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).

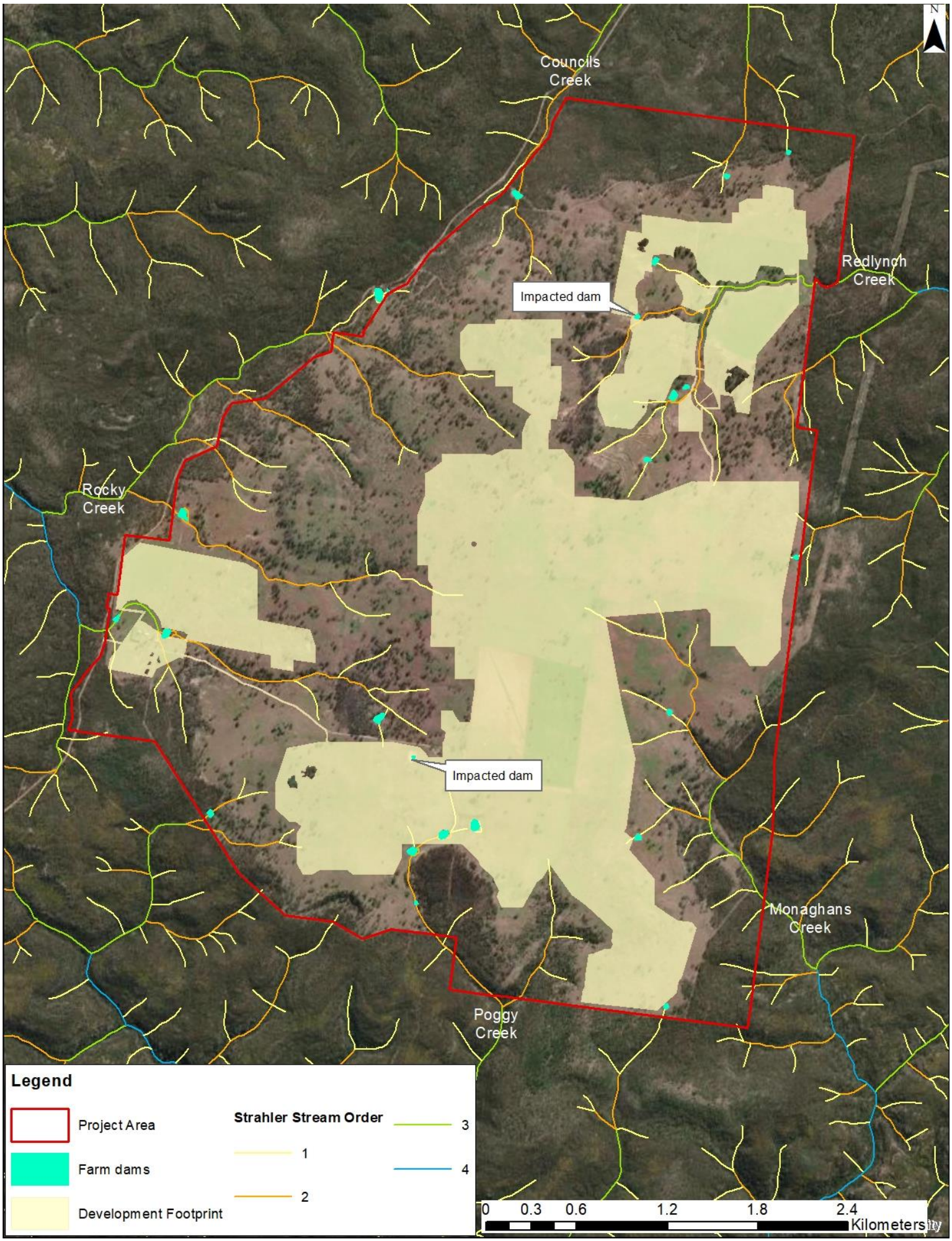

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Figure 4.2. Farm dams within the project area
Goulburn River Solar Farm
Job No. 220222 Date. 01/12/2023

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.

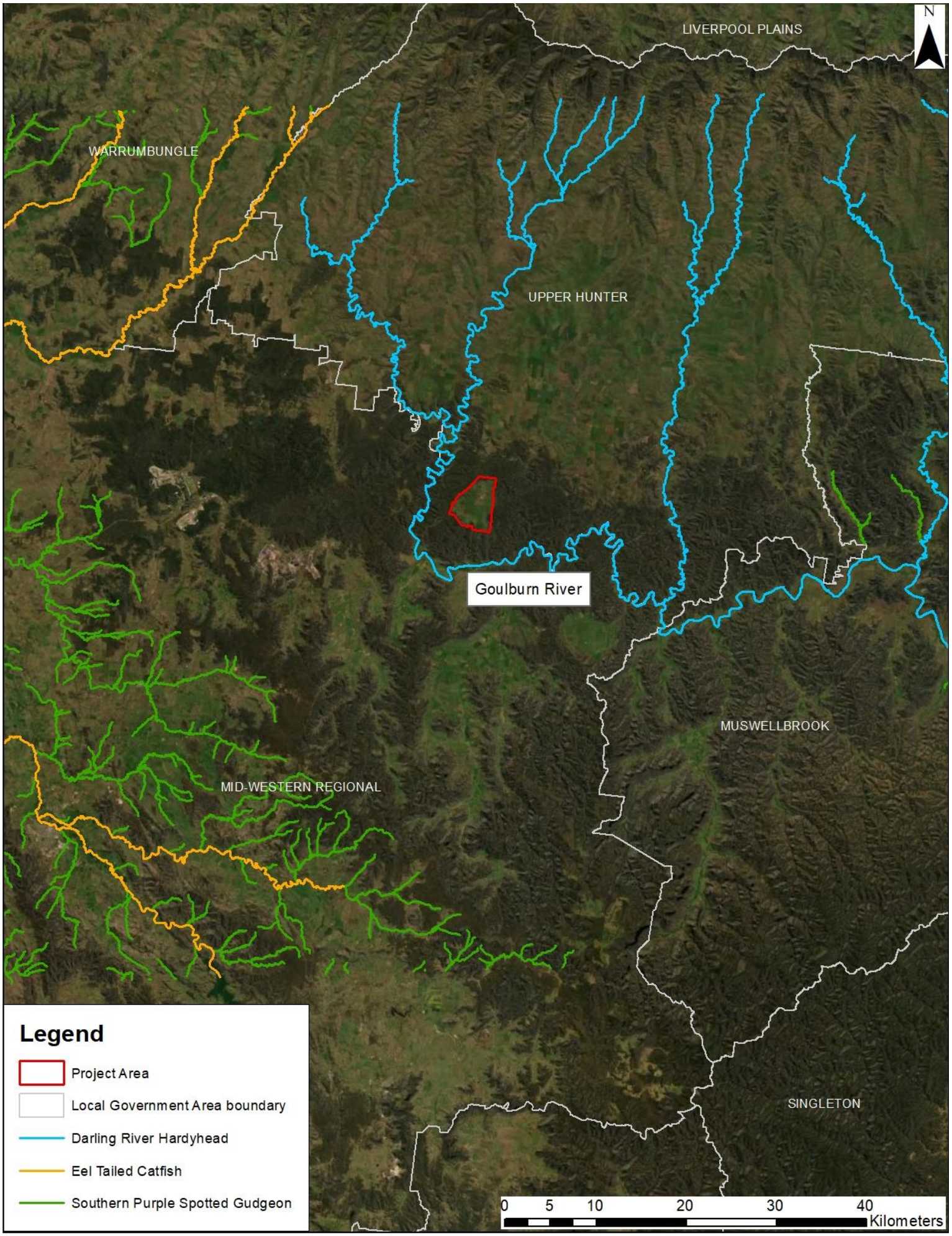

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Figure 4.3. Indicative distribution mapping (DPI, 2016) for threatened aquatic species in the locality
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5. Impact assessment

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:

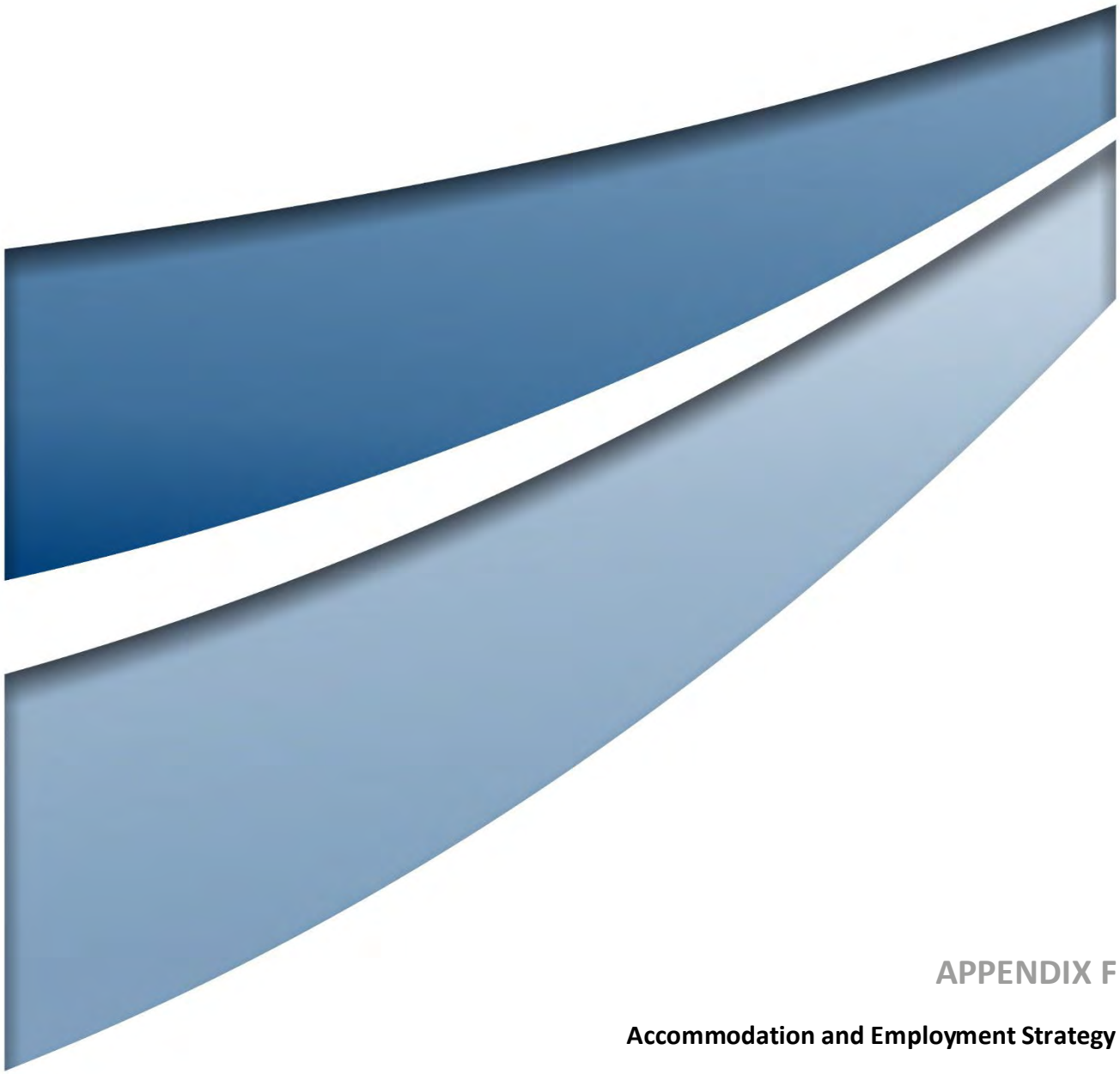
1. Degradation of native riparian vegetation along New South Wales water courses
2. Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams
3. Removal of large woody debris from New South Wales rivers and streams

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

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.

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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Figures

Tables

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**).

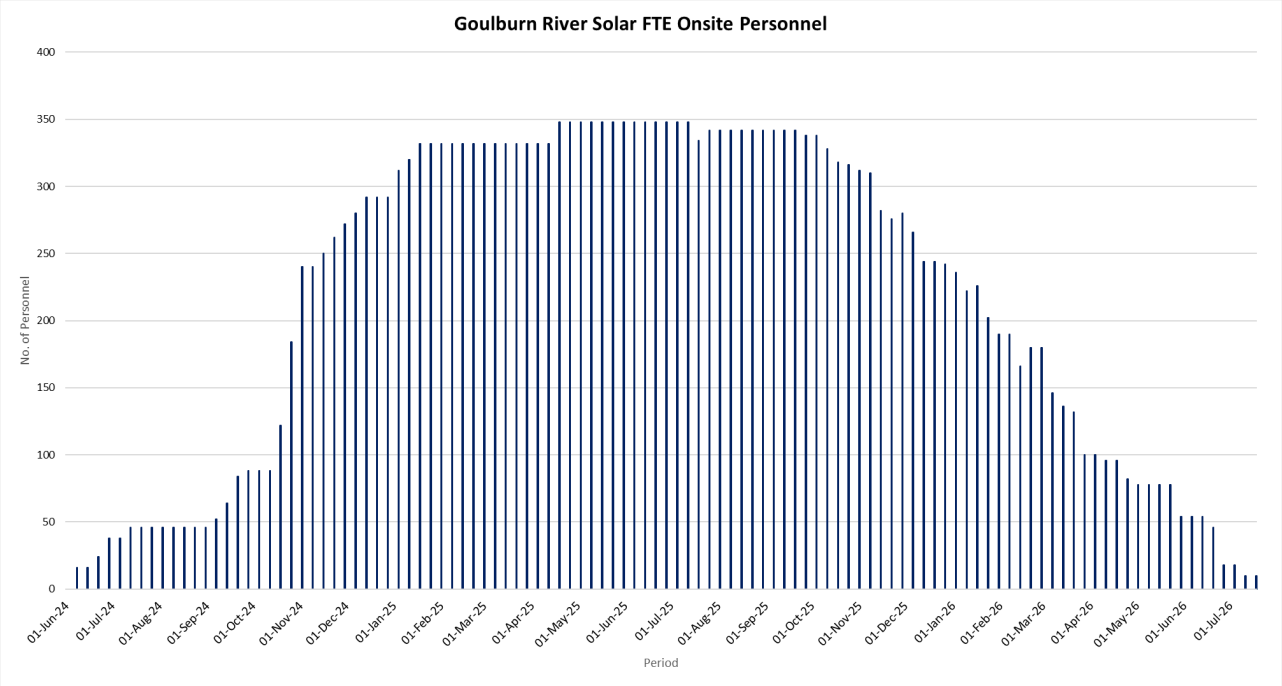

Figure 1.1 Goulburn River Solar Farm FTE Onsite Personnel

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**.

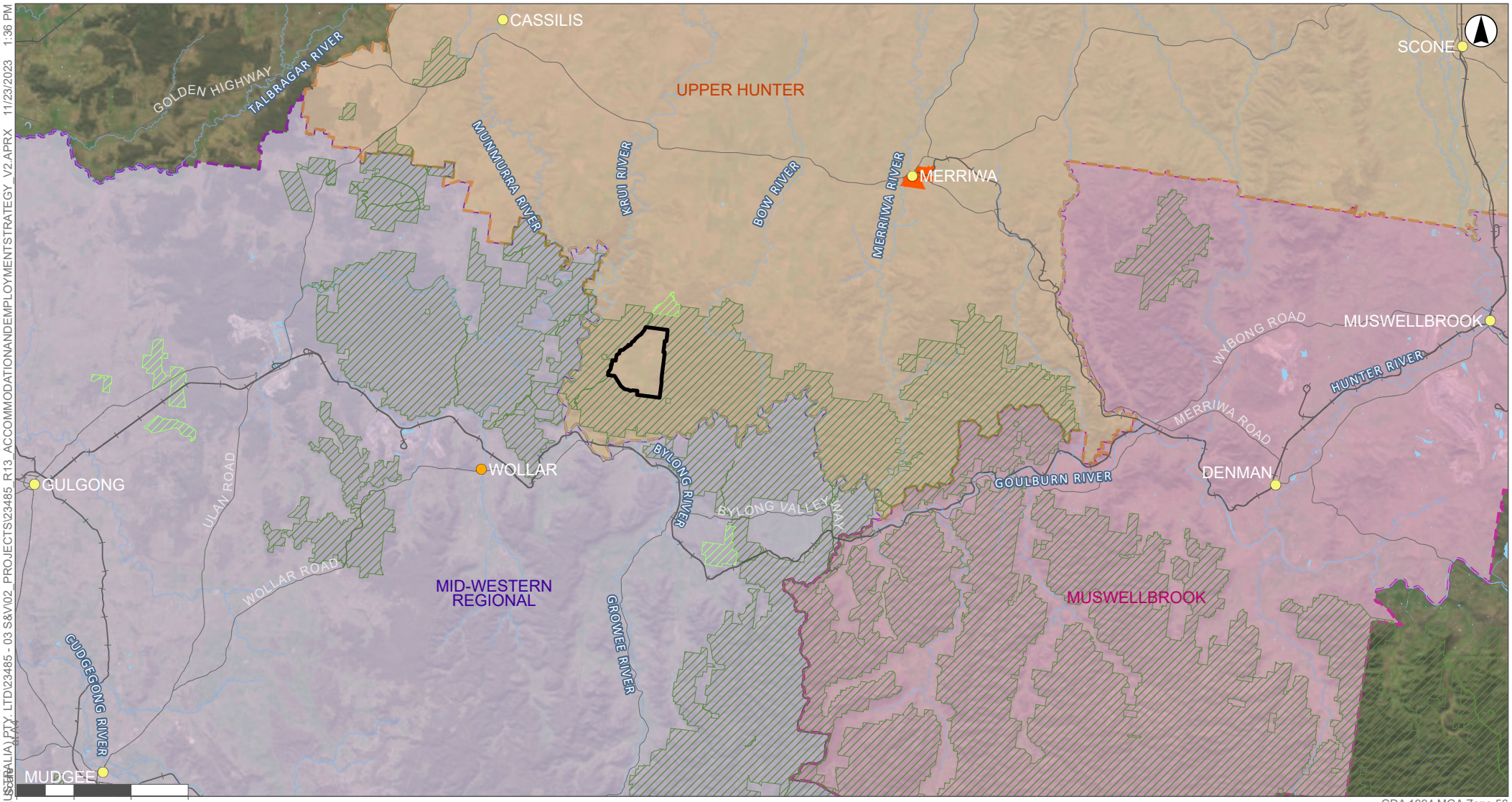

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FIGURE 2.4
Social Locality

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).

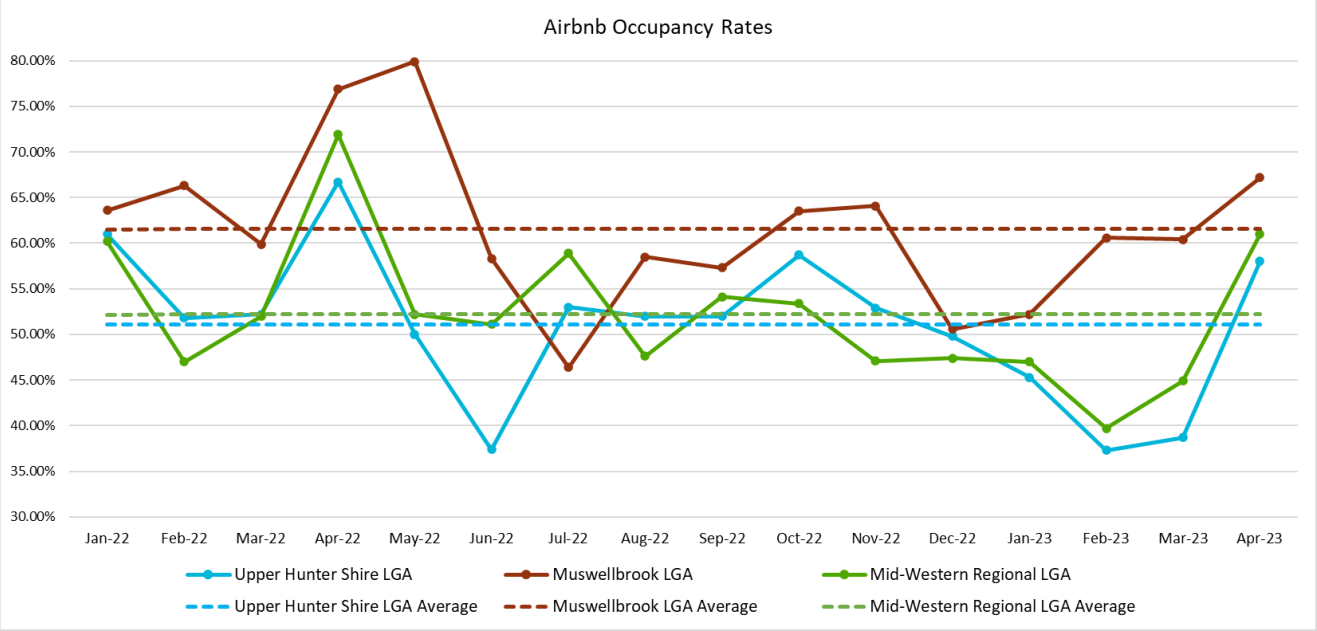

Figure 4.1 Airbnb Occupancy Rates

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.

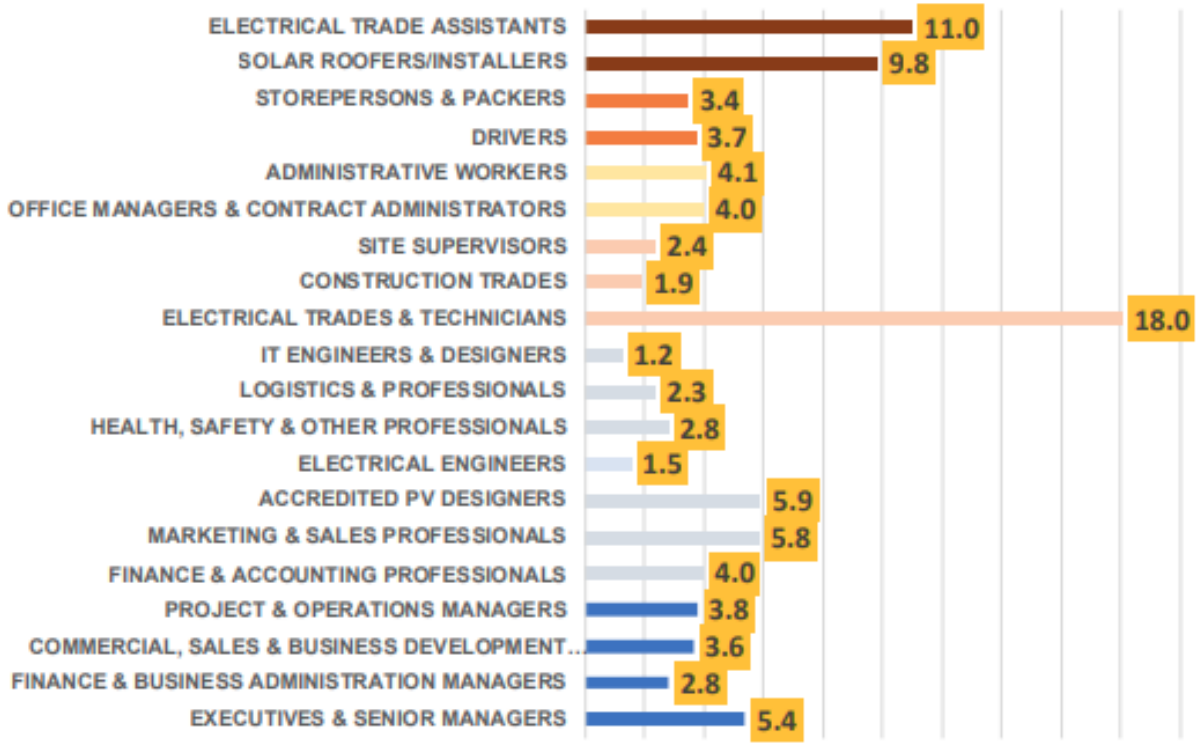

Figure 5.1 Key Occupations for Solar Farms

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.

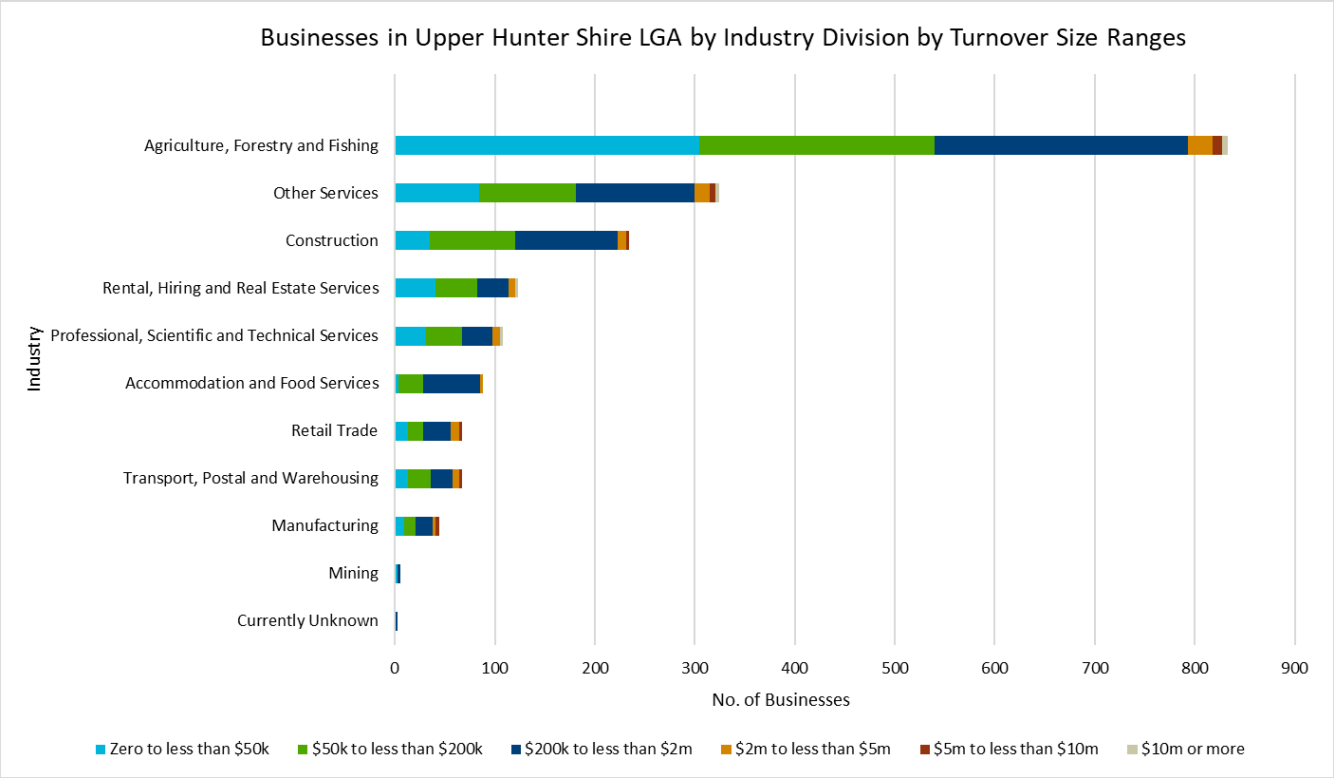

Figure 5.2 Businesses in Upper Hunter Shire LGA by Industry Division by Turnover Size Ranges

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.

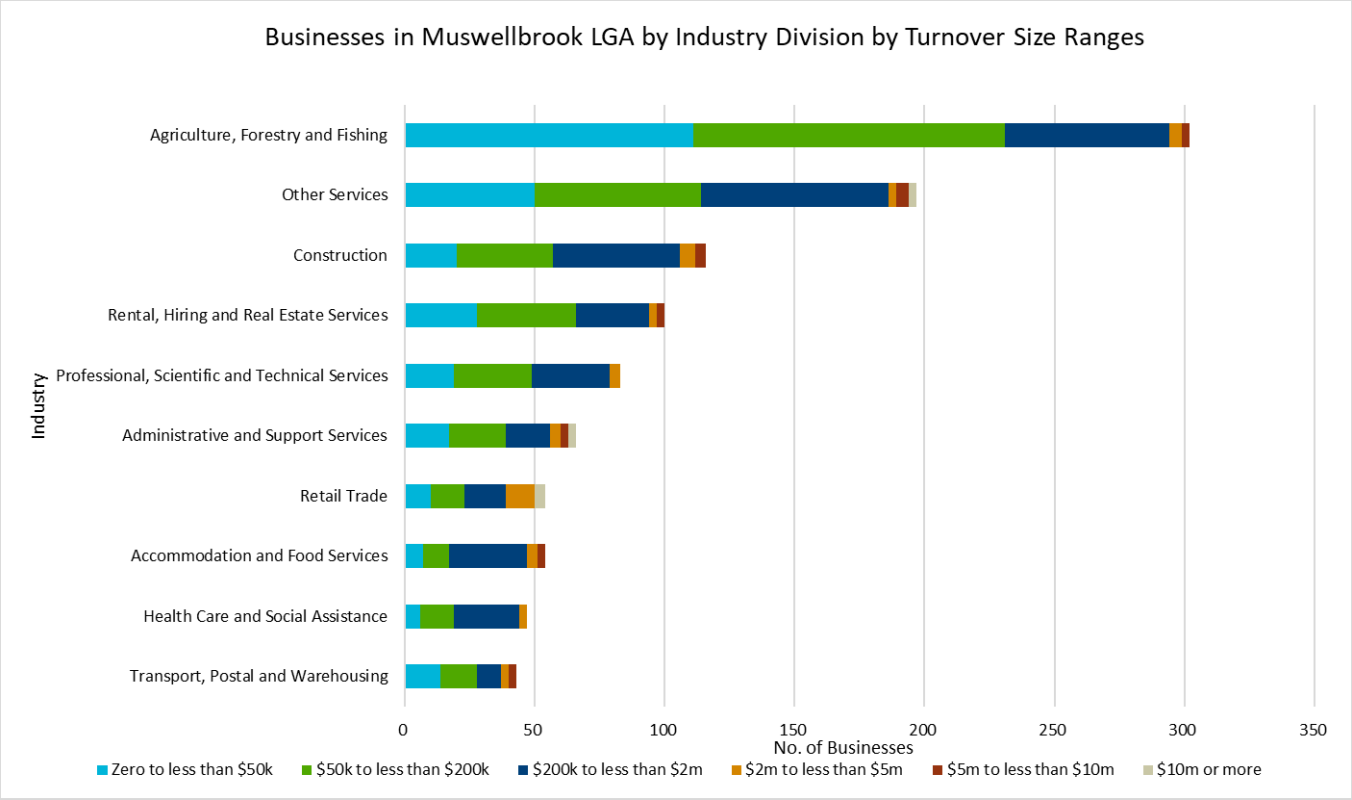

Figure 5.3 Businesses in Muswellbrook LGA by Industry Division by Turnover Size Ranges

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.

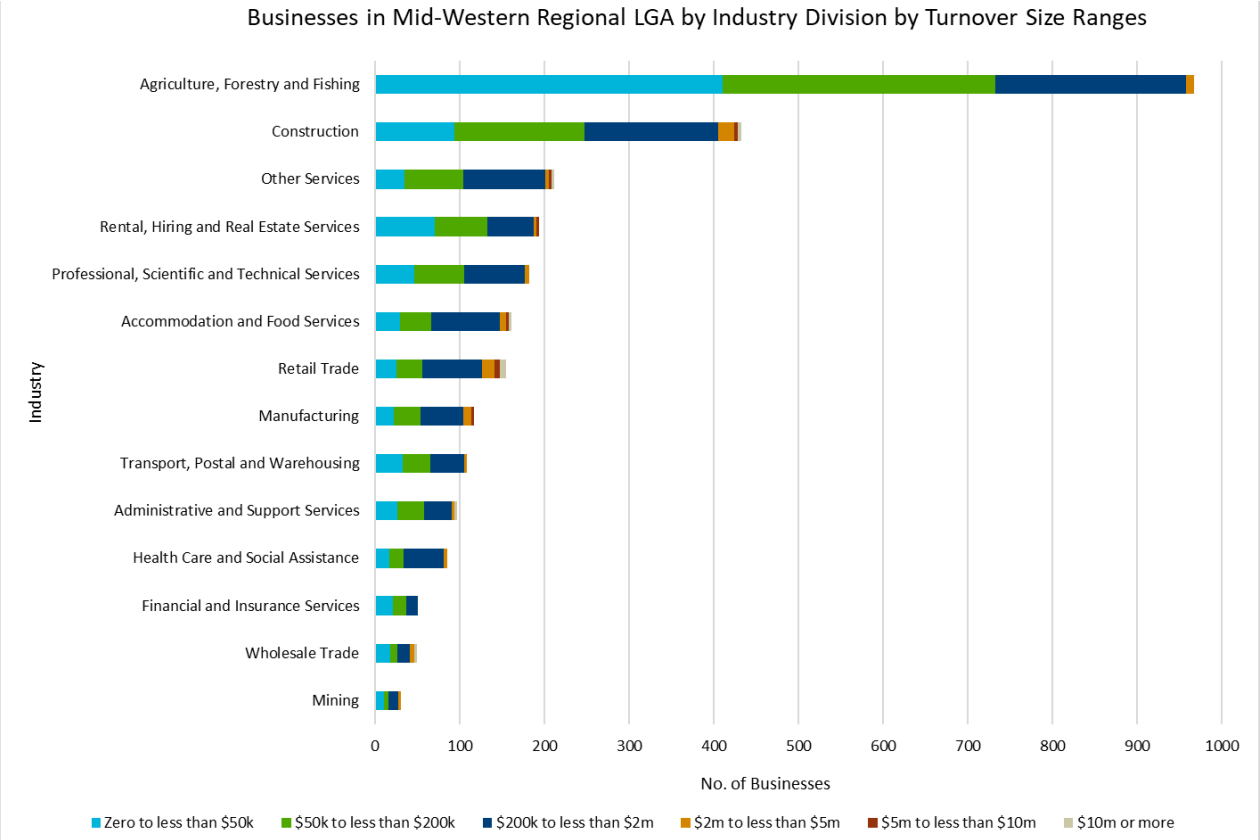

Figure 5.4 Businesses in Mid-Western Regional LGA by Industry Division by Turnover Size Ranges

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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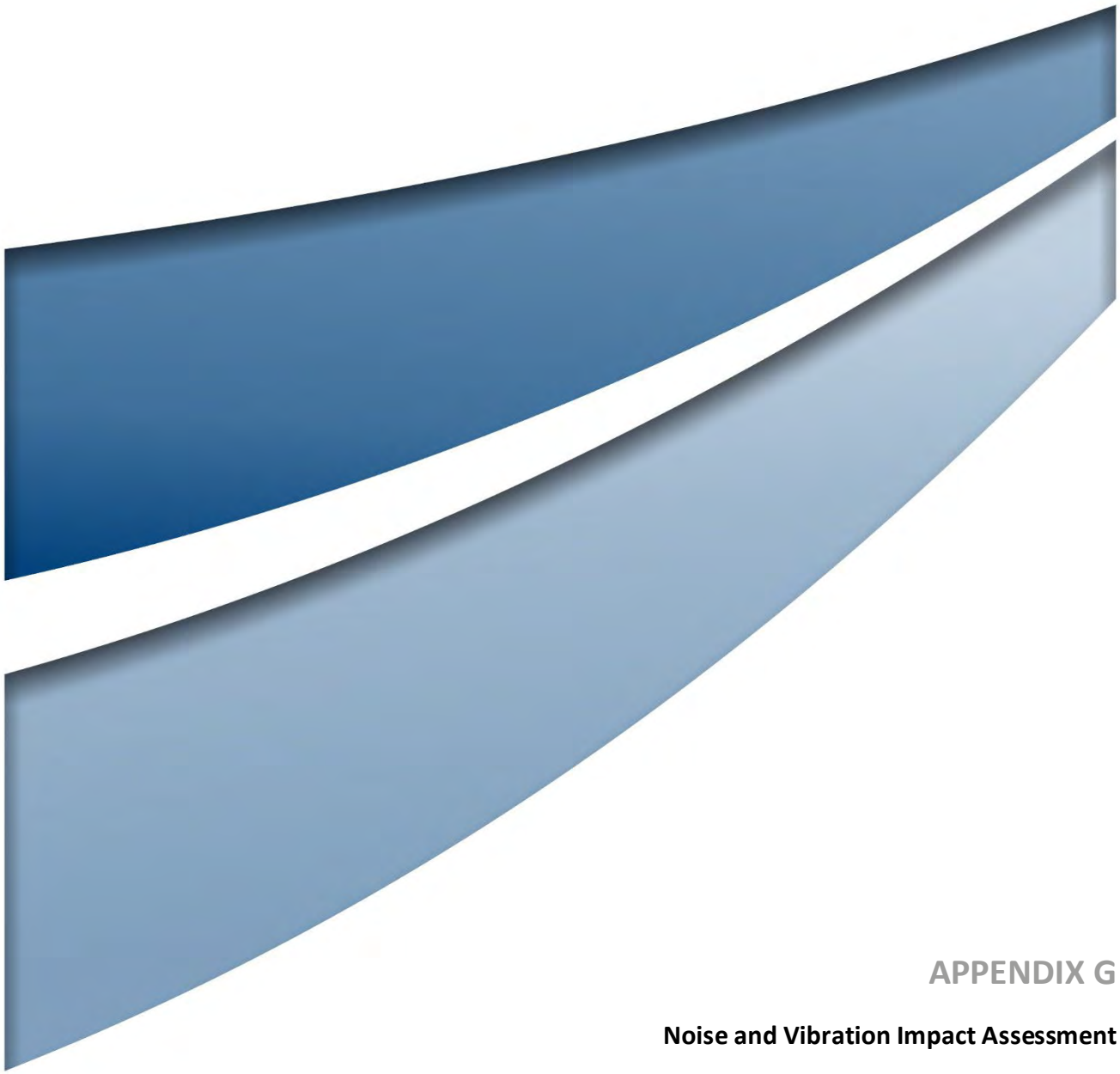

APPENDIX G

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
Lightsource bp

Project Director: Malinda Facey
Project Manager: Jessica Henderson-Wilson
Technical Director: Tim Procter
Technical Manager: Ben Carlyle
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.

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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Figures

Tables

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

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

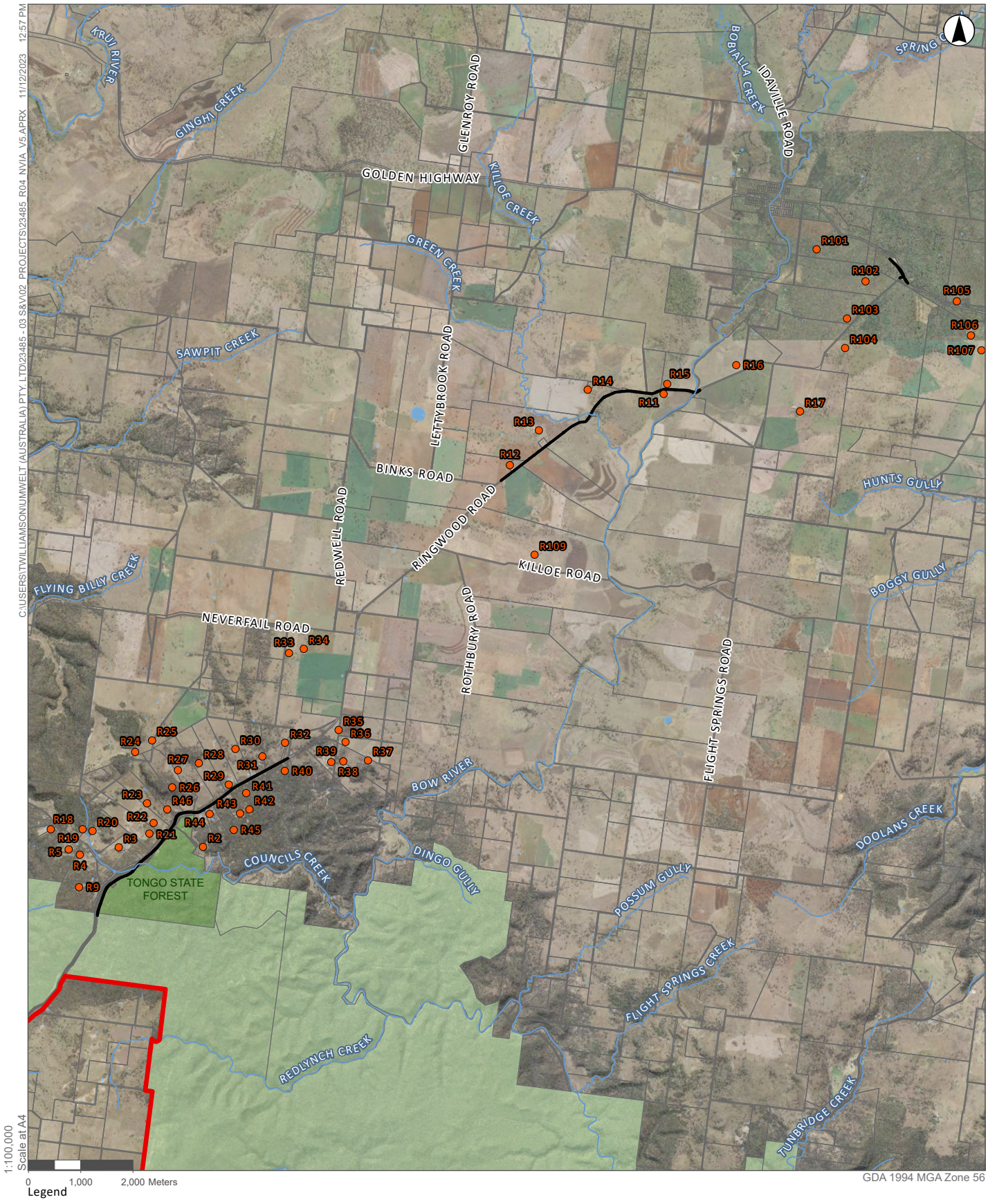


FIGURE 3.1

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)

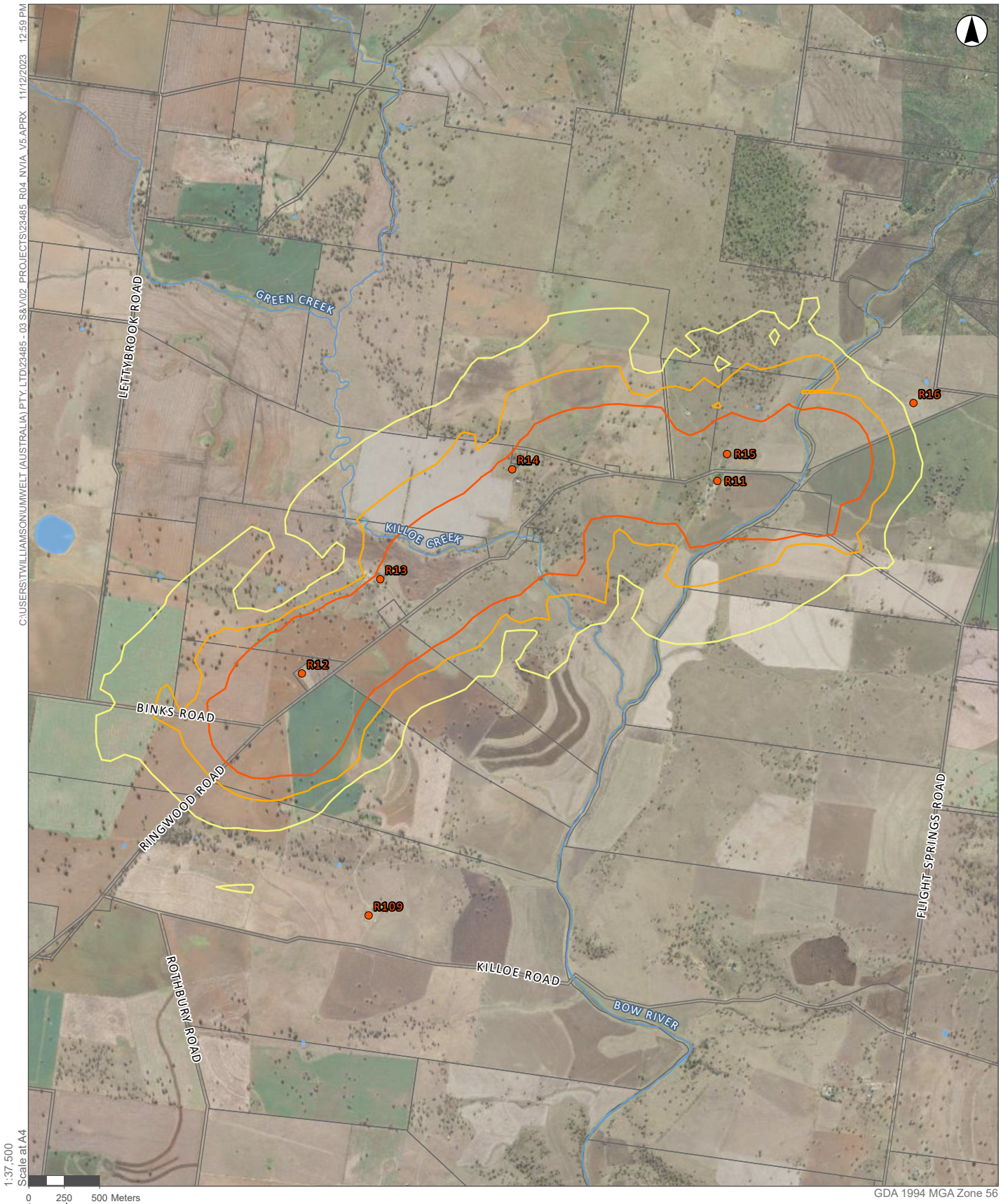


FIGURE 3.3

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)

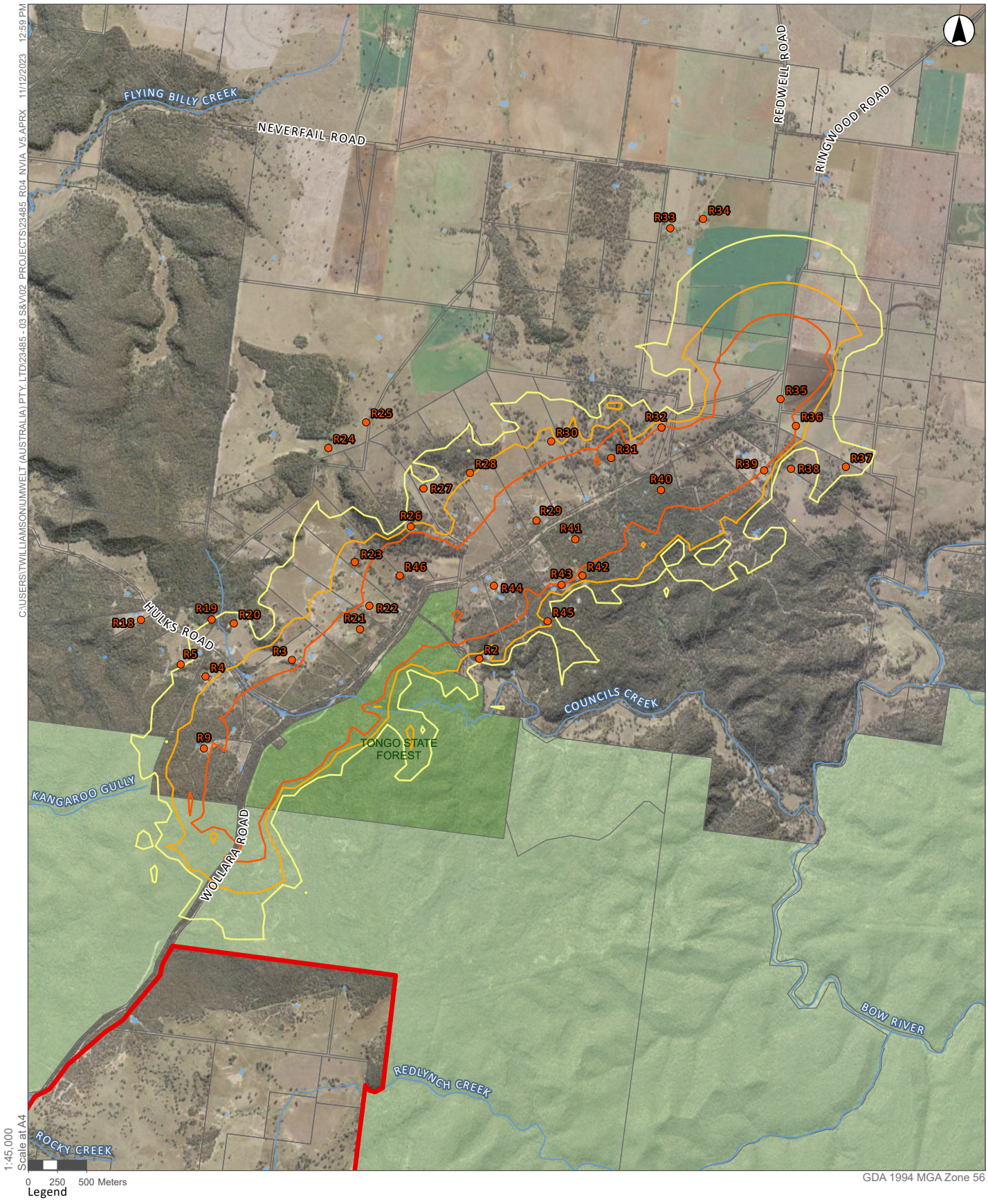


FIGURE 3.4

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.

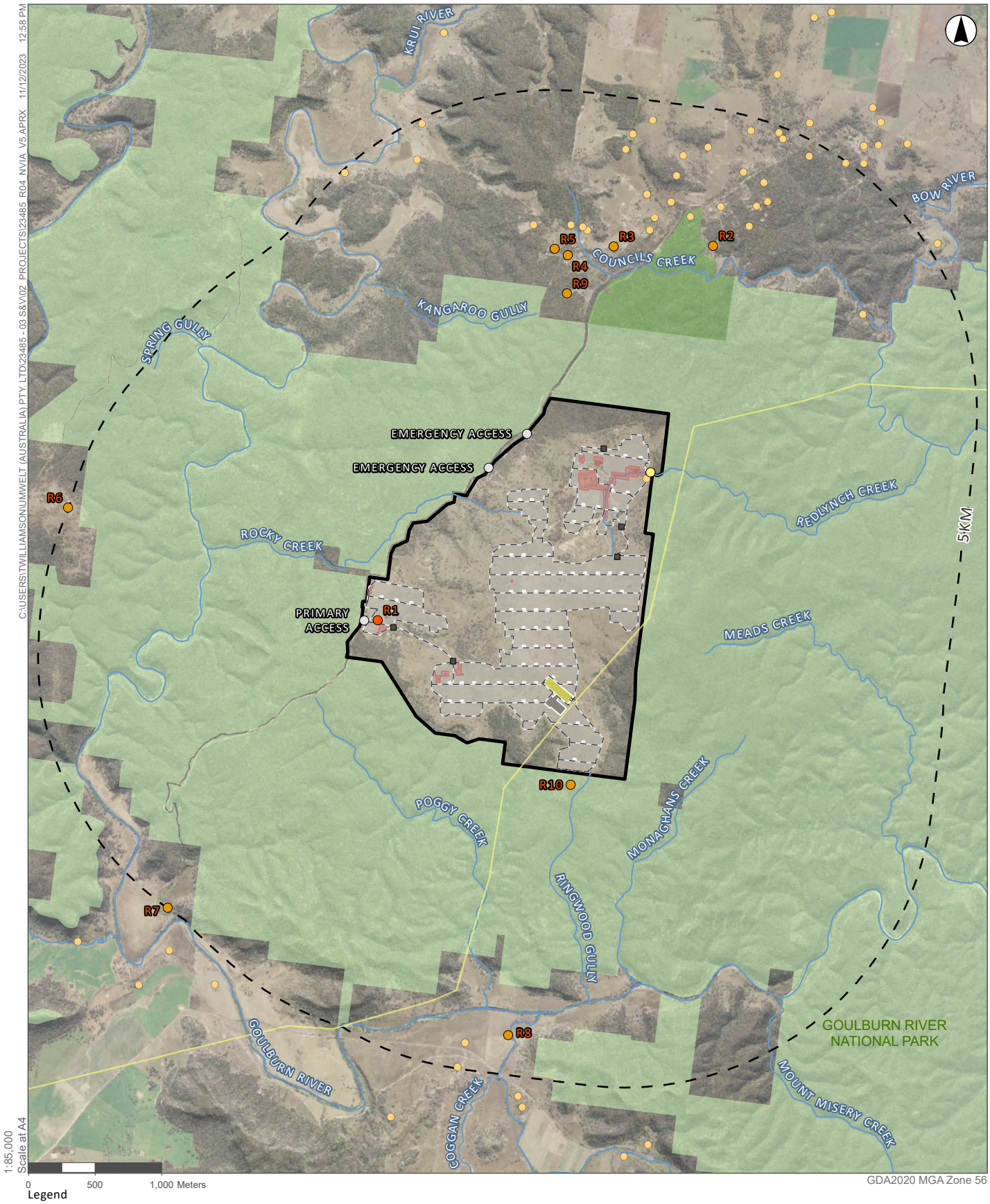
[4] PANL – Project Amenity Noise Level.

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)

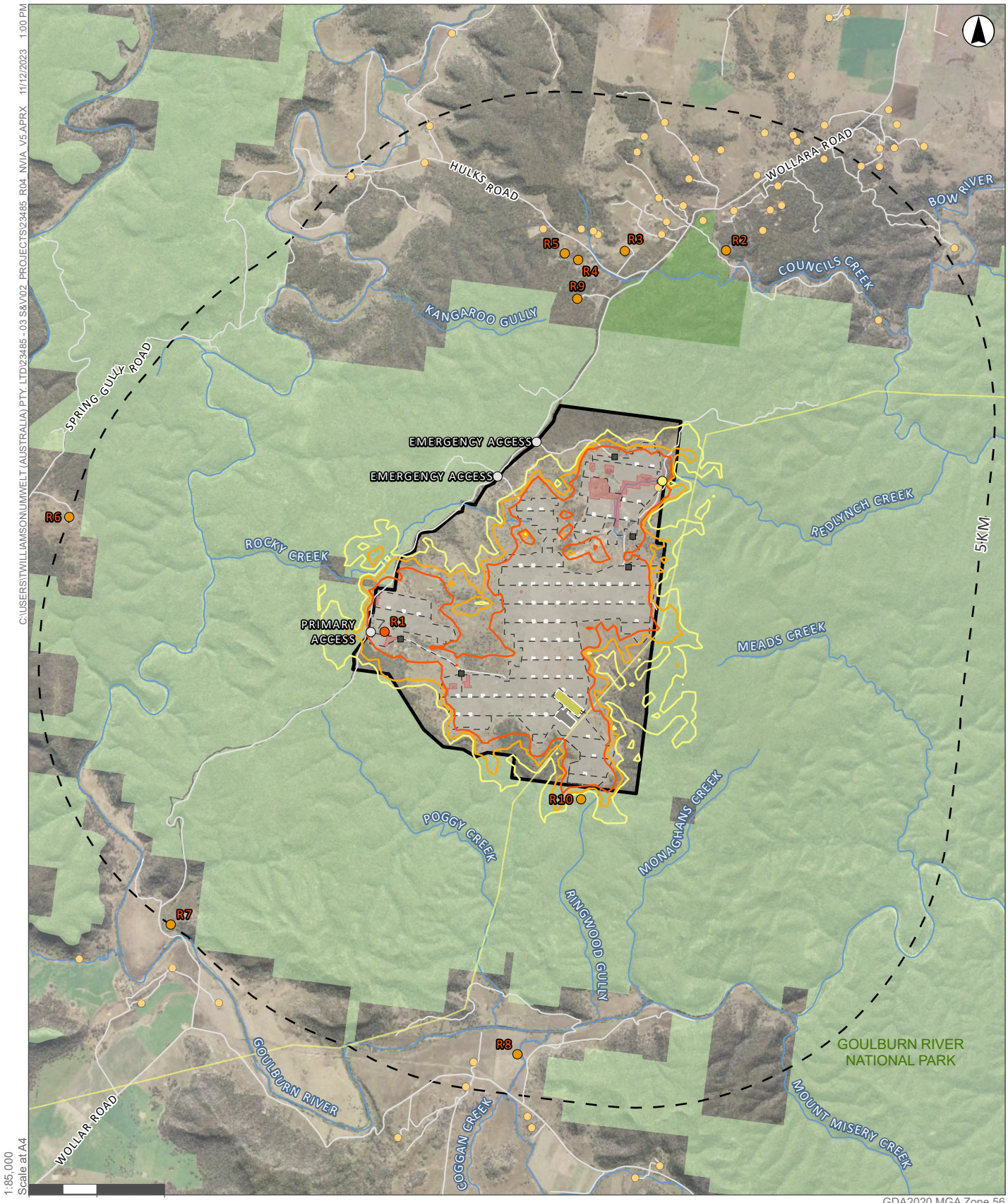
Rec ID	Predicted Noise Level, $L_{Aeq(15\ min)}$			Night-time PNTL, $L_{Aeq(15\ min)}$
	Decentralised BESS	Centralised BESS	Decentralised plus Centralised	
R01 (host receiver) [1]	52	30	52	-
R02	<20	<20	<20	35
R03	<20	<20	<20	35
R04	<20	<20	<20	35
R05	<20	<20	<20	35
R06	<20	<20	<20	35
R07	<20	<20	<20	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.*



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1:85,000 Scale at A4

0 500 1,000 Meters

GDA2020 MGA Zone 56

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

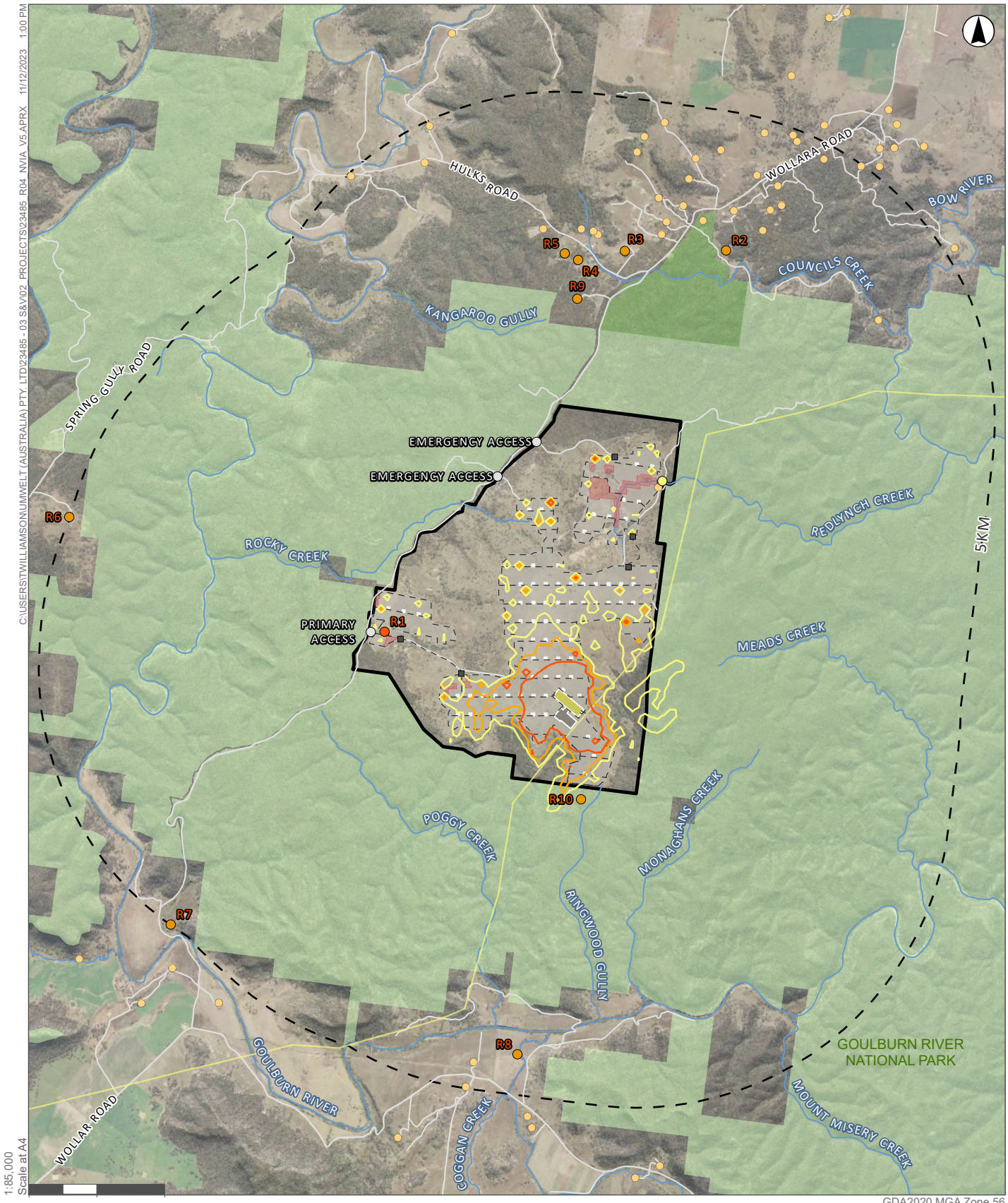
- 35 dB(A)
- 40 dB(A)
- 45 dB(A)

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

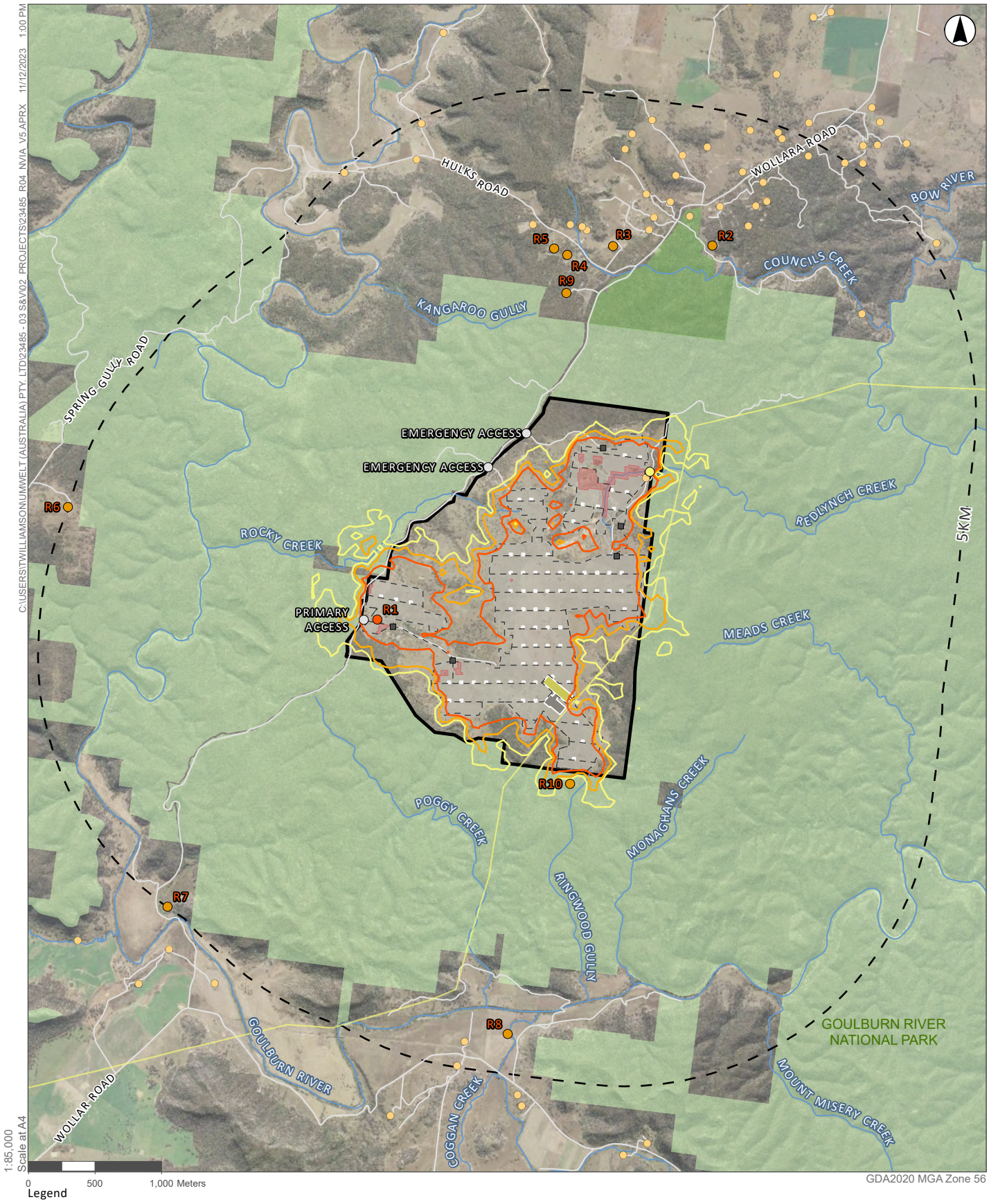
- 35 dB(A)
- 40 dB(A)
- 45 dB(A)

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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Environmental & Social
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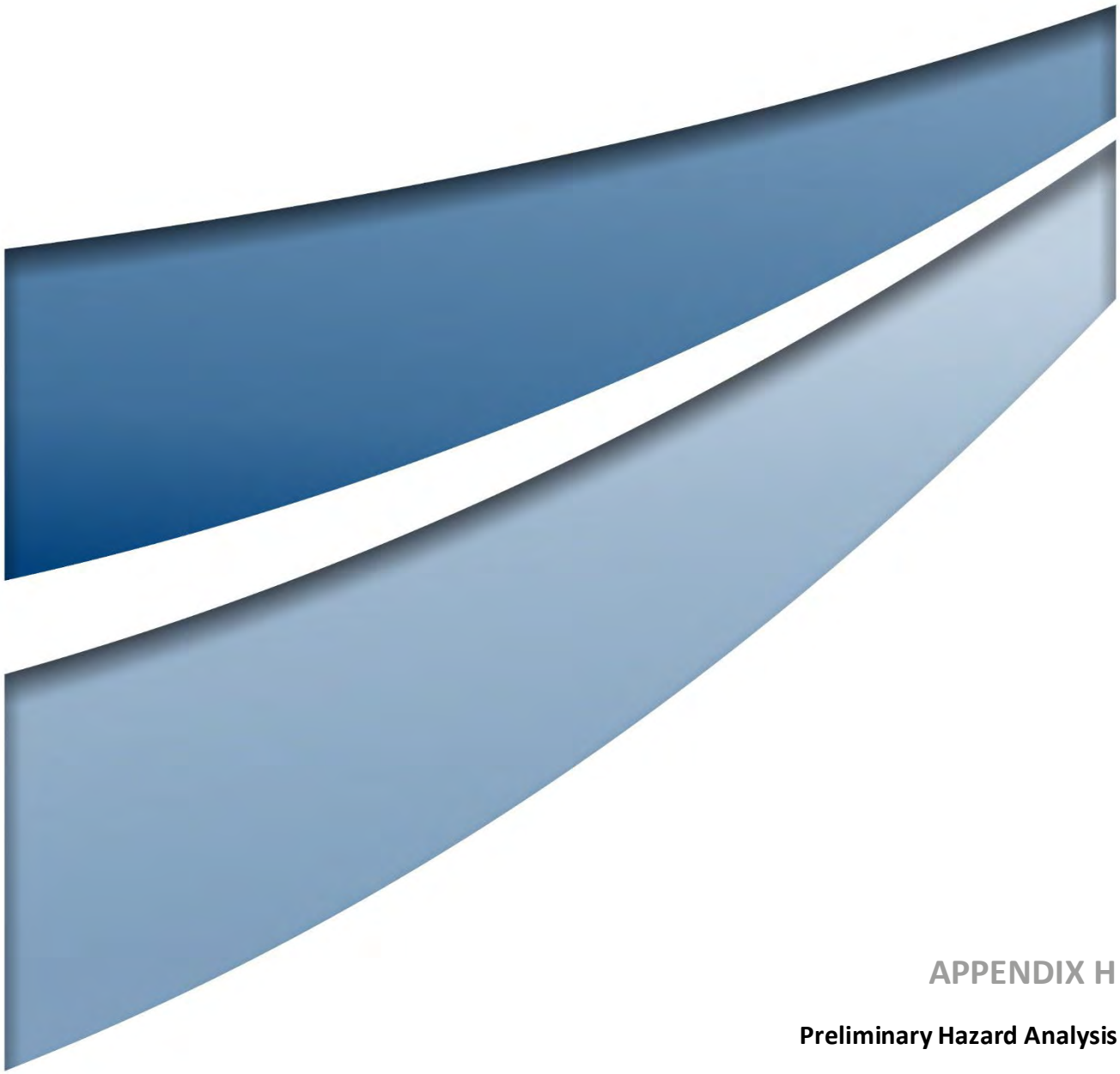

APPENDIX H

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

Project Director: Malinda Facey
Project Manager: Jessica Henderson-Wilson
Technical Director: Tim Procter
Technical Manager: Tim Procter
Report No. 23485 / R12
Date: December 2023

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.

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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Figures

Tables

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).

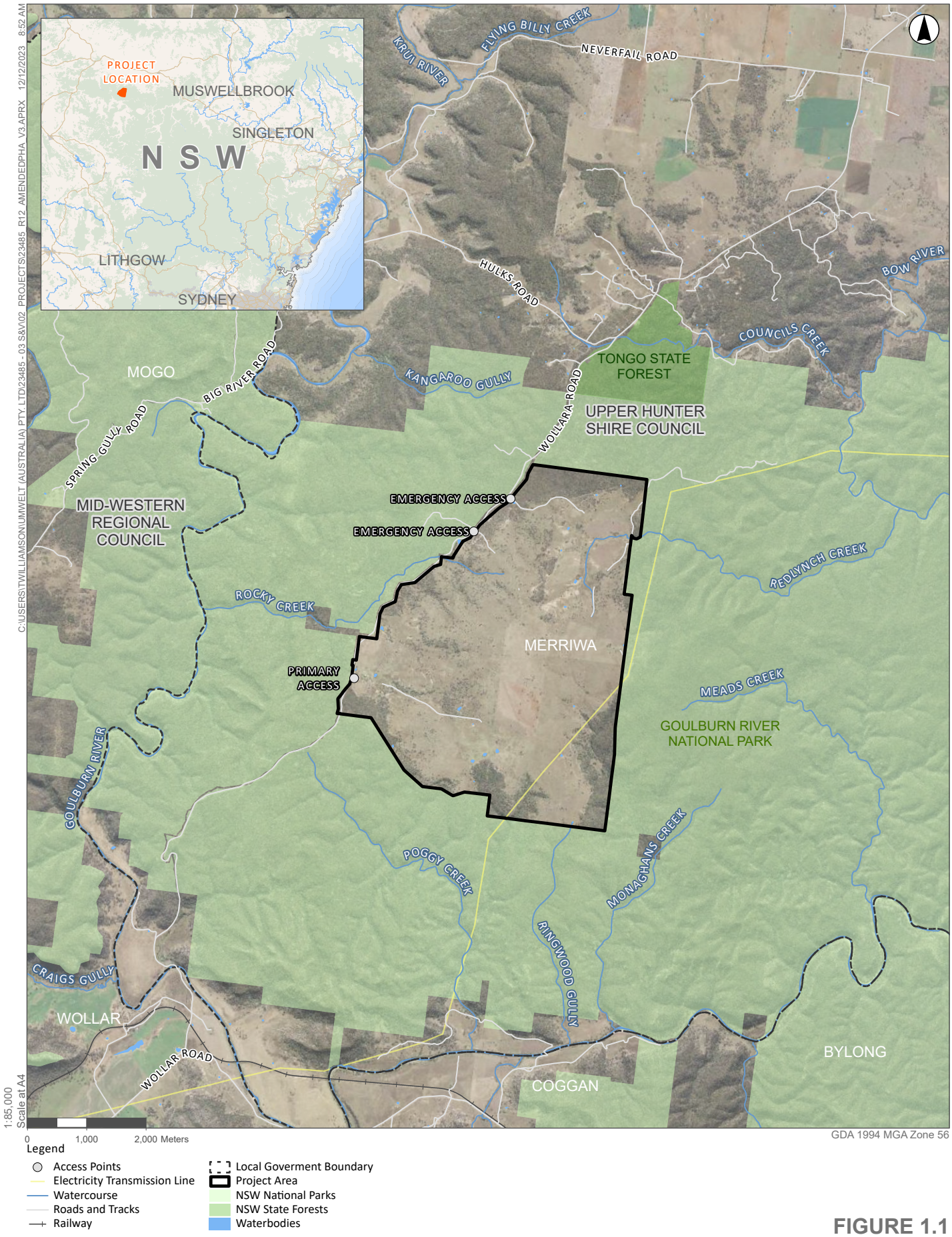


FIGURE 1.1

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

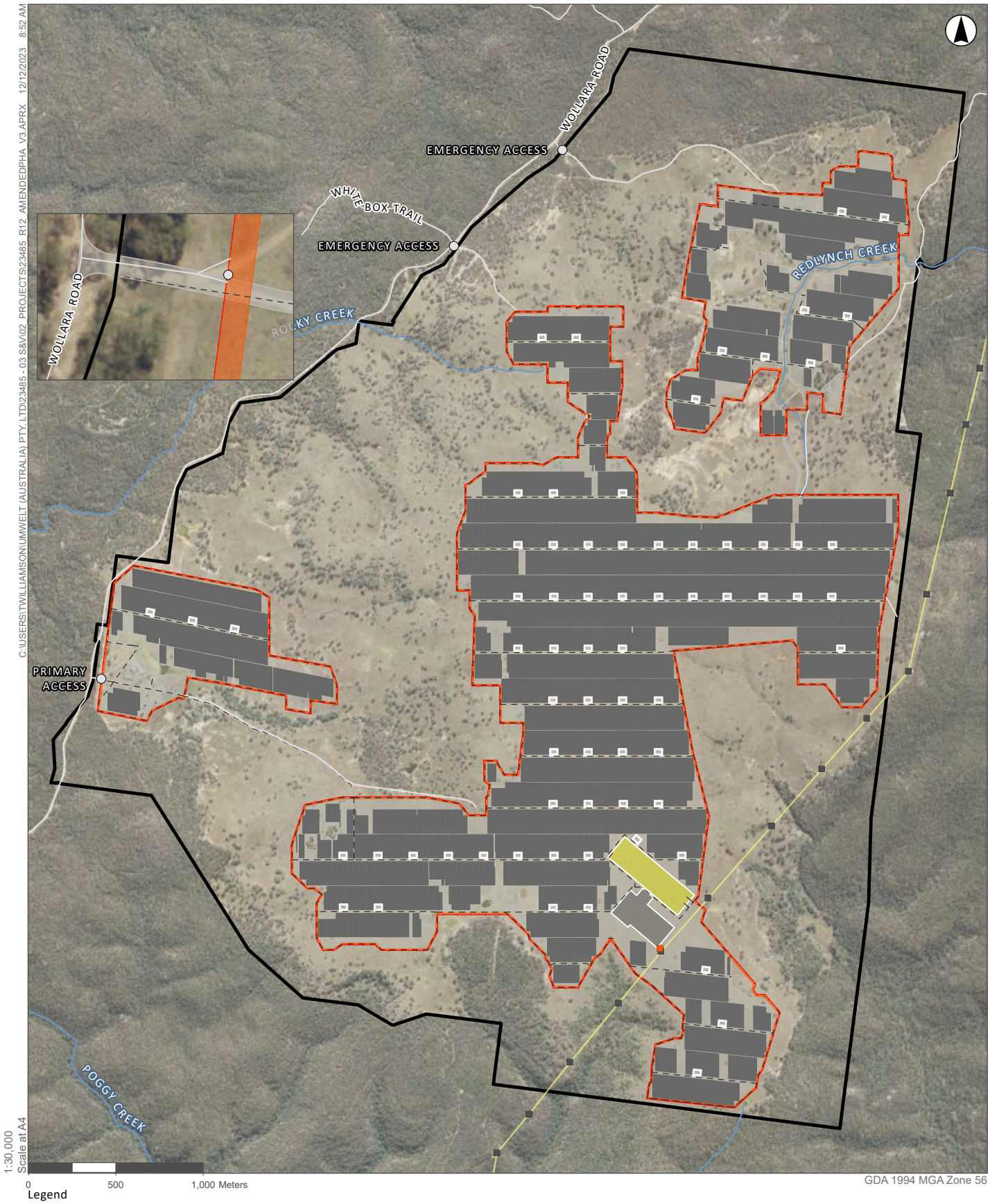


FIGURE 2.1

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.

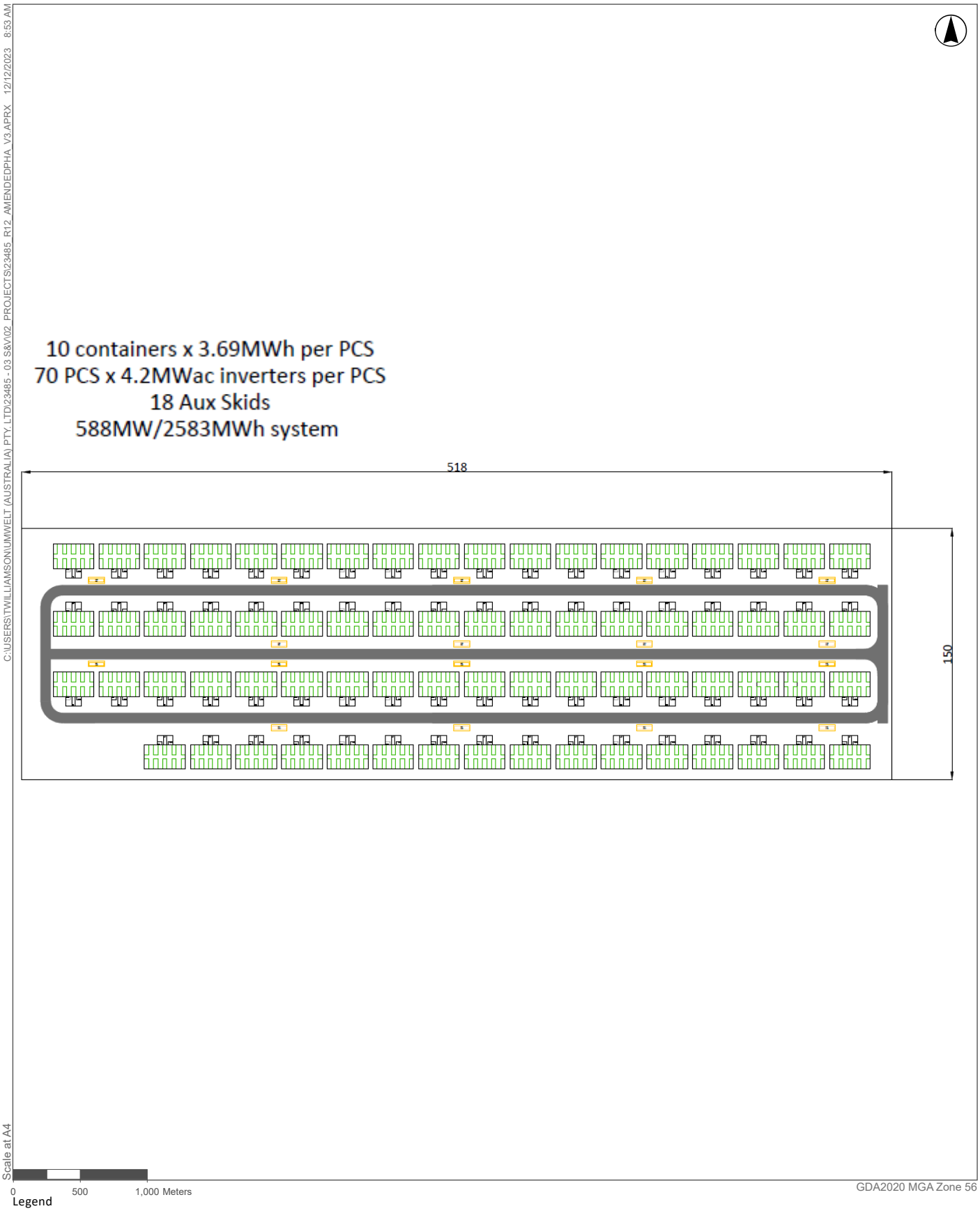
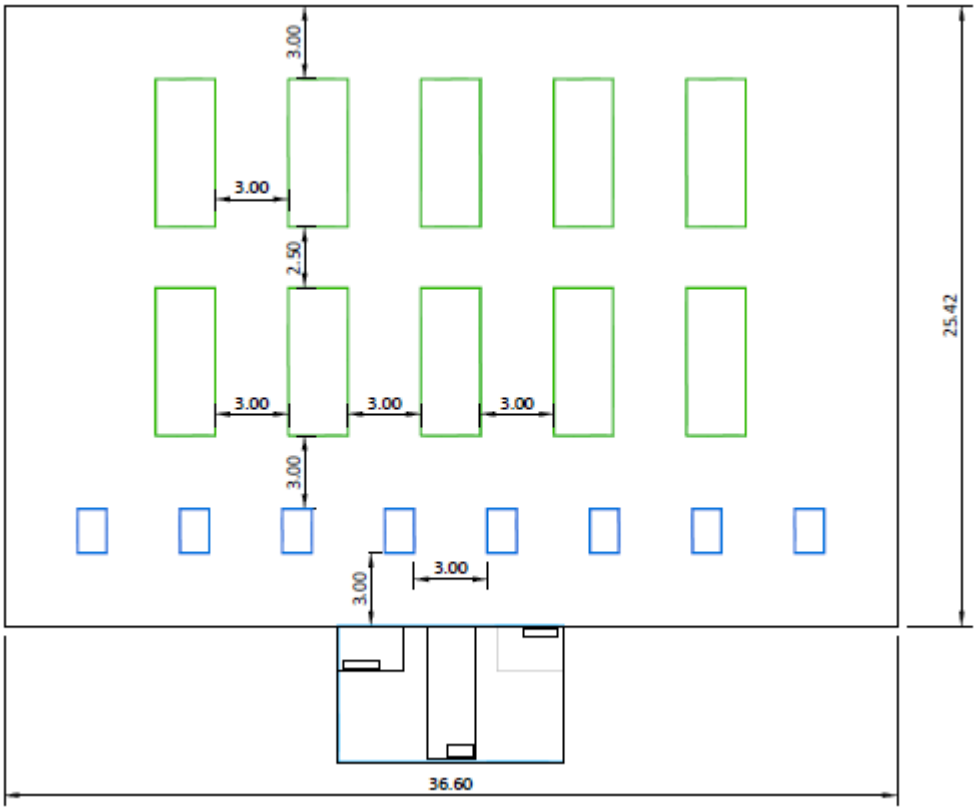


FIGURE 3.1

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)

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



1:56,424
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 3.2

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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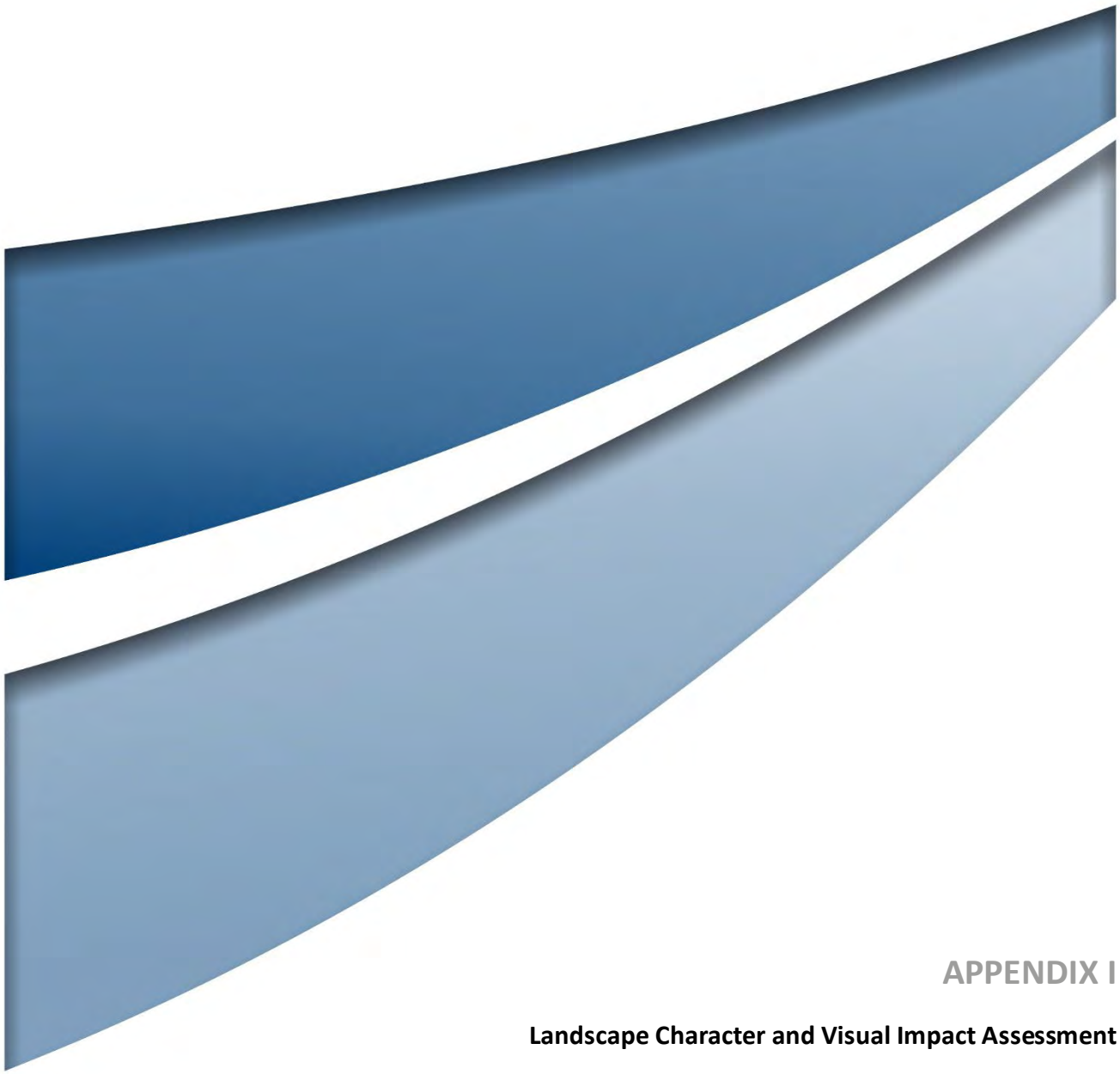
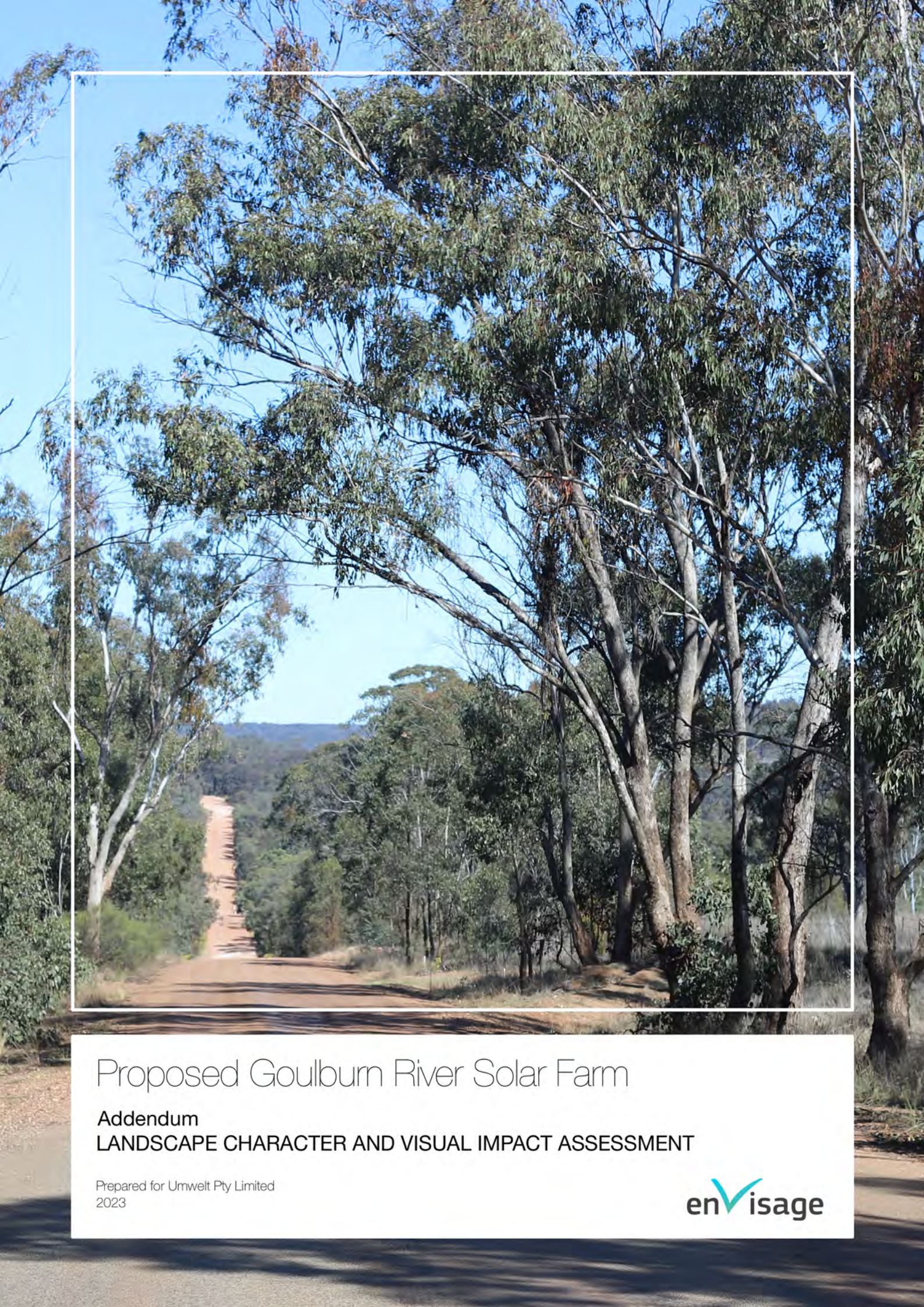


APPENDIX I

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

PREPARED BY: Alison Dodds, *PGCert Public Policy, BPlan, BLArch, Registered Planner (PIA), and* Stacey Brodbeck, *MEnvPlan, BLArch, Registered Landscape Architect (AILA) and Registered Planner (PIA)*

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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

Contents

Figures

Tables

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.

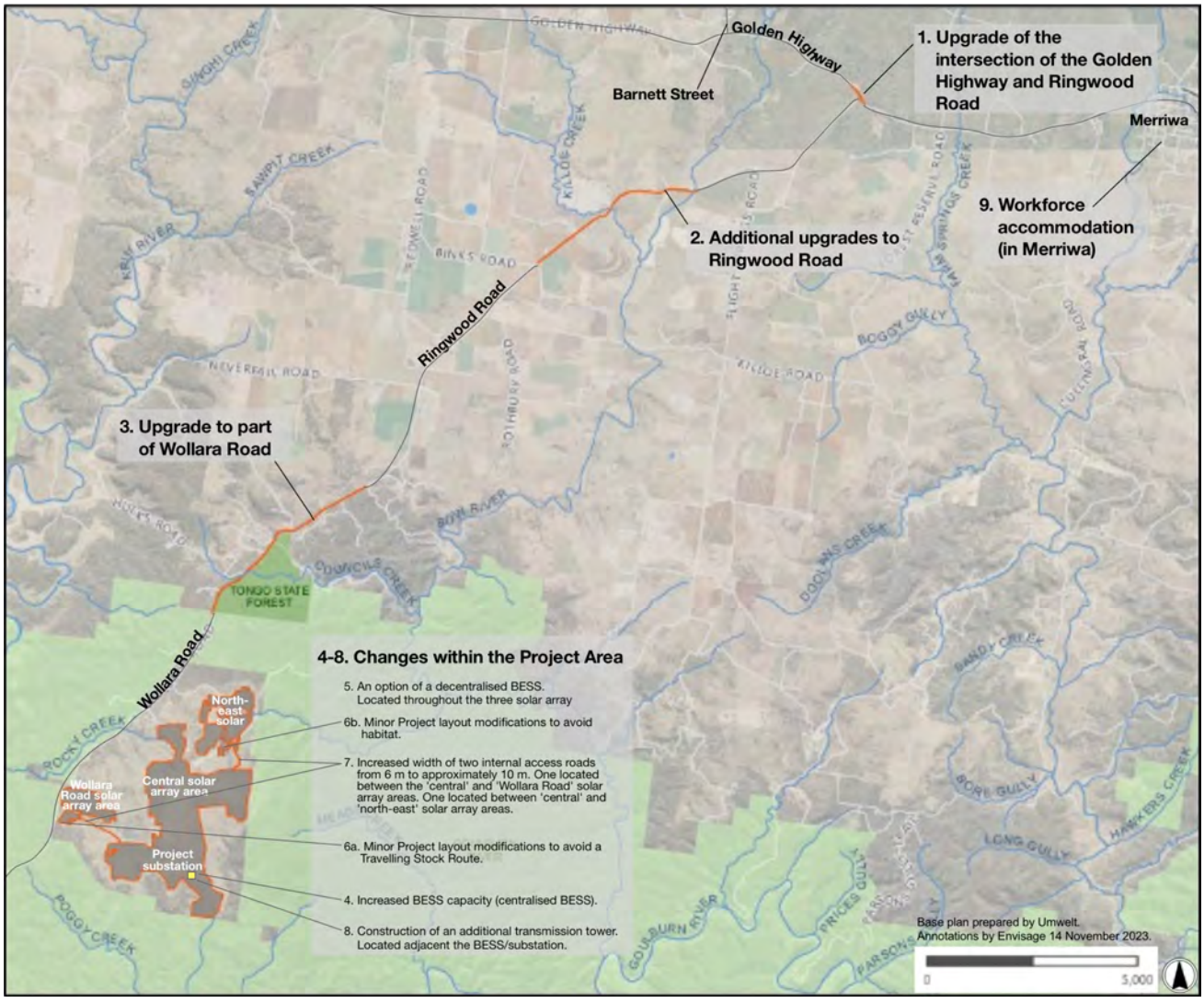

Figure 2-1: Location of Proposed Amendments

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

DCS Spatial Services

Figure 2-3

Proposed disturbance footprint, Ringwood Road

GOULBURN RIVER SOLAR FARM

ADDENDUM LANDSCAPE CHARACTER AND VISUAL IMPACT ASSESSMENT