormwater: Soils and Construction (Landcom, 2004).	Appendix 5 of the Project EIS confirms that a CSWMP will be prepared to outline measures to manage soil and water impacts associated with the construction works. This will also include an ESCP. In order to address this submission, LSbp confirms that these management plans will be developed in consultation with DPE Water and in accordance with industry standards including the guideline, Managing Urban Stormwater: Soils and Construction (Landcom, 2004). These measures have also been included in **Table 8.1**.



APPENDIX B

Risk Assessment and Mitigation Measures

Risk Assessment and Mitigation Measures

The Risk Assessment Framework set out in *Australian Standard/New Zealand Standard (AS/NZS) ISO 31000:2018 Risk Management – Principles and Guidelines (2018)* was adopted for this assessment. Criteria used to rank the likelihood and consequences of potential impacts and how they are combined to determine the level of impact are set out in **Table B1** through to **Table B3** below. Specifically, the degree of sensitivity for Environmental Values (EV) (High, Moderate or Low) is outlined in **Table B1**, while the magnitude of impacts (High, Moderate or Low) is described in **Table B2**. Finally, the sensitivity and impact magnitude are combined to give five categories for the significance of impacts in **Table B3** (Major, High, Moderate, Low or Negligible). The five categories for the significance of an impact are explained below:

- **Major** significance of impact – arises when an impact will potentially cause irreversible or widespread harm to an EV that is irreplaceable because of its uniqueness or rarity. Avoidance through appropriate design responses is the only effective mitigation.
- **High** significance of impact – occurs when the proposed activities are likely to exacerbate threatening processes affecting the intrinsic characteristics and structural elements of the EV. While replacement of unavoidable losses is possible, avoidance through appropriate design responses is preferred to preserve its intactness or conservation status.
- **Moderate** significance of impact – although reasonably resilient to change, the EV would be further degraded due to the scale of the impact or its susceptibility to further change. The abundance of the EV ensures it is adequately represented in the region, and that replacement, if required, is achievable.
- **Low** significance of impact – occurs where an EV is of local importance and temporary and transient changes will not adversely affect its viability provided standard environmental management controls are implemented.
- **Negligible** significance of impact – impact on the EV will not result in any noticeable change in its intrinsic value and hence the proposed activities will have negligible effect on its viability. This typically occurs where the activities occur in industrial or highly disturbed areas.

Mitigation measures were applied to the potential (unmitigated) impacts to identify the residual (mitigated) impacts as shown in **Table B4**.

Table B1 Description of Sensitivity Criteria

Sensitivity	Description
High	The EV is listed on a recognised or statutory state, national or international register as being of conservation significance. The EV is intact and retains its intrinsic value. The EV is unique to the environment in which it occurs. It is isolated to the affected system/area which is poorly represented in the region, territory, country, or the world. It has not been exposed to threatening processes, or they have not had a noticeable impact on the integrity of the EV. Project activities would have an adverse effect on the value.
Moderate	The EV is recorded as being important at a regional level and may have been nominated for listing on recognised or statutory registers. The EV is in a moderate to good condition despite it being exposed to threatening processes. It retains many of its intrinsic characteristics and structural elements. It is relatively well represented in the systems/areas in which it occurs, but its abundance and distribution are limited by threatening processes. Threatening processes have reduced its resilience to change. Consequently, changes resulting from project activities may lead to degradation of the prescribed value. Replacement of unavoidable losses is possible due to its abundance and distribution.
Low	The EV is not listed on any recognised or statutory register. It might be recognised locally by relevant suitably qualified experts or organisations e.g., historical societies. It is in a poor to moderate condition as a result of threatening processes which have degraded its intrinsic value. It is not unique or rare and numerous representative examples exist throughout the system/area. It is abundant and widely distributed throughout the host systems/areas. There is no detectable response to change, or change does not result in further degradation of the EV. The abundance and wide distribution of the EV ensures replacement of unavoidable losses is achievable.

Table B2 Description of Magnitude Criteria

Magnitude	Description
High	An impact that is widespread, long lasting and results in substantial and possibly irreversible change to the EV. Avoidance through appropriate design responses or the implementation of Project Area-specific environmental management controls are required to address the impact.
Moderate	An impact that extends beyond the area of disturbance to the surrounding area but is contained within the region where the Project is being developed. The impacts are short term and result in changes that can be ameliorated with specific environmental management controls.
Low	A localised impact that is temporary or short term and either unlikely to be detectable or could be effectively mitigated through standard environmental management controls.

Table B3 Significance Assessment Matrix

Magnitude of Impact	Sensitivity of Environmental Value		
	High	Moderate	Low
High	Major	High	Moderate
Moderate	High	Moderate	Low
Low	Moderate	Low	Negligible

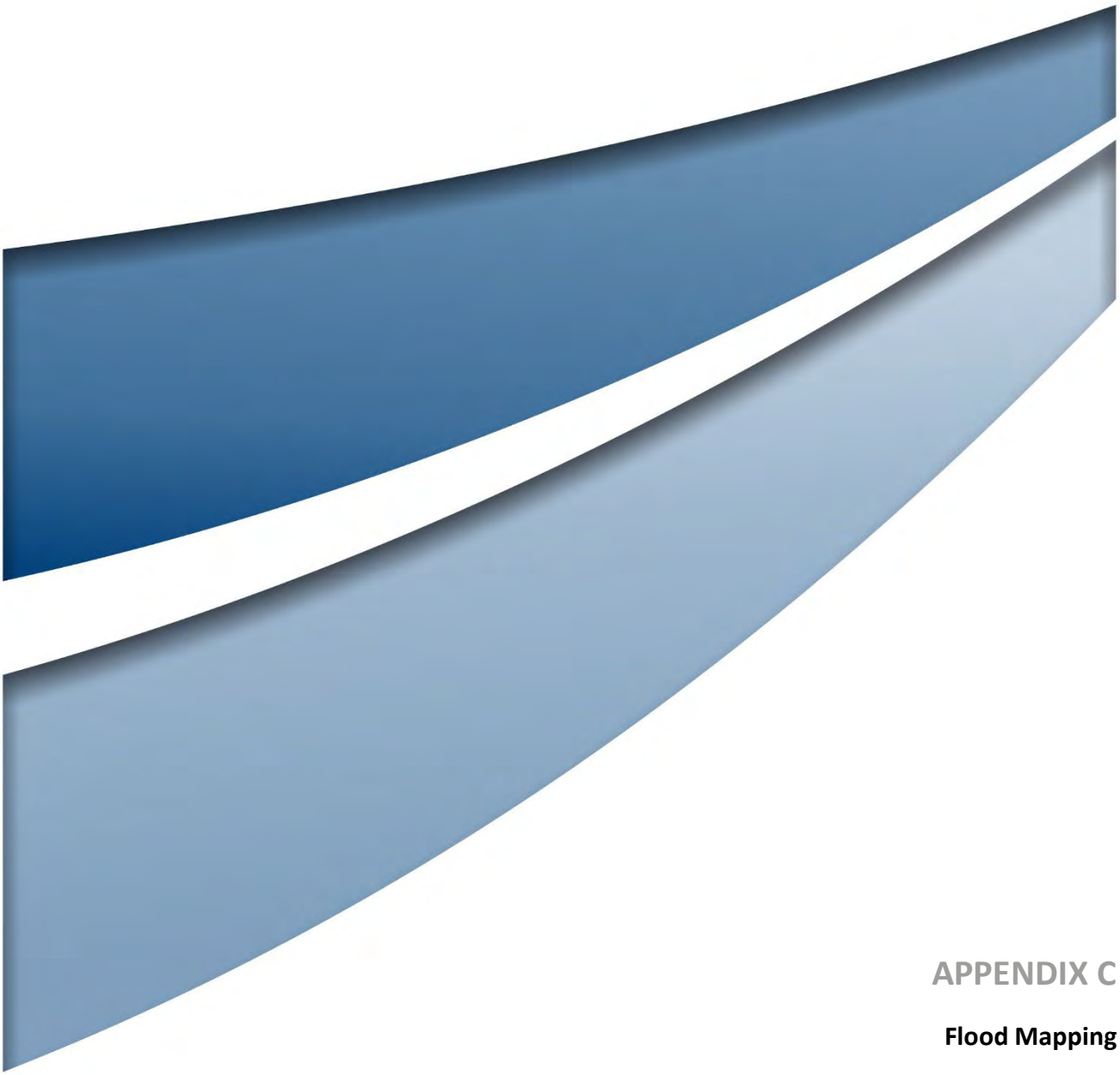
Table B4 Risk Assessment and Mitigation Measures

Potential Impacts to Surface Water	Relevant Environmental Value/s	Pre-Mitigated Impact			Mitigation Measure	Residual (Mitigated) Impact	
		Sensitivity	Magnitude	Significance		Magnitude	Significance
Discharge of sediments (both air and water-borne) from exposed ground during construction and decommissioning phases resulting in impacts on receiving environment surface water quality.	• Aquatic ecosystems • Irrigation • Farm supply • Stock watering • Visual Recreation • Cultural & Spiritual Values.	**Moderate**	**Moderate**	**Moderate**	A Construction Soil and Water Management Plan (CSWMP) will be prepared to outline measures to manage soil and water impacts associated with the construction works and decommissioning. The CSWMP will provide: • Measures to minimise/manage erosion and sediment transport both within the construction footprint and offsite including requirements for the preparation of erosion and sediment control plans (ESCP) for all progressive stages of construction. • Measures to manage waste including the classification and handling of spoil. • Procedures to manage unexpected, contaminated finds. • Measures to manage stockpiles including locations, separation of waste types, sediment controls and stabilisation. • Measures to manage accidental spills including the requirement to maintain materials such as spill kits. • Controls for receiving waterways which may include designation of 'no go' zones for construction plant and equipment. • Creation of catch/diversion drains and sediment fences at the downstream boundary of construction activities where practicable to support containment of sediment-laden runoff. • Erosion and sediment control measures will be implemented and maintained at all work sites in accordance with the principles and requirements in Managing Urban Stormwater - Soils and Construction, Volume 1 (Landcom 2004) and Volume 2D (NSW Department of Environment, Climate Change and Water 2008b), commonly referred to as the "Blue Book".	Low	Low
Soil disturbance	• Aquatic ecosystems • Primary Recreation • Secondary Recreation • Visual Recreation • Cultural & Spiritual Values.	**Low**	**Moderate**	**Low**	• The area of vegetation to be cleared will be kept to a minimum and determined during detailed design of the Project. • Placement of infrastructure in vegetated areas will be avoided where possible. Where clearance of vegetation is required, clearance activities would be undertaken in accordance with the Project Area-specific CSWMP prior to the commencement of construction.	Low	Negligible
Discharge of stormwater from the Project Area during operational phase resulting in impacts on receiving environment surface water quality.	• Aquatic ecosystems • Irrigation • Farm supply • Stock watering • Visual Recreation • Cultural & Spiritual Values.	**Low**	**Moderate**	**Low**	• Infrastructure such as inverters and battery storage will be located with a minimum 300 mm freeboard above the maximum 1% AEP flood level. It is common for this type of infrastructure to be housed within containers or small sheds with relatively small footprints. Given the shallow depths across the site, raising these small fill pads is highly unlikely to result in any adverse impacts offsite. • Operation phase mitigation measures will be guided by an operational management plan developed for the Project, which will detail methods for minimising sediment loss from the Project Area in accordance with best practice guidelines. • Stormwater runoff from the Project Area during the operational phase will be discharged diffusely across the Project Area via vegetated surfaces wherever practical.	Low	Negligible

Potential Impacts to Surface Water	Relevant Environmental Value/s	Pre-Mitigated Impact			Mitigation Measure	Residual (Mitigated) Impact	
		Sensitivity	Magnitude	Significance		Magnitude	Significance
					• Post-construction, disturbed areas will be stabilised by the establishment and maintenance of a vegetated groundcover consisting of low-growing grasses. A weed control program will be implemented for the Project Area to manage noxious weeds and reduce weed invasion. In order to reduce the potential impact of pesticide use, glyphosate-based products, or similar non-residual and non-persistent herbicides, will be used to manage vegetation and grazing on the Project Area. This groundcover is expected to both significantly reduce the incidence of impact erosion as well as provide for the additional filtering of suspended solids and biological uptake of nutrients. Consequently, the likelihood that stormwater generated from the Project Area will contain levels of suspended solids significantly greater than baseline existing conditions is low. • Stormwater discharging from the Project Area post-development is anticipated to be of a quality that will not impact the surface water receiving environment. Specific treatment and/or detention of stormwater for the removal of sediments and gross pollutants prior to the release to the environment are not considered necessary.		

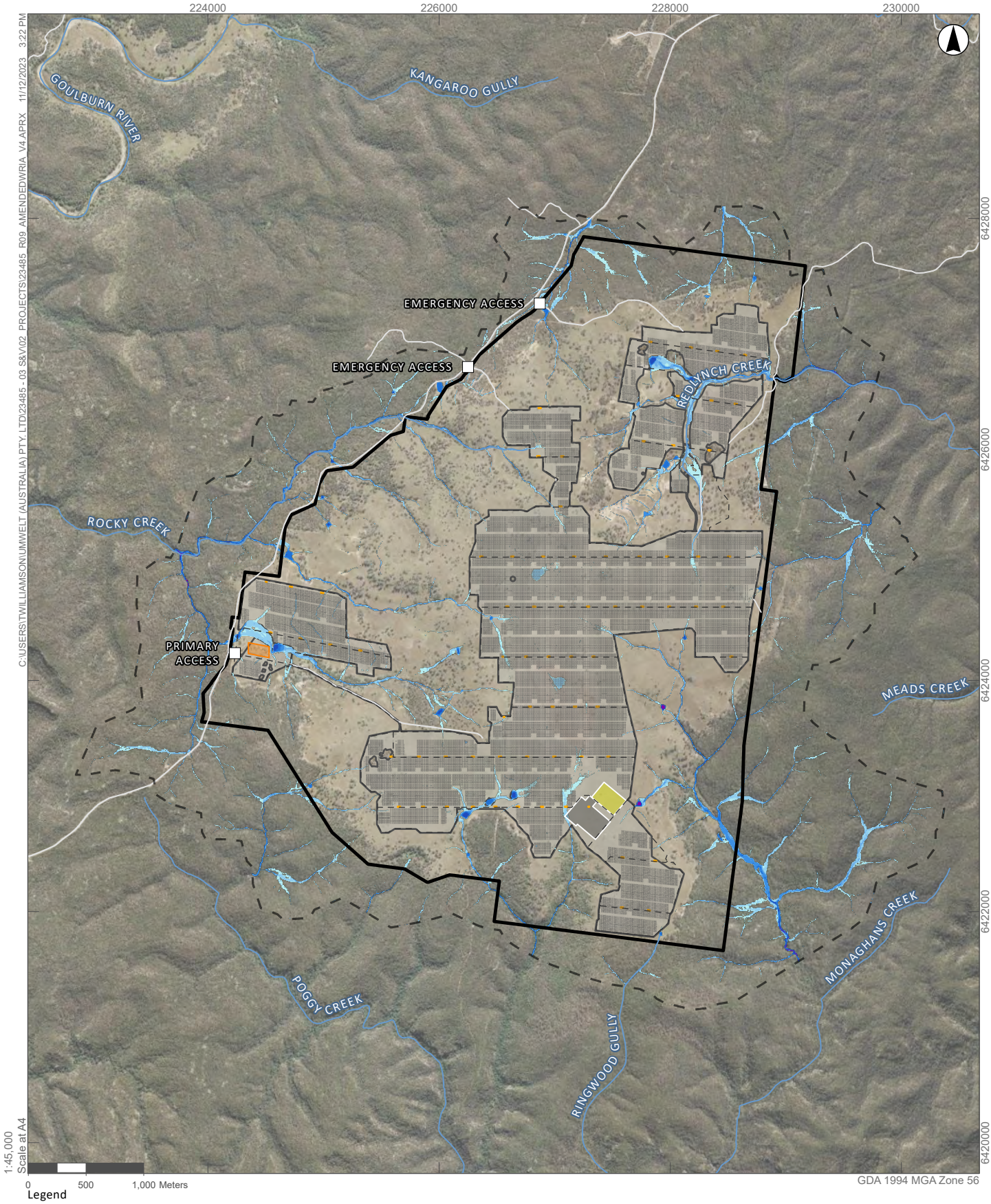
Discharge of stormwater from the Project Area during <u>operational</u> phase resulting in adverse impacts on receiving environment surface water geomorphology (e.g., stream bank erosion and scouring) or hydroecology	• Aquatic ecosystems
	• Irrigation
	• Farm supply
	• Stock watering
	• Visual Recreation
	• Industrial use
	• Cultural & Spiritual Values.
		Low	**Moderate**	**Low**	• Project Area drainage works will aim to minimise potential impacts on the existing overland flow paths and stormwater will be discharged diffusely across the Project Area via vegetated surfaces wherever practical. Project Area drainage works will aim to minimise potential impacts on the existing overland flow paths.
					• Debris will be cleared from fencing following flood events.
					• Erosion controls (e.g., rip rap, i.e. rock protection) will be installed where considered necessary in accordance with BPESC Guidelines (IECA, 2008).
					• Although peak flows of stormwater runoff from the Project are expected to increase slightly post-development at locations where surfaces are made impervious or less pervious, these increases are not expected to impact the downstream environment for the following reasons:
					  ○ A very small proportion of the catchment will be subject to development and this runoff is expected to form a very small percentage of peak flow in each receiving watercourse.
					  ○ The areas to be developed are spread across the Project Area, and any increases in runoff will be dissipated across the Project Area.
					  ○ Mitigation measures such as grassy buffer strips and vegetated table drains will attenuate peak flows.
					• Additional specific mitigation measures to control stormwater discharge from the Project Area are not considered necessary given the small volume discharged in the context of each receiving catchment. The proposed mitigation measures are considered sufficient to reduce any impacts to stream water quality and geomorphology.
					• The proposed road upgrades will be designed to minimise afflux and appropriate scour protection will be designed to minimise erosion and scour.
						Low	Negligible

Potential Impacts to Surface Water	Relevant Environmental Value/s	Pre-Mitigated Impact			Mitigation Measure	Residual (Mitigated) Impact	
		Sensitivity	Magnitude	Significance		Magnitude	Significance
Spills/leaks from chemical (e.g., fuel and oil) storage areas into surface water bodies during <u>construction</u> and <u>decommissioning</u> phases resulting in adverse impacts on receiving environment surface water quality.	• Aquatic ecosystems • Irrigation • Farm supply • Stock watering • Primary Recreation • Secondary Recreation • Visual Recreation • Cultural & Spiritual Values.	**Low**	**Moderate**	**Low**	• Chemicals such as hydrocarbon materials will be stored in accordance with relevant Australian Standards to ensure that any spillages are contained.	Low	Negligible
Untreated discharges from on-Project Area wastewater during <u>operational</u> phase into surface water environment.	• Aquatic ecosystems • Irrigation • Farm supply • Stock watering • Primary Recreation • Secondary Recreation • Visual Recreation • Cultural & Spiritual Values.	**Low**	**Moderate**	**Low**	• Effluent will be removed from the Project Area and disposed in a suitable facility by a licensed operator.	Low	Negligible
Discharge of stormwater from the Project Area following the <u>decommissioning</u> phase resulting in impacts on receiving environment surface water quality and/or quantity	• Aquatic ecosystems • Irrigation • Farm supply • Stock watering • Visual Recreation • Cultural & Spiritual Values.	**Low**	**Moderate**	**Low**	• After the Project reaches the end of its operational life, the project would either be upgraded (pending any additional approval requirements) or decommissioned. Decommissioning would involve removing all project infrastructure and returning the development footprint to its pre-existing land use, as far as practicable. Mitigation measures are therefore not considered necessary post decommissioning.	Low	Negligible
Changes to the quantity of downstream water flows (e.g., from diversion of surface water bodies during construction) as a result of <u>construction</u> of the project.	• Aquatic ecosystems • Irrigation • Farm supply • Stock watering • Primary Recreation • Secondary Recreation • Visual Recreation • Industrial use • Cultural & Spiritual Values.	**Moderate**	**Moderate**	**Moderate**	• Project Area drainage works will aim to minimise potential impacts on the existing overland flow paths. Waterway crossings will be built in accordance with the code for self-assessable development for waterway barrier works. • Detailed design of project will be undertaken to minimise the need for waterway diversions as far as practical and to ensure minimal changes to downstream flows through the use of water attenuation devices (tanks/dams etc.) where increases to Area discharges are anticipated due to increases in impervious areas. • The proposed road upgrades will be designed to minimise afflux. • A construction management plan will be developed for the Project which will incorporate an Erosion and Sediment Control Plan and detail methods for minimising sediment-laden runoff in accordance with the International Erosion Control Association's (IECA) Best Practice Erosion and Sediment (BPESC) guidelines (IECA, 2008). • Debris will be cleared from fencing following flood events.	Low	Low



APPENDIX C

Flood Mapping



Legend

- Access Points
- Proposed Access Tracks
- Roads and Tracks
- Watercourse
- Model Extent
- Project Area
- Development Footprint - Amended Project

Proposed Infrastructure

- Battery Energy Storage System
- Battery Substation
- Inverters
- Compound Area
- Solar Panel Footprint

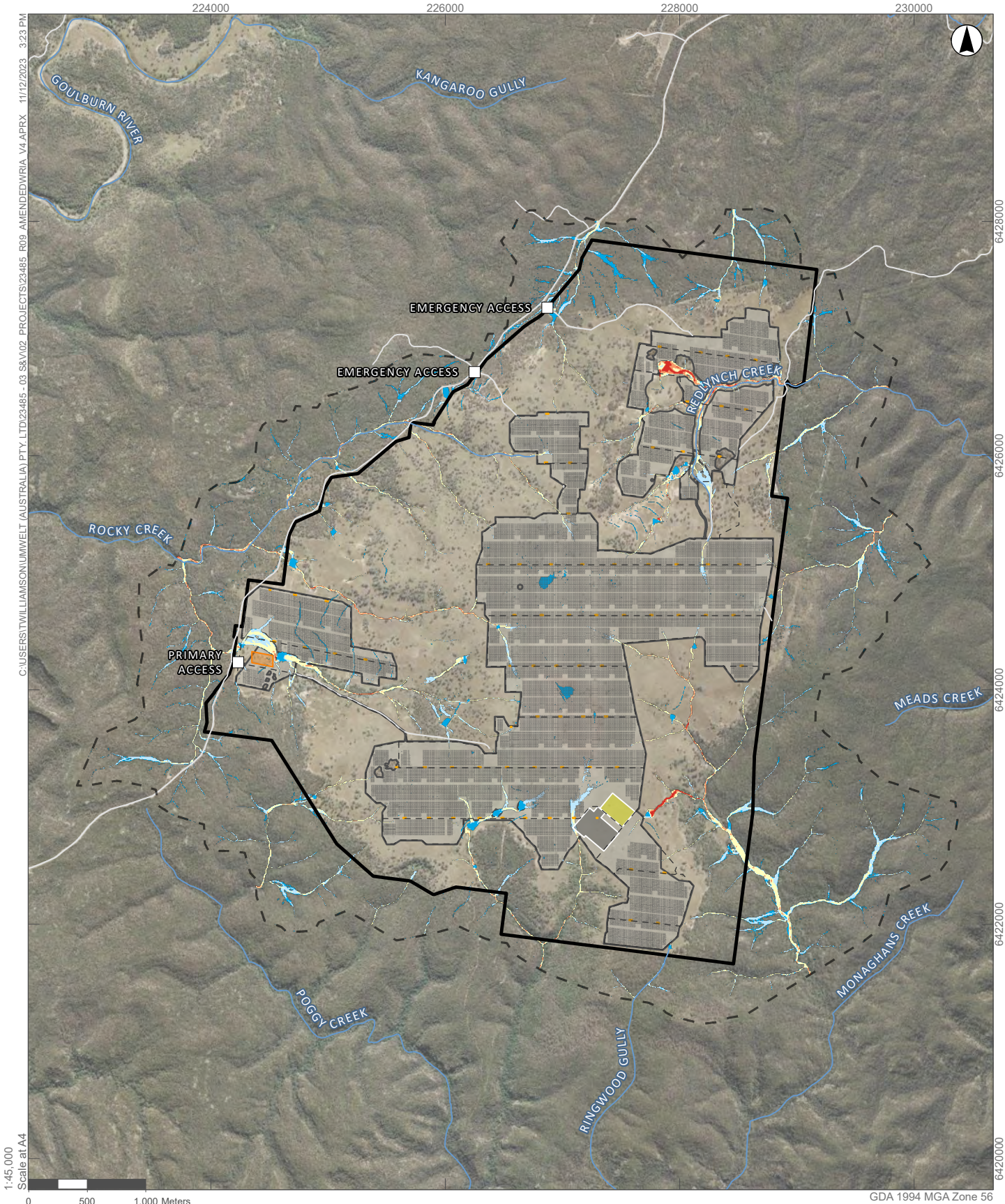
Water Depth (m)

- 0 - 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- >4

APPENDIX C.1

10% AEP Flood Depth for Existing Conditions

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)



Legend

- Access Points
- Proposed Access Tracks
- Roads and Tracks
- Watercourse
- Model Extent
- Project Area
- Development Footprint - Amended Project

Proposed Infrastructure

- Battery Energy Storage System
- Battery Substation
- Inverters
- Compound Area
- Solar Panel Footprint

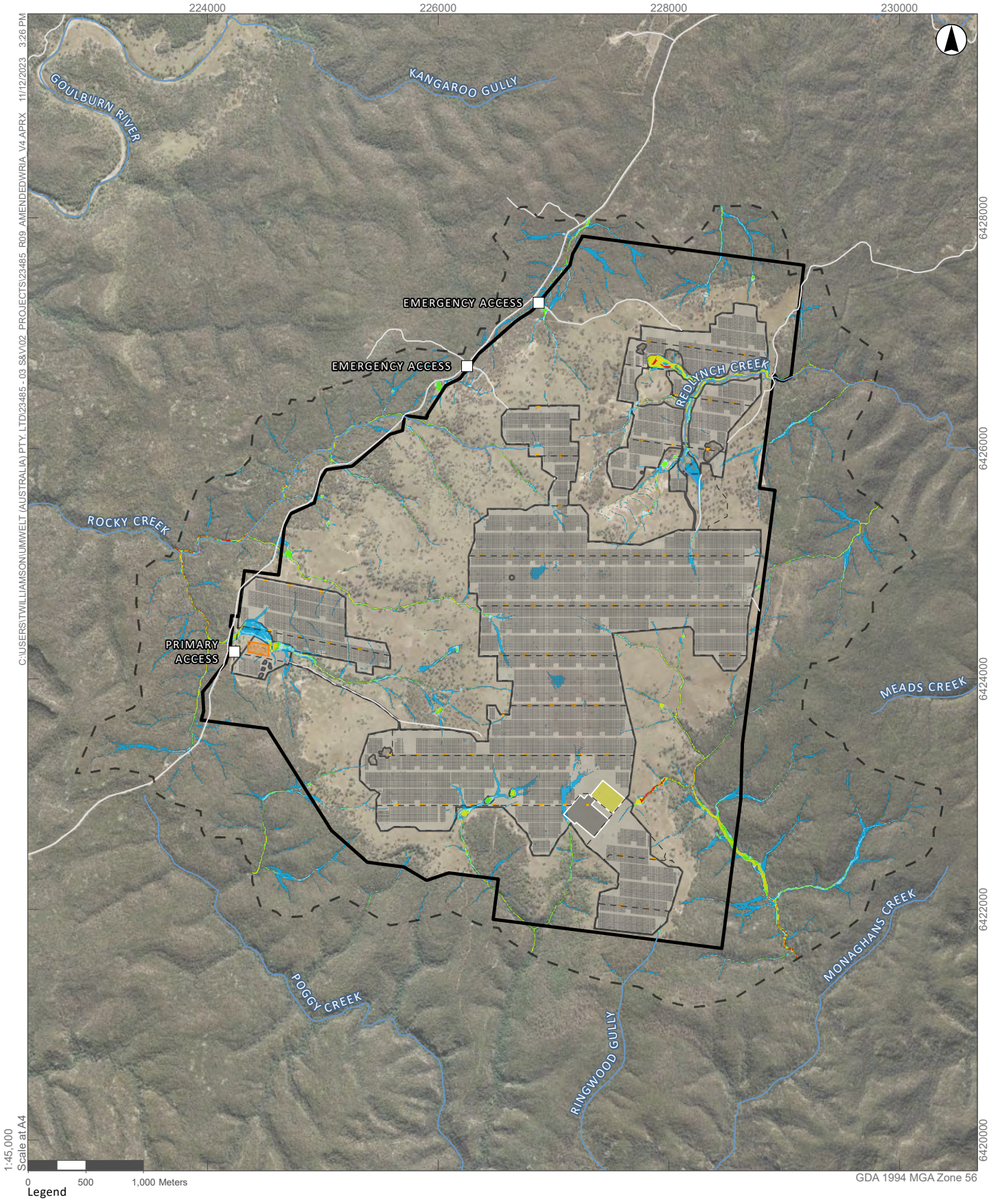
Water Velocity (m/s)

- < 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3.0

APPENDIX C.2

10 % AEP Flood Velocity for Existing Conditions

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)



Legend

- Access Points
- Proposed Access Tracks
- Roads and Tracks
- Watercourse
- Model Extent
- Project Area
- Development Footprint - Amended Project
- Compound Area

Proposed Infrastructure

- Battery Energy Storage System
- Battery Substation
- Inverters
- Solar Panel Footprint

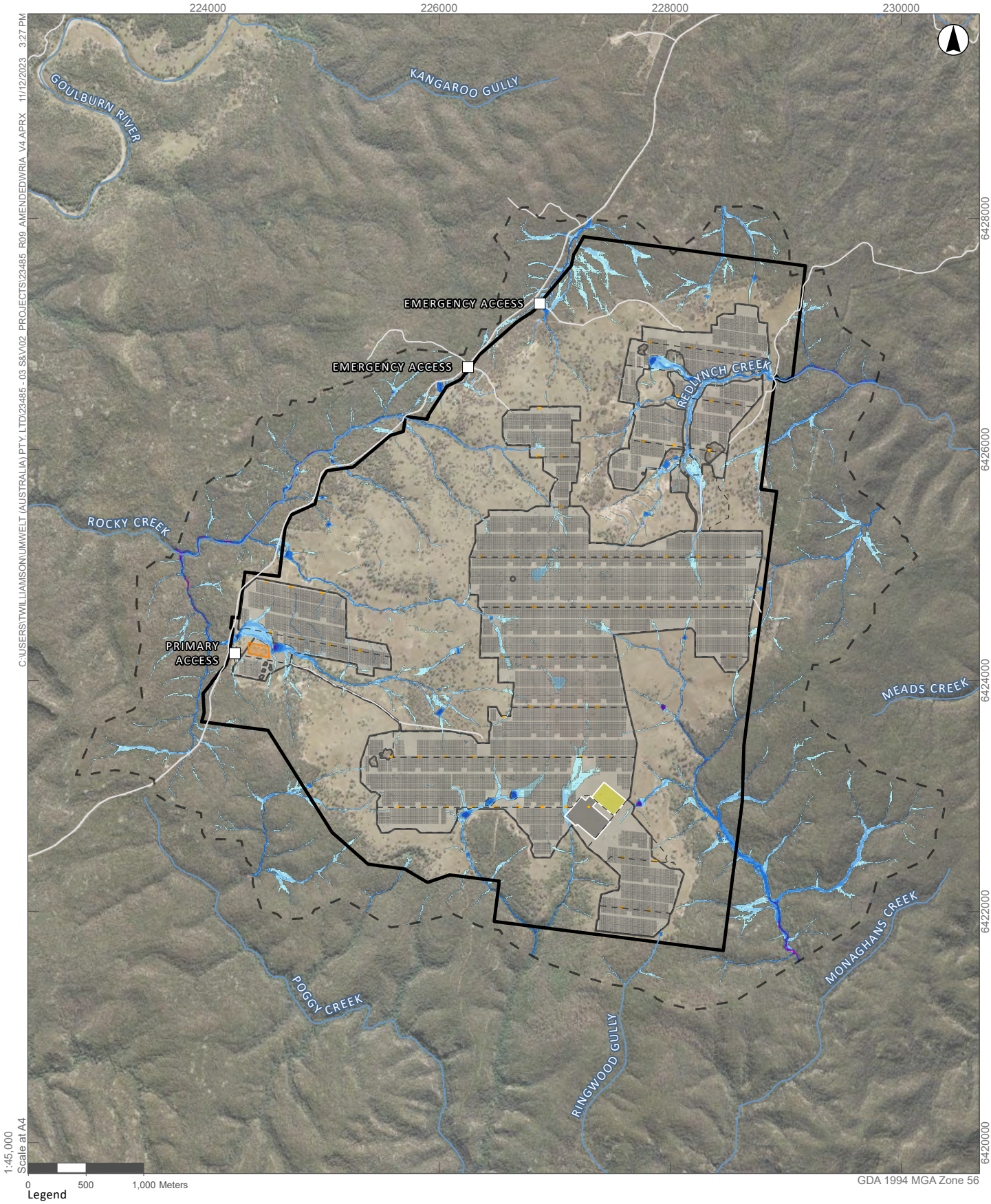
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX C.3

10% AEP Flood Hazard for Existing Conditions

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)



Legend

- Access Points
- Proposed Access Tracks
- Roads and Tracks
- Watercourse
- Model Extent
- Project Area
- Development Footprint - Amended Project
- Compound Area

Proposed Infrastructure

- Battery Energy Storage System
- Battery Substation
- Inverters
- Solar Panel Footprint

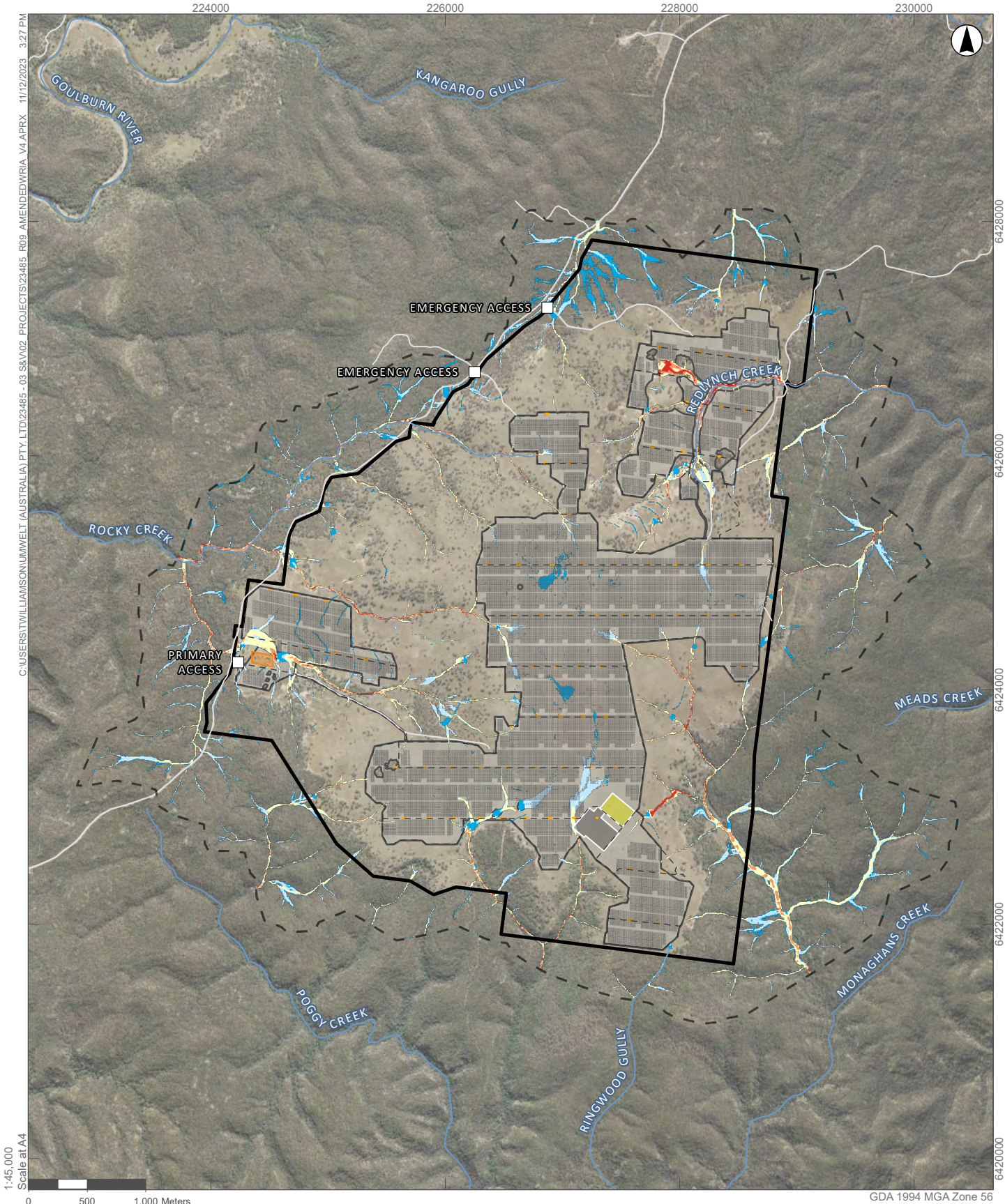
Water Depth (m)

- < 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- > 4.0

APPENDIX C.4

1% AEP Flood Depth for Existing Conditions

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)



Legend

- Access Points
- Proposed Access Tracks
- Roads and Tracks
- Watercourse
- Model Extent
- Project Area
- Development Footprint - Amended Project
- Compound Area

Proposed Infrastructure

- Battery Energy Storage System
- Battery Substation
- Inverters
- Solar Panel Footprint

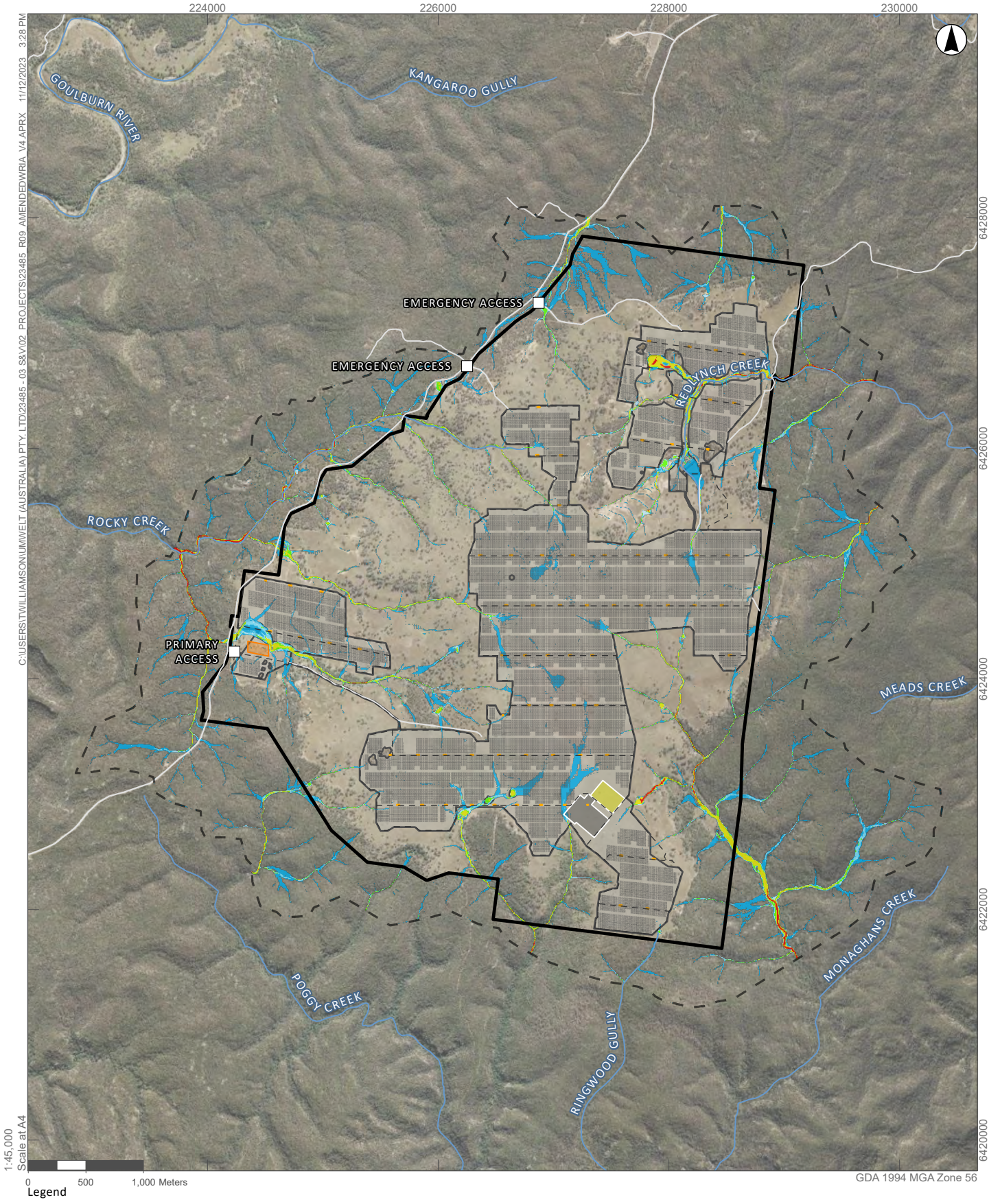
Water Velocity (m/s)

- < 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3.0

APPENDIX C.5

1% AEP Flood Velocity for Existing Conditions

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)



Legend

- Access Points
- Proposed Access Tracks
- Roads and Tracks
- Watercourse
- Model Extent
- Project Area
- Development Footprint - Amended Project
- Compound Area

Proposed Infrastructure

- Battery Energy Storage System
- Battery Substation
- Inverters
- Solar Panel Footprint

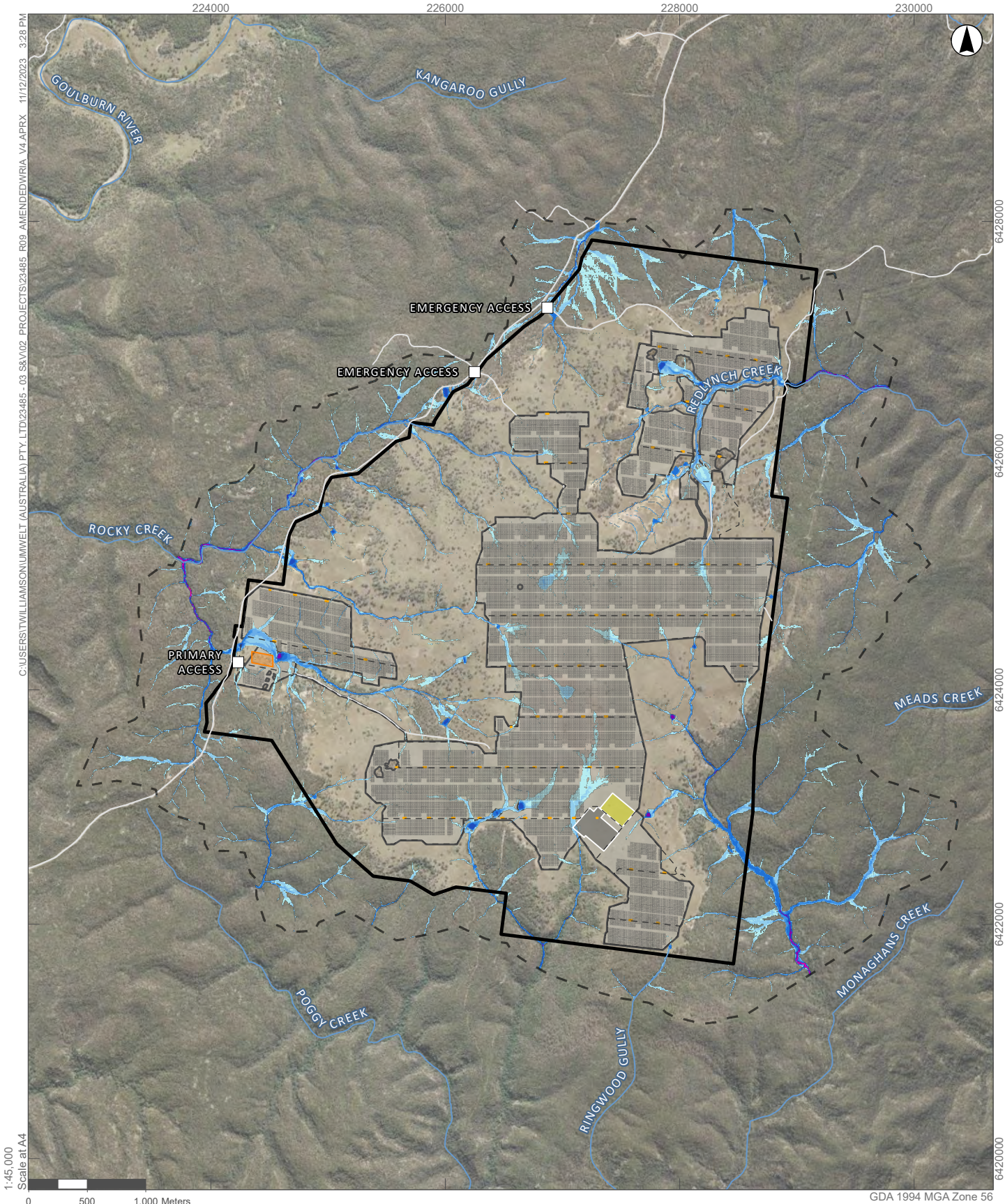
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX C.6

1% AEP Flood Hazard for Existing Conditions

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)



Legend

- Access Points
- Proposed Access Tracks
- Roads and Tracks
- Watercourse
- Model Extent
- Project Area
- Development Footprint - Amended Project
- Compound Area

Proposed Infrastructure

- Battery Energy Storage System
- Battery Substation
- Inverters
- Solar Panel Footprint

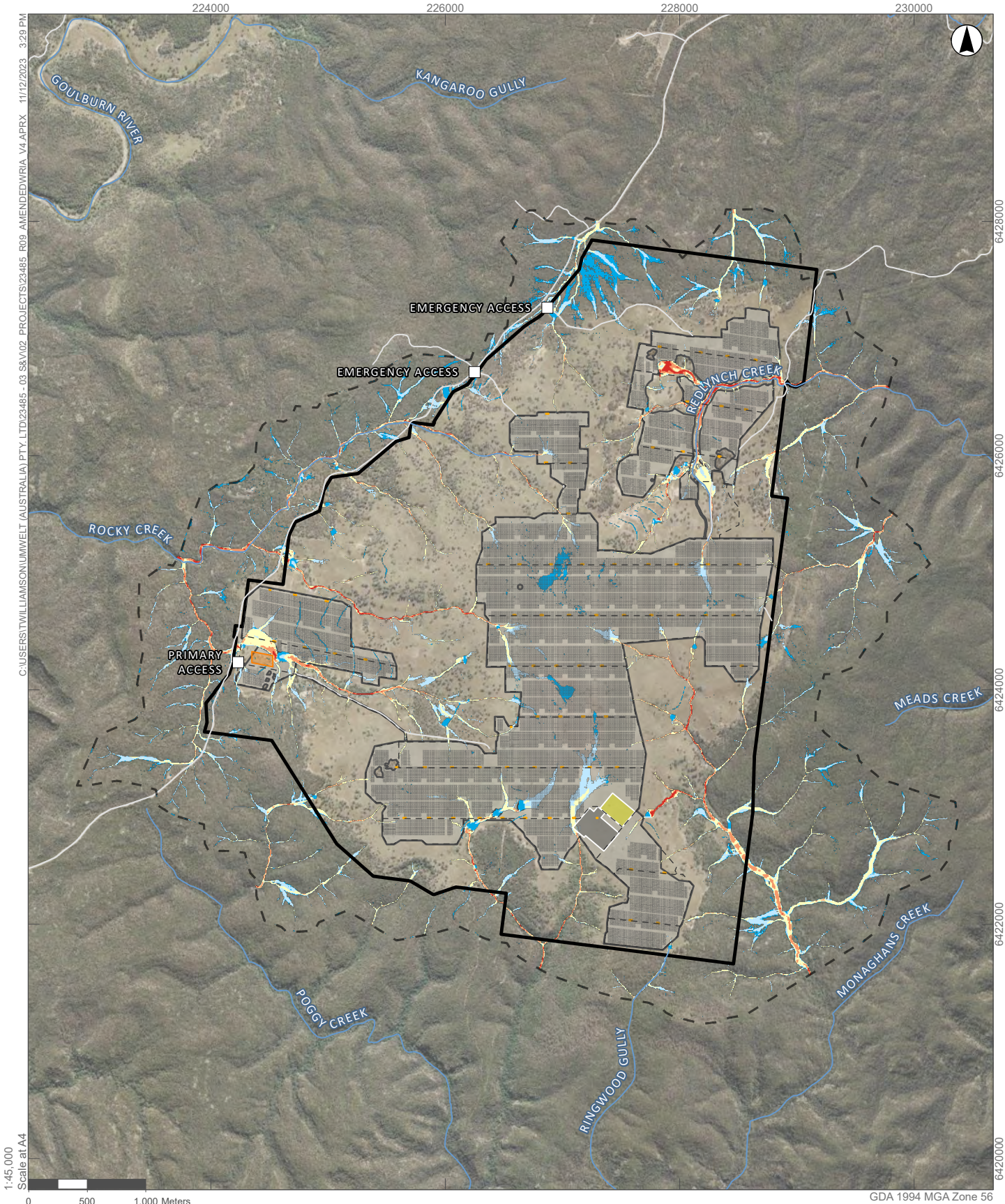
Water Depth (m)

- < 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- > 4.0

APPENDIX C.7

0.5% AEP Flood Depth for Existing Conditions

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)



Legend

- Access Points
- Proposed Access Tracks
- Roads and Tracks
- Watercourse
- Model Extent
- Project Area
- Development Footprint - Amended Project
- Compound Area

Proposed Infrastructure

- Battery Energy Storage System
- Battery Substation
- Inverters
- Solar Panel Footprint

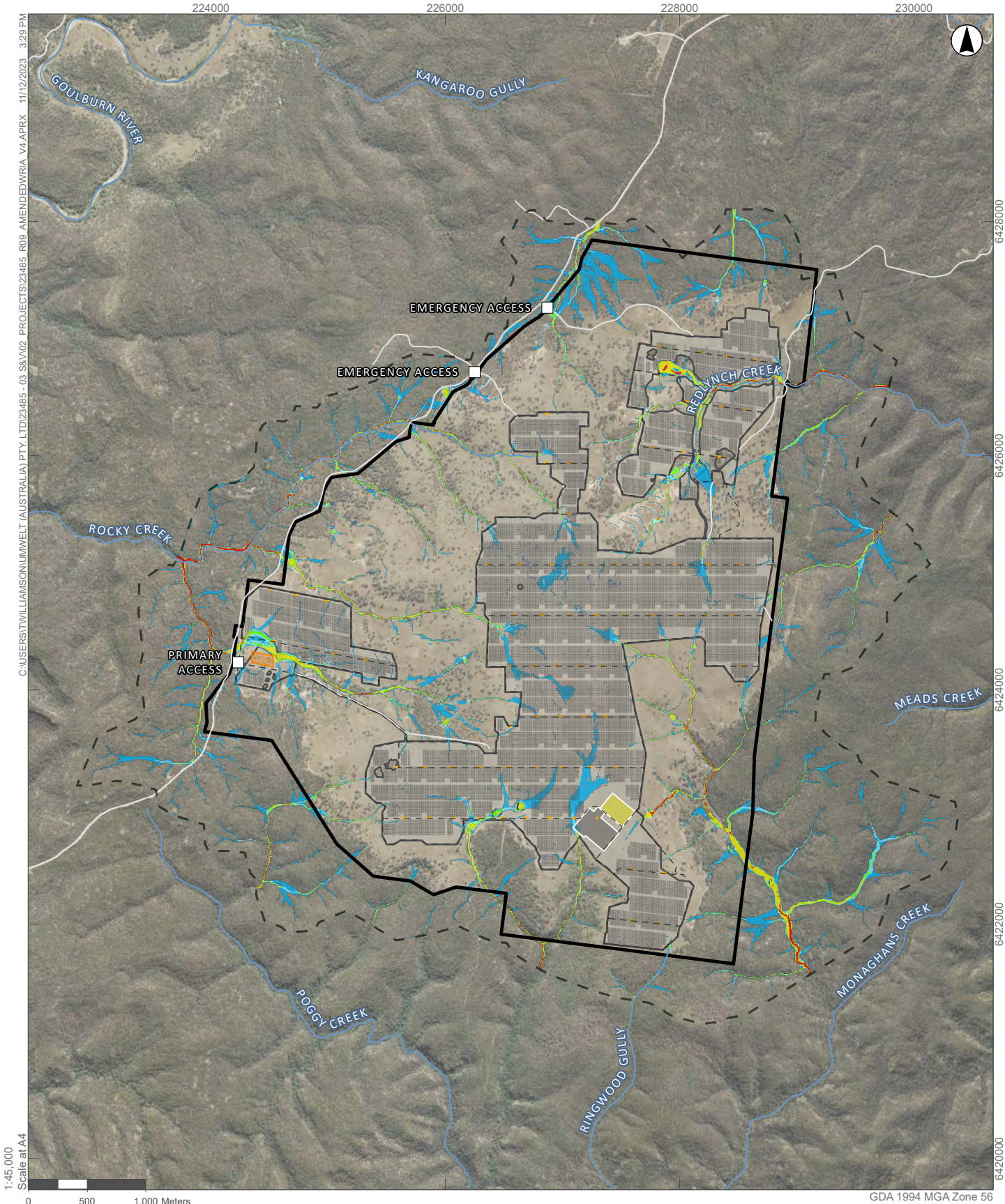
Water Velocity (m/s)

- < 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3.0

APPENDIX C.8

0.5% AEP Flood Velocity for Existing Conditions

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)



Legend

- Access Points
- Proposed Access Tracks
- Roads and Tracks
- Watercourse
- Model Extent
- Project Area
- Development Footprint - Amended Project
- Compound Area

Proposed Infrastructure

- Battery Energy Storage System
- Battery Substation
- Inverters
- Solar Panel Footprint

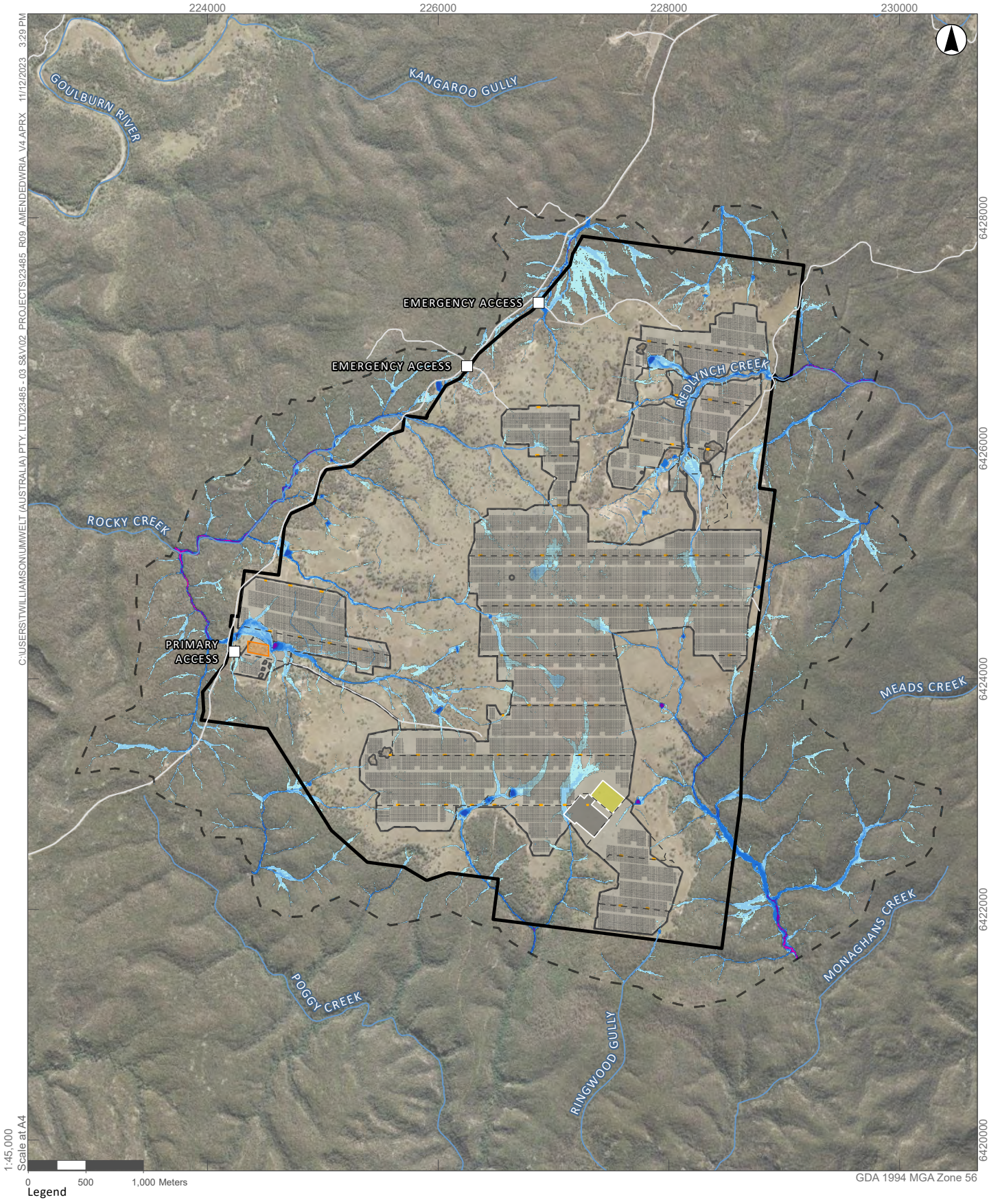
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX C.9

0.5% AEP Flood Hazard for Existing Conditions

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)



Legend

- Access Points
- Proposed Access Tracks
- Roads and Tracks
- Watercourse
- Model Extent
- Project Area
- Development Footprint - Amended Project
- Compound Area

Proposed Infrastructure

- Battery Energy Storage System
- Battery Substation
- Inverters
- Solar Panel Footprint

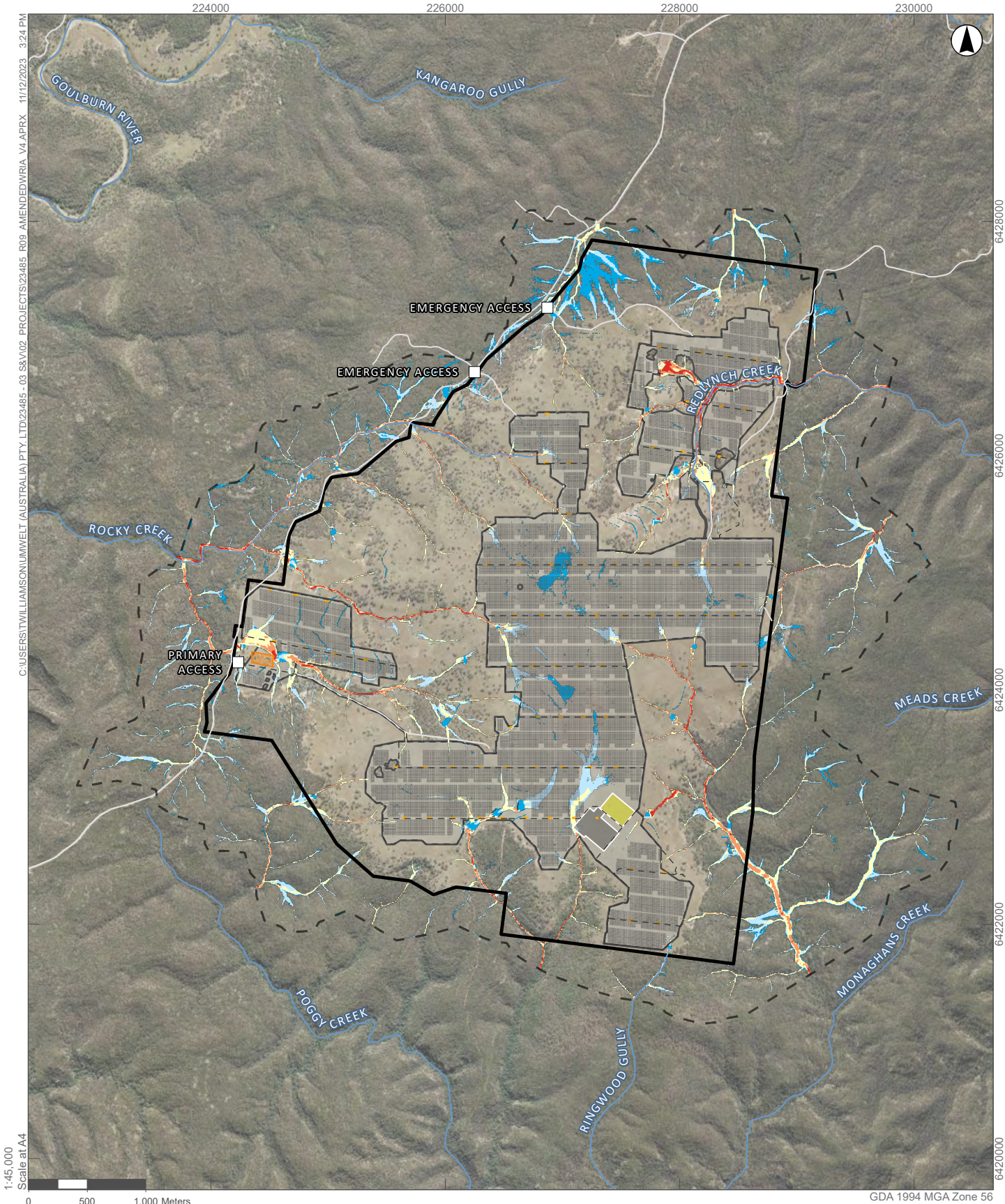
Water Depth (m)

- < 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- > 4.0

APPENDIX C.10

0.2% AEP Flood Depth for Existing Conditions

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)



Legend

- Access Points
- Proposed Access Tracks
- Roads and Tracks
- Watercourse
- Model Extent
- Project Area
- Development Footprint - Amended Project
- Compound Area

Proposed Infrastructure

- Battery Energy Storage System
- Battery Substation
- Inverters
- Solar Panel Footprint

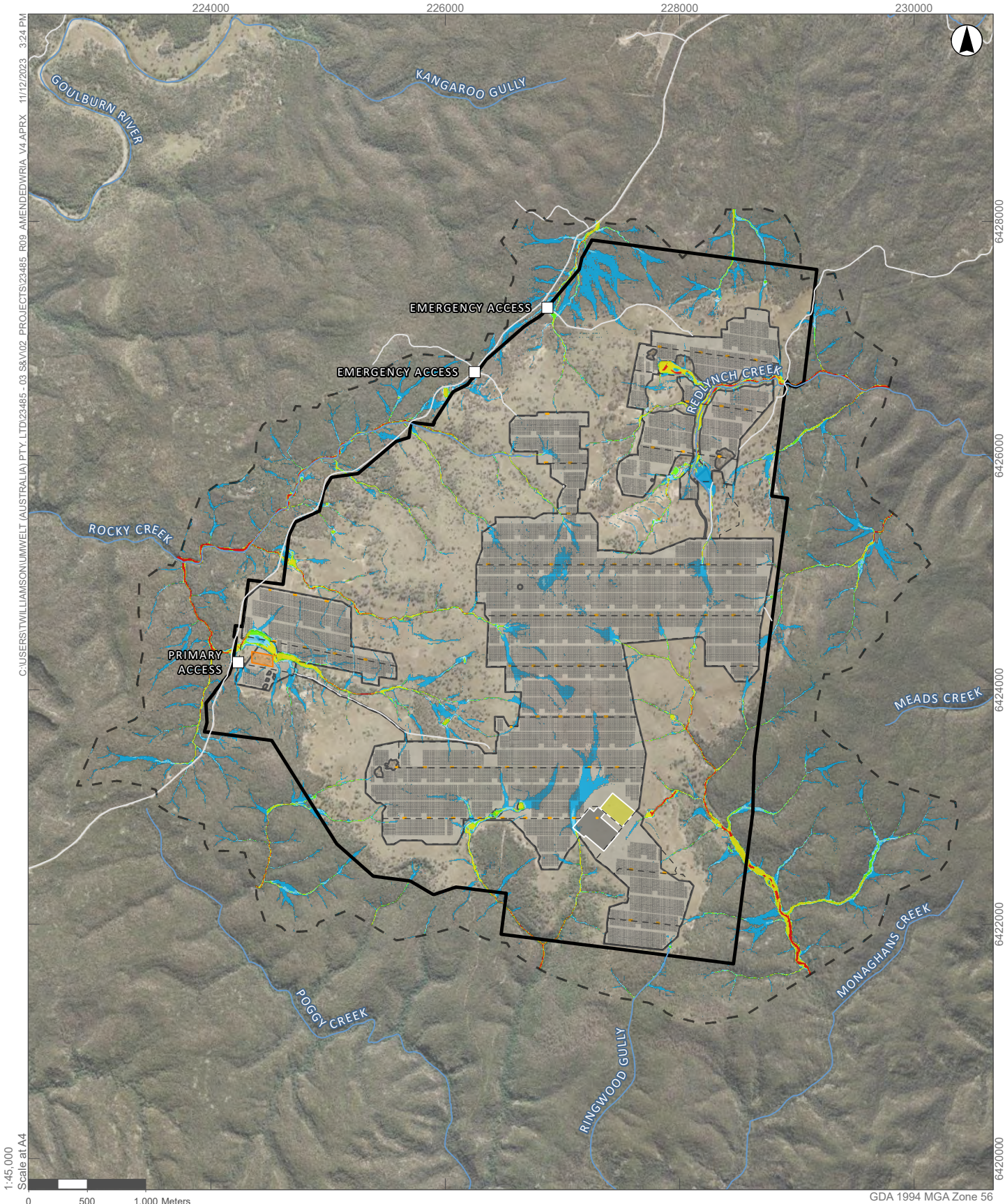
Water Velocity (m/s)

- < 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3.0

APPENDIX C.11

0.2% AEP Flood Velocity for Existing Conditions

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)



Legend

- Access Points
- Proposed Access Tracks
- Roads and Tracks
- Watercourse
- Model Extent
- Project Area
- Development Footprint - Amended Project
- Compound Area

Proposed Infrastructure

- Battery Energy Storage System
- Battery Substation
- Inverters
- Solar Panel Footprint

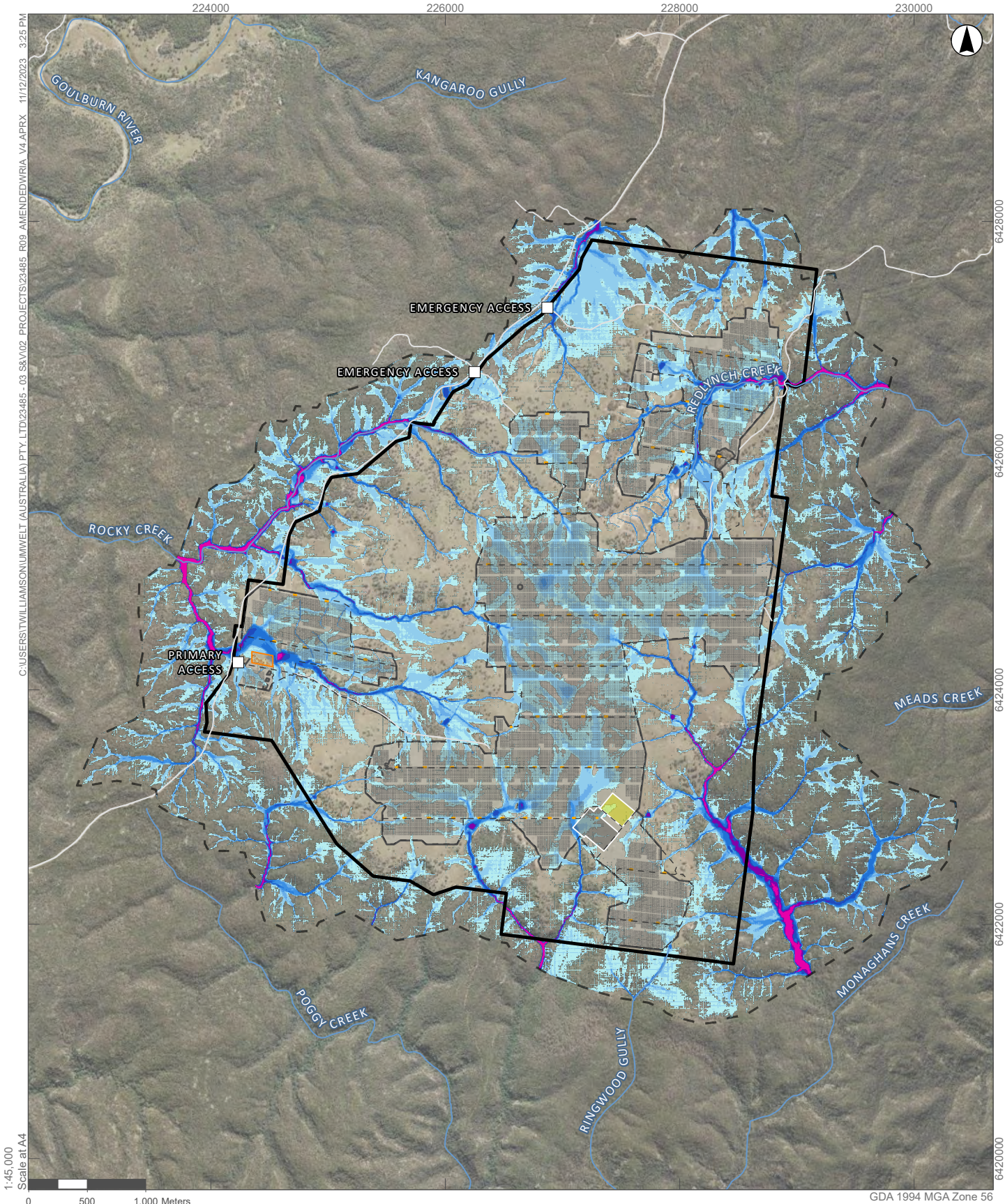
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX C.12

0.2% AEP Flood Hazard for Existing Conditions

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)



Legend

- Access Points
- Proposed Access Tracks
- Roads and Tracks
- Watercourse
- Model Extent
- Project Area
- Development Footprint - Amended Project
- Compound Area

Proposed Infrastructure

- Battery Energy Storage System
- Battery Substation
- Inverters
- Solar Panel Footprint

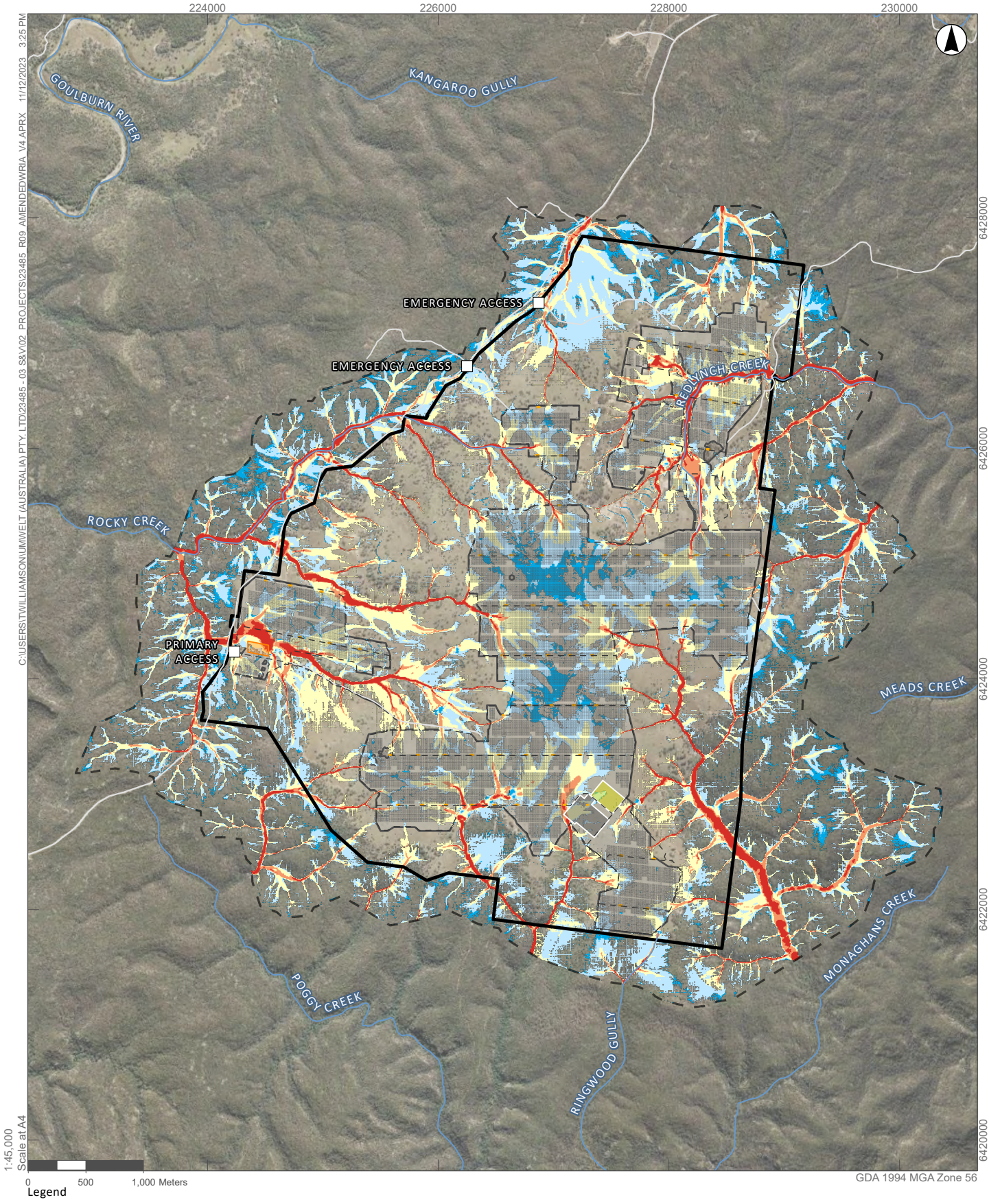
Water Depth (m)

- < 0.1
- 0.1 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- > 4.0

APPENDIX C.13

PMF Flood Depth for Existing Conditions

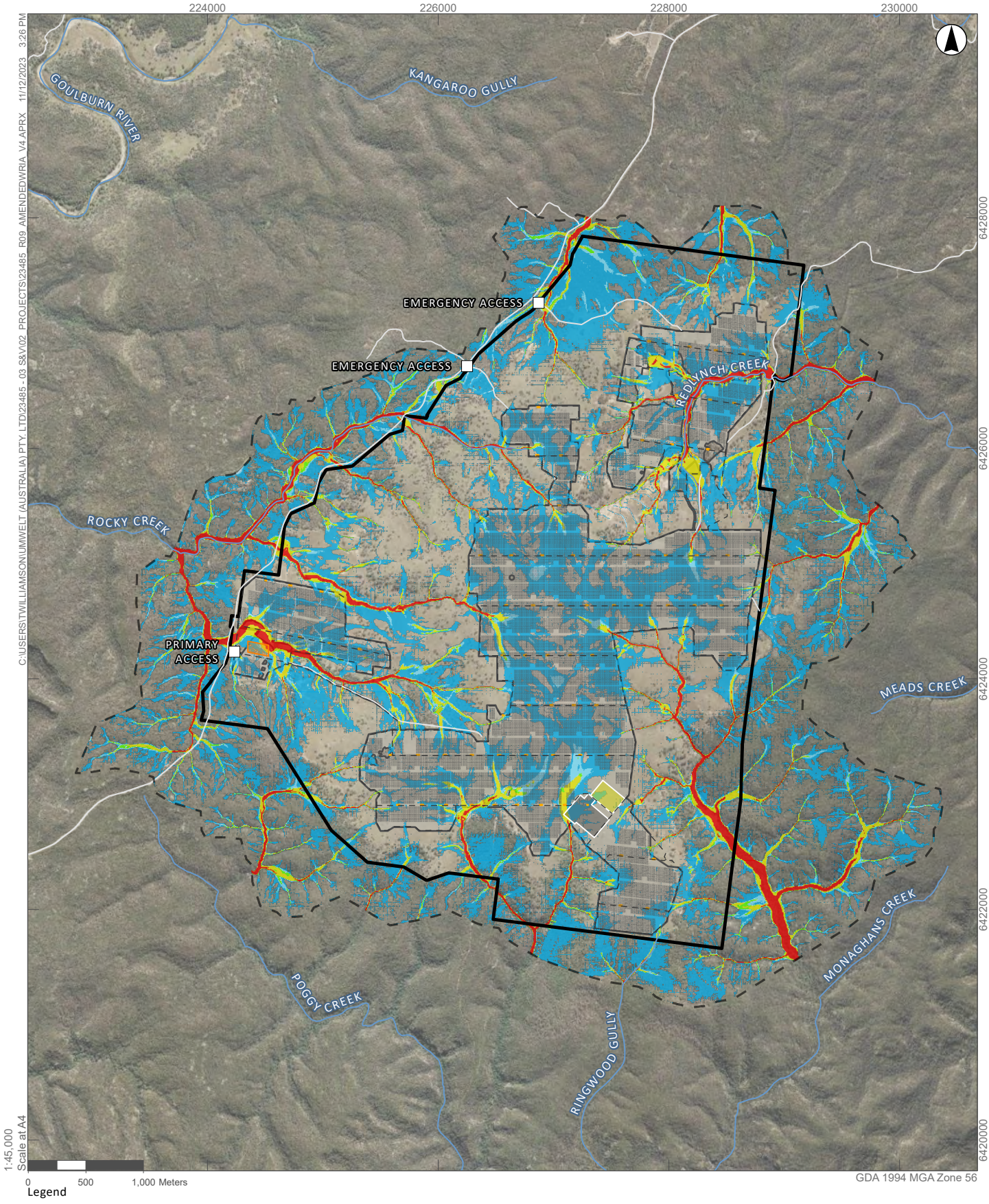
Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)



APPENDIX C.14

PMF Flood Velocity for Existing Conditions

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)



Legend

- Access Points
- Proposed Access Tracks
- Roads and Tracks
- Watercourse
- Model Extent
- Project Area
- Development Footprint - Amended Project

Proposed Infrastructure

- Battery Energy Storage System
- Battery Substation
- Inverters
- Compound Area
- Solar Panel Footprint

Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX C.15

PMF Flood Hazard for Existing Conditions

Image Source: ESRI Basemap (2021) **Data source:** NSW LPI (2021), NSW DSFI (2021); NPWS Estate (2019); Lightsource BP (2022)

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