# Regional Joint Development Assessment Panel Agenda

**Meeting Date and Time:** Tuesday, 19 September 2023; 9.30am
**Meeting Number:** RJDAP/115
**Meeting Venue:** Electronic Means

**To connect to the meeting via your computer - https://us06web.zoom.us/j/85135429858**

**To connect to the meeting via teleconference dial the following phone number - +61 8 7150 1149 Australia**
**Insert Meeting ID followed by the hash (#) key when prompted - 851 3542 9858**

*This DAP meeting will be conducted by electronic means (Zoom) open to the public rather than requiring attendance in person.*

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## Attendance

### DAP Members

Tony Arias (Presiding Member)
Lindsay Baxter (A/Deputy Presiding Member)
Shelley Shephard (A/Third Specialist Member)
Cr Peter Scharf (Local Government Member, Shire of Dandaragan)

### Officers in attendance

Rory Mackay (Shire of Dandaragan)
Louis Fouche (Shire of Dandaragan)

### Minute Secretary

Tenielle Brownfield (DAP Secretariat)

### Applicants and Submitters

Ryan Green (PWR Hybrid (Cataby) Pty Ltd)

### Members of the Public / Media

Nil.

### 1. Opening of Meeting, Welcome and Acknowledgement

The Presiding Member declares the meeting open and acknowledges the traditional owners and pay respects to Elders past and present of the land on which the meeting is being held.

This meeting is being conducted by electronic means (Zoom) open to the public. Members are reminded to announce their name and title prior to speaking.

### 2. Apologies

Justin Page (Third Specialist Member)
Cr Ann Eyre (Local Government Member, Shire of Dandaragan)

### 3. Members on Leave of Absence

DAP Member, Kanella Hope (Deputy Presiding Member) has been granted leave of absence by the Director General for the period of 11th September 2023 to 6th October 2023 inclusive.

### 4. Noting of Minutes

Signed minutes of previous meetings are available on the DAP website.

### 5. Declarations of Due Consideration

Any member who is not familiar with the substance of any report or other information provided for consideration at the DAP meeting must declare that fact before the meeting considers the matter.

## 6. Disclosure of Interests

| Member | Item | Nature of Interest |
|---|---|---|
| Justin Page | 8.1 | Indirect Pecuniary Interest – Mr Page's employer (Element) is currently liaising with and offering consultancy services to the landowner on another project. |

## 7. Deputations and Presentations

The Shire of Dandaragan may be provided with the opportunity to respond to questions of the panel, as invited by the Presiding Member.

## 8. Form 1 – Responsible Authority Reports – DAP Applications

### 8.1 Lot 101 (No.11019) Brand Highway, Cataby

| | |
|---|---|
| Development Description: | Proposed Solar Photovoltaic Facility |
| Applicant: | PWR Hybrid (Cataby) Pty Ltd |
| Owner: | Iluka Resources Limited |
| Responsible Authority: | Shire of Dandaragan |
| DAP File No: | DAP/23/02515 |

## 9. Form 2 – Responsible Authority Reports – DAP Amendment or Cancellation of Approval

Nil.

## 10. State Administrative Tribunal Applications and Supreme Court Appeals

| Current SAT Applications | | | | |
|---|---|---|---|---|
| **File No. & SAT DR No.** | **LG Name** | **Property Location** | **Application Description** | **Date Lodged** |
| DP/14/00039 DR 65/2020 | Shire of York | Lots 4869 (2256), 5931, 9926 (2948) and 26934 Great Southern Highway, St Ronans | Construction and Use of Allawuna Farm for the purposes of a Class II Landfill | 28 July 2020 |
| DAP/21/02063 DR241/2021 | Shire of Dardanup | Lot 2 Banksia Road, Crooked Brook | Cleanaway Dardanup Landfill Facility | 5 November 2021 |
| DAP/22/02256 PA80/2022 | Shire of Capel | 79 (Lot 100) Bussell Highway, Gelorup | Proposed Service Station and Motor Vehicle Wash | 30 May 2023 |
| DAP/23/02479 DR 146/2023 | Shire of Capel | Lot 148 (No.168) Skippings Road, Boyanup | Extractive Industry Development Proposal | 30 August 2023 |

## 11. General Business

In accordance with Section 7.3 of the DAP Standing Orders 2020 only the Presiding Member may publicly comment on the operations or determinations of a DAP and other DAP members should not be approached to make comment.

## 12. Meeting Closure

# LOT 101 (NO.11019) BRAND HIGHWAY, CATABY
# PROPOSED SOLAR PHOTOVOLTAIC FACILITY

**Form 1 – Responsible Authority Report**
(Regulation 12)

| | | |
|---|---|---|
| **DAP Name:** | Regional Joint Development Assessment Panel | |
| **Local Government Area:** | Shire of Dandaragan | |
| **Applicant:** | PWR Hybrid (Cataby) Pty Ltd | |
| **Owner:** | Iluka Resources Ltd | |
| **Value of Development:** | $19 million<br>☒ Mandatory (Regulation 5)<br>☐ Opt In (Regulation 6) | |
| **Responsible Authority:** | Shire of Dandaragan | |
| **Authorising Officer:** | Rory Mackay, Principal Planning & Building Officer | |
| **LG Reference:** | DA 61/23 | |
| **DAP File No:** | DAP/23/02515 | |
| **Application Received Date:** | 5 July 2023 | |
| **Report Due Date:** | 13 September 2023 | |
| **Application Statutory Process Timeframe:** | 90 Days | |
| **Attachment(s):** | 1. Development proposal report<br>2. Proposed development plans<br>3. Schedule of Referral Responses<br>4. Council Minutes (extract only) | |
| **Is the Responsible Authority Recommendation the same as the Officer Recommendation?** | ☒ Yes<br>☐ N/A | Complete Responsible Authority Recommendation section |
| | ☐ No | Complete Responsible Authority and Officer Recommendation sections |

**Responsible Authority Recommendation**

That the Regional Joint Development Assessment Panel resolves to:

1. **Determine** that the "solar photovoltaic facility" land use applied for in DAP application reference DAP/23/02515 is consistent with the objectives of the Rural zone and is therefore permitted in accordance with clause 3.4.2(a) of the *Shire of Dandaragan Local Planning Scheme no.7*; and

2. **Approve** DAP Application reference DAP/23/02515 and accompanying plans for a solar photovoltaic facility on Lot 101 Brand Highway, Cataby in accordance with Clause 68 of Schedule 2 (Deemed Provisions) of the *Planning and Development (Local Planning Schemes) Regulations 2015*, subject to the following conditions and advice notes:

**Conditions**

1. This decision constitutes development approval only and is valid for a period of four years from the date of approval. If the subject development is not substantially commenced within the specified period, the approval shall lapse and be of no further effect.

2. All development shall be in accordance with the approved development plans and accompanying documentation submitted by PWR Hybrid dated June 2023, which forms part of this development approval, to the specifications and satisfaction of the Shire of Dandaragan, subject to any modifications required as a consequence of any condition(s) of this approval.

3. Prior to commencement of construction, the crossover to the subject site and any associated road works shall be located and constructed, in consultation with and to the satisfaction of Main Roads Western Australia and include all necessary drainage and signage. Costs applicable to the construction of the crossover onto the site and any related issues shall be borne by the proponent.

4. Prior to commencement of construction, the proponent must submit and have approved by the Shire of Dandaragan, and thereafter implement to the satisfaction of the Shire of Dandaragan, a Construction Management Plan addressing the following matters:
   a) How materials and equipment will be delivered and removed from the site;
   b) How materials and equipment will be stored on the site;
   c) Traffic management arrangements for contractors;
   d) Construction waste disposal strategy and location of waste disposal bins;
   e) How risks of wind and/or water borne erosion and sedimentation will be minimised during and after the works; and
   f) Other relevant matters likely to impact on the surrounding properties.

5. Prior to commencement of the approved use, the proponent must submit and have approved by the Shire of Dandaragan, and thereafter implement to the satisfaction of the Shire of Dandaragan, an Operational Management Plan addressing the operating strategy and emergency management on the site.

6. Prior to commencement of the approved use, the proponent must submit and have approved by the Shire of Dandaragan, and thereafter implement to the satisfaction of the Shire of Dandaragan, a post construction Landscape Management Plan addressing the potential impacts of wind and stormwater soil erosion.

7. Prior to commencement of decommissioning the approved use, the proponent must submit and have approved by the Shire of Dandaragan, and thereafter implement to the satisfaction of the Shire of Dandaragan, a Decommissioning and Rehabilitation Management Plan addressing the rehabilitation of the development site post decommission of the approved use.

**Advice Notes**

1. Should the Applicant be aggrieved by the decision (in part or whole) there is a right pursuant to the *Planning and Development Act 2005* to have the decision reviewed by the State Administrative Tribunal. Such an application must be lodged within twenty-eight (28) days from the date of the decision.

2. This approval is not an authority to ignore any constraint to development on the land which may exist through contract or on title, such as an easement, memorial or restrictive covenant. It is the responsibility of the applicant and landowner and not the Shire of Dandaragan to investigate any such constraints before commencing development. This approval will not necessarily have regard to any such constraint to development, regardless of whether or not it has been drawn to the Shire of Dandaragan's attention.

3. This is a development approval of the Shire of Dandaragan under its *Local Planning Scheme No.7.* It is not a building permit or an approval to commence or carry out development under any other law. It is the responsibility of the applicant/landowner to obtain any other necessary approvals, consents, permits and licenses required under any other law, and to commence and carry out development in accordance with all relevant laws.

4. Failure to comply with any of the conditions of this development approval constitutes an offence under the provisions of the *Planning and Development Act 2005* and the *Shire of Dandaragan Local Planning Scheme No.7* and may result in legal action being initiated by the Shire of Dandaragan.

5. In relation to Condition 3, Main Roads Western Australia advise that the upgrade to the existing Brand Highway shall facilitate the turning movement of a 26m B-Double and be sealed from the edge of the Brand Highway Road surface for 50m into the subject site.

6. In relation to Condition 3, Main Roads Western Australia advises that prior to submitting an *Application to undertake works within the road reserve*, the applicant shall complete a plan to Main Roads' satisfaction detailing the existing crossover upgrade in accordance with *Main Roads Driveway Policy.* No works are permitted within the Brand Highway Road Reservation, unless Main Roads has accepted the *Application to undertake works within the road reserve*. Application forms and supporting information about the procedure can be found on the Main Roads website > Technical & Commercial > Working on Roads.

7. In relation Condition 3, Main Roads Western Australia advises that according to *Main Roads Driveway Policy* maintenance of the crossover remains the responsibility of the landowner. Should it become apparent that damage is being done to the Brand Highway as a result of the vehicle turning movements or a change in the usage of the crossover, Main Roads reserves the right to ask the landowner to maintain or improve the crossover as necessary.

**Details: outline of development application**

| | |
|---|---|
| Region Scheme | N/A |
| Region Scheme - Zone/Reserve | N/A |
| Local Planning Scheme | Shire of Dandaragan Local Planning Scheme No.7 |
| Local Planning Scheme - Zone/Reserve | Rural |
| Structure Plan/Precinct Plan | N/A |

| | |
|---|---|
| Structure Plan/Precinct Plan - Land Use Designation | N/A |
| Use Class and permissibility: | Use not listed |
| Lot Size: | 810Ha |
| Existing Land Use: | Agriculture – extensive<br>Minerals mining |
| State Heritage Register | No |
| Local Heritage | ☒ N/A<br>☐ Heritage List<br>☐ Heritage Area |
| Design Review | ☒ N/A<br>☐ Local Design Review Panel<br>☐ State Design Review Panel<br>☐ Other |
| Bushfire Prone Area | No |
| Swan River Trust Area | No |

**Proposal:**

The applicant, PWR Hybrid seeks development approval for the construction of a 9.5MW solar photovoltaic (PV) facility on a 29ha portion of Lot 101 Brand Highway, Cataby. The development will consist of the following components:

- 16,704 PV modules across 192 east/west tracker rows
- 2 Inverters and transformers
- Substation compound (metering building)
- Meteorological station
- Control room
- Underground cabling with a transmission system connecting into the Cataby substation for Iluka's mining site
- Gravel access road with site entry from internal property accessway (Marianna's Road)
- 2 hardstand areas for parking and laydown/maintenance works
- Fencing and access gates

The produced electricity will be used to power Iluka Resources' neighbouring mine site operations for the life of the mine. At the end of the mine site's life, the produced electricity will be transmitted to the public electricity supply market for the remainder of the development's expected 25-year lifespan. At cessation of the development, the development site will be returned to its current agriculture extensive land use.

| | |
|---|---|
| Proposed Land Use | Use not listed (solar photovoltaic facility) |
| Proposed Net Lettable Area | N/A |
| Proposed No. Storeys | N/A |
| Proposed No. Dwellings | N/A |

**Background:**

The development site borders Iluka Resources' Cataby mining operation which commenced operation in 2019 and has a mine life of up to 14 years. Prior to this, the

subject property and the balance of the locality was/is used for broadacre farming (agriculture extensive).

The subject property is situated within Iluka Resources' mining tenement; however, the proposed development site is not within the mining envelope approved by the Department of Mining Industry Regulation and Safety (DMIRS) or the Environmental Protection Authority (EPA). As such, the proposed development will be independent from Iluka Resources' mine site and will be operated by PWR Hybrid under the lease agreement from the landowner (Iluka Resources).

The development site has been leased for the grazing of cattle and sheep since the commencement of mining operations adjacent and is largely covered with tagasaste (tree lucerne), grasses and some eucalyptus trees.

**Legislation and Policy:**

Legislation

*Planning and Development Act 2005*
*Section 162. No development except with approval*
*(1) Subject to this Act, where a planning scheme or interim development order provides that development referred to in the planning scheme or interim development order is not to be commenced or carried out without approval being obtained upon the making of a development application, a person must not commence or carry out that development on land to which the planning scheme or interim development order applies unless —*
*(a) the approval has been obtained and is in force under the planning scheme or interim development order; and*
*(b) the development is carried out in accordance with the conditions subject to which the approval was granted.*

*Aboriginal Heritage Act 1972* (~~*Aboriginal Cultural Heritage Act 2021)*~~
*Section 5. Application to places*
*This Act applies to —*
*(a) any place of importance and significance where persons of Aboriginal descent have, or appear to have, left any object, natural or artificial, used for, or made or adapted for use for, any purpose connected with the traditional cultural life of the Aboriginal people, past or present;*
*(b) any sacred, ritual or ceremonial site, which is of importance and special significance to persons of Aboriginal descent;*
*(c) any place which, in the opinion of the Committee, is or was associated with the Aboriginal people and which is of historical, anthropological, archaeological or ethnographical interest and should be preserved because of its importance and significance to the cultural heritage of the State;*
*(d) any place where objects to which this Act applies are traditionally stored, or to which, under the provisions of this Act, such objects have been taken or removed.*

*Planning and Development (Local Planning Scheme) Regulations 2015*
*Schedule 2 – Deemed Provisions*
*Clause 64 – advertising applications*
*Clause 66 – consultation with authorities*
*Clause 67 – consideration of application by local government (relevant provisions):*

*(a) the aims and provisions of this Scheme and any other local planning scheme operating within the Scheme area;*
*(c) any approved State planning policy;*
*(d) any environmental protection policy approved under the Environmental Protection Act 1986 section 31(d);*
*(e) any policy of the Commission;*
*(f) any policy of the State;*
*(fa) any local planning strategy for this Scheme endorsed by the Commission;*
*(m) the compatibility of the development with its setting, including —*
*(i) the compatibility of the development with the desired future character of its setting; and*
*(ii) the relationship of the development to development on adjoining land or on other land in the locality including, but not limited to, the likely effect of the height, bulk, scale, orientation and appearance of the development;*
*(n) the amenity of the locality including the following —*
*(i) environmental impacts of the development;*
*(ii) the character of the locality;*
*(iii) social impacts of the development;*
*(o) the likely effect of the development on the natural environment or water resources and any means that are proposed to protect or to mitigate impacts on the natural environment or the water resource;*
*(q) the suitability of the land for the development taking into account the possible risk of flooding, tidal inundation, subsidence, landslip, bush fire, soil erosion, land degradation or any other risk;*
*(r) the suitability of the land for the development taking into account the possible risk to human health or safety;*
*(s) the adequacy of —*
*(i) the proposed means of access to and egress from the site; and*
*(ii) arrangements for the loading, unloading, manoeuvring and parking of vehicles;*
*(t) the amount of traffic likely to be generated by the development, particularly in relation to the capacity of the road system in the locality and the probable effect on traffic flow and safety;*
*(u) the availability and adequacy for the development of the following —*
*(iii) storage, management and collection of waste;*
*(w) the history of the site where the development is to be located;*
*(za) the comments or submissions received from any authority consulted under clause 66;*
*(zb) any other planning consideration the local government considers appropriate.*

*Shire of Dandaragan Local Planning Scheme No.7* (Scheme)
*Part 3 — Zones and the use of land:*
*3.2 Rural Zone*
*To provide for a range of rural activities such as broadacre and diversified farming so as to retain the rural character and amenity of the locality, in such a way as to prevent land degradation and further loss of biodiversity.*
*3.4.2. If a person proposes to carry out on land any use that is not specifically mentioned in the Zoning Table and cannot reasonably be determined as falling within the type, class or genus of activity of any other use category the local government may:*

a) *determine that the use is consistent with the objectives of the particular zone and is therefore permitted;*
b) *determine that the use may be consistent with the objectives of the particular zone and thereafter follow the advertising procedures of clause 64 of the deemed provisions in considering an application for development approval; or*

*c) determine that the use is not consistent with the objectives of the particular zone and is therefore not permitted.*

Strategies

*State Planning Strategy 2050*
*Strategic Direction*
- *Energy – enabling secure, reliable, competitive and clean energy that meets the State's growing demand.*
- *Land availability – ensuring the sustainable supply, use and development of land with a strong presumption in favour of the sustainability of prime agriculture land.*

*Wheatbelt Regional Planning and Infrastructure Framework Parts 1 and 2*
*4.12 Planning approach for Vibrant Economy*
*2) Promote rural-zoned land as highly flexible areas that can accommodate a wide variety of enterprises;*
*4) Support development of the energy sector to meet regional and State energy needs;*

*Shire of Dandaragan Local Planning Strategy 2020* (Strategy)
- *Strategic Directions – Rural*
  *Support non-rural uses that are compatible with, and complement, the primary use of the land.*
- *Strategic Directions – Economy*
  *Work with industry to investigate and identify opportunities for renewable energy projects based on the Shire's competitive advantages (i.e.: coastal winds and flat terrain).*
- *Actions – Economy*
  *Promote opportunities for renewable energy across the Shire, based on the Shire's favourable climactic and environmental attributes and investigate how agricultural projects may benefit.*
- *Strategic Directions – Utility Infrastructure*
  *Encourage alternative energy generation to support the growth of energy intensive agricultural activities where compatible with other rural uses and character.*
- *Actions – Utility Infrastructure*
  *When assessing proposals for wind farms and other alternative energy infrastructure, the Shire will consider visual landscape issues and other relevant matters set out in the Western Australian Planning Commission's Position Statement on Renewable Energy Facilities.*
- *Strategic Directions – Environment and Natural Resources*
  *Maintain the quantity and quality of surface water and groundwater resources as key assets for biodiversity, economic activities and drinking water.*
- *Actions – Native Title and Historic/Cultural Heritage Acknowledge and work with the Yued Noongar people as designated Native Title holders to understand their requirements in regard to land use planning.*

State Government Policies

*State Planning Policy 2.0 Environment and Natural Resources Policy*
*5.10 Greenhouse Gas Emissions and Energy Efficiency*
*There is widespread awareness of the need to increase the efficiency with which energy is used in Western Australia, including the need to reduce our reliance on energy produced from non-renewable resources such as fossil fuels. The primary objective is to reduce greenhouse gas emissions by means including (but not limited*

*to) increasing energy efficiency, decreasing reliance on non-renewable fuels, and increasing usage of renewable energy sources.*

*State Planning Policy 2.5 Rural Planning & Guidelines* (SPP2.5)
*5.5 Regional variation, economic opportunities and regional development*
*WAPC policy is to continue to promote rural zones in schemes as flexible zones that cater for a wide range of land uses that may support primary production, regional facilities, environmental protection and cultural pursuits.*

*WAPC Position Statement Renewable Energy Facilities*
*The local planning framework, principally administered by local government, can effectively manage the development assessment of renewable energy facilities.*
*Renewable energy can enhance local economies and easily connect into the network grid. The contribution that renewable energy facilities make to the reduction in carbon emissions is an important consideration for the growth of the industry, as well as the socio-economic benefits to the State.*

*WAPC Visual Landscape Planning in Western Australia – A manual for Evaluation, Assessment, Siting and Design*
*The careful assessment and determination of planning and subdivision applications is important in ensuring state, regional and local objectives for the landscape are met and plans and policies put into place.*

*WAPC Draft Operational Policy 1.12 Planning Proposals adjoining Regional Roads in Western Australia*
*On Regional Roads not constructed or planned to freeway standards, there is a general presumption on traffic and safety grounds against the creation of new driveways or increased use of existing accesses to these roads, particularly where alternative access is available from a side or rear street, right of way or laneway.*
*Land uses with high peak hour traffic volumes such as a service station may have vehicle access to a Regional Road, however access via an adjoining/ nearby lower order road should be preferred where practicable. In regional areas, access may be appropriate for land uses and activities such as industry, abattoirs, stock saleyards and rural properties.*
*In determining planning proposals with direct access to Regional Roads, the following should be considered in consultation with transport planners/ engineers:*

- *the effects of the development on traffic flow and safety of all road users.*
- *the character and function of the road (existing and proposed).*
- *the volume and speed of traffic.*
- *the width of the carriageway and visibility.*
- *the volume and type of traffic generated by the development.*
- *the setting and context of the locality.*
- *emergency access requirements, including bushfire access.*

*Where access is permitted, conditions may be imposed prescribing the location and width of the junction or driveway to ensure adequate visibility and to provide for the safe and convenient movement of vehicles both entering and leaving the Regional Road. This may include full-movements or include restrictions on certain movements, depending on traffic conditions.*

Local Policies

Nil

**Consultation:**

Public Consultation

The development application was advertised from 22 June 2023 to 11 August 2023 to surrounding landowners via letter and the general public by the Shire's newsletter in all local papers, the Shire's website and the Shire's Facebook page. No public submissions were received.

Referrals/consultation with Government/Service Agencies

The development application was referred to the following agencies for a period of 42 days in accordance with clause 66 of the Deemed Provisions:

- Department of Biodiversity, Conservation and Attractions (DBCA);
- Main Roads Western Australia (Main Roads);
- Department of Primary Industries and Regional Development (DPIRD); and
- Department of Planning, Lands and Heritage (DPLH).

The comments received from the above listed agencies, and the officer's response to each are detailed in the attached Schedule of Referral Responses. It is noted no objections were received from these agencies.

**Planning Assessment:**

Key considerations for determination of the development proposal against the applicable planning framework listed previously are outlined below.

Development site and visual amenity

The proposed development site is on cleared broadacre farming land and requires no clearing of identified significant species of flora or vegetation. The development will not be visually intrusive to views from Brand Highway due to the road reserve buffer vegetation and public power line between the development site and the highway.

Traffic and accessways

The site will be accessed from Brand Highway via "Marianna's Road" which is a non-gazetted gravel accessway with a Brand Highway crossover. This accessway currently provides adjoining farmers and enterprises alternative Brand Highway access while a portion of Caro Road is temporarily closed to enable Iluka Resources' mining activities. There are currently 36-46 vehicle movements on this accessway daily.

The Shire of Dandaragan resolved to temporarily close a portion of Caro Road for a period of 10 years or at the cessation of mining activities (whichever occurs sooner) at the request of Iluka Resources on 26 April 2018 under Section 3.50 of the *Local Government Act 1995.* This temporary closure was approved subject to the requirement that Iluka Resources provides alternative access to neighbouring land managers who utilised the portion of Caro Road temporarily closed for mining.

The sight distances at the intersection of Brand Highway and ungazetted Marianna's Road is estimated to be: 305m southbound and 390m northbound.

No significant increase in traffic movements is expected over the life of the development, except for construction traffic, which is estimated to be 10-20 vehicle movements per day for a period of around 10 months. Construction hours are

expected to be 6am – 6pm. The peak traffic peak period is expected to be in the morning and early evening when sub-contractors move from accommodation to site and vice versa. These vehicles will be predominantly light vehicles. To minimise traffic, carpooling will be actively encouraged, and vehicle movements will be staggered where possible during peak periods. Nonetheless, these vehicle movements are not expected to cause any congestion or potential conflicts with other traffic. The largest vehicle to access the development during construction will be a B-double road train which will be intermittently for the delivery of solar PV facility components and not during any peak periods. The road trains will travel from the south to the site. It is recommended that construction traffic management forms part of a construction management plan as discussed below.

Consultation with Main Roads resulted in concern with the safety of the accessway ("Marianna's Road") due to the number of traffic and the way it is currently being used. In response to this, the proponent has agreed to restrict access to the accessway, to authorised vehicles only by installation of a secure gate with signposting stating 'Private Road – authorised vehicles only'. Other local traffic will be required to use another route accessed off Mimegarra Road further south.

A recommended condition (3) of development approval will ensure that the crossover is appropriately constructed to Main Roads' standards prior to construction of the solar PV facility, with all works and associated costs to be borne by the proponent.

During operation the solar PV facility will have no personnel on site. It will be managed and monitored remotely from PWR Hybrid's Perth headquarters. Irregular site visits may be conducted (possibly monthly) for a duration of a few hours or as and if required by PWR Hybrid technicians in light vehicles.

Construction management plan

The applicant has provided the following overview of construction activities:

- New access road (compacted gravel single lane)
- Earthworks and preparation of the site including array area and laydown areas
- Erection of reinforced foundations
- Delivery of solar panels to laydown area
- Assembly of the solar array using cranes
- Installation of underground electrical services between the solar arrays and substation to Iluka Cataby mine site
- Outbuildings for construction and maintenance as and if required (temporary)

A recommended condition (4) of development approval requires a construction management plan prior to the commencement of site works to coordinate the above build stages, traffic to and from the site, and to minimise any site and locality disturbances (noise, dust, waste).

Operational management plan

A condition (5) requiring an operational management plan is recommended, which includes the emergency protocols amongst general operating procedures for the solar PV facility.

Soil erosion

The property borders the Bassendean Sand Special Control Area (BSSCA) of the Scheme:

*The Bassendean Sands is an important environmental unit in the central coast area, noted as a significant area comprising deep porous sands hydrologically connected to a number of wetlands. It is particularly vulnerable to pollution, eutrophication and salination due to its low nutrient-holding ability and the potential for winter waterlogging. It contains areas of native vegetation and wetlands that provide habitat for threatened species and communities, notably Banksia woodlands and black cockatoos*.

Although the development site is not required to comply with the BSSCA provisions of the Scheme the management of stormwater is a relevant consideration given the site also borders the Minyulo Brook. To avoid impacts on this waterway and associated wetlands and groundwater, stormwater from the development site will be managed by gravel windrows bordering the site as well as vegetation cover.

DPIRD has advised that the typical soil conditions of the development site are also at high risk of wind erosion due to their acidic nature and subsoil compaction. To manage the impacts of wind erosion, DPIRD has recommended that the development site be planted with an appropriate perennial species post construction. In response to this recommendation, a recommended condition (6) of development approval requires the proponent to submit to the Shire for approval and thereafter implement, a post construction landscape management plan for the development site to prevent soil erosion by wind and stormwater.

Aboriginal cultural heritage

The applicant has concluded that no impacts to Aboriginal cultural heritage are expected by the development. Although, Minyulo Brook which borders the development site is a Registered Site (28326) declared under the *Aboriginal Heritage Act 1972*, the proponent has consulted with the Yued Traditional Owners, and with their support, provisioned a 100m buffer from the brook to the development site to protect the registered site, particularly from stormwater flows. A scar tree located to the south of the development site (Register item 20227 Iluka Cataby 04 under assessment) will not be impacted by the development.

Use not listed compatibility with the Rural zone

SPP2.5 outlines rural zones are highly flexible and can cater for a wide range of land uses and notes that a local planning strategy and/or scheme should demonstrate or express what land uses are considered appropriate in a given local government's rural zone.

In this circumstance, the Strategy provides for the diversification of the Rural zone to enable renewable energy developments and to promote sustainable energy resources in the medium to long term where it does not compromise high priority agricultural land. As the proposed solar PV facility will be developed on segregated rural land not identified for prime agriculture use; will provide an additional clean energy fuel source in the Shire (which already has two like developments on rural land); while also allowing limited extensive agriculture on the balance of the property in the medium to long term; the development is consistent with the intent of SPP2.5, the stated Strategy objectives, and is therefore, deemed compatible with the Scheme's objective for the rural zone.

The proposed use is also considered to be compatible with other land uses permissible in the Rural Zone in the land use table of the Scheme.

Decommissioning of the development

In regard to the decommission of the solar PV facility at the end of its useful life, DPIRD has advised that rehabilitation of the development site back to its current extensive agriculture land use may be less optimum than revegetating the site. This is due to the historical low potential for cropping or pastures on the typical soil conditions of the development site. DPIRD has recommended that the development site be assessed to determine its post decommissioning optimum use in future years.

In response to this recommendation, a recommended condition (7) of development approval requires the proponent to submit to the Shire for approval and thereafter implement, a decommissioning and rehabilitation management plan for the development site prior to the commencement of decommissioning the development.

**Conclusion:**

It is in the proponent's best interest that the development is operated safely with little disturbance to the locality and in doing so, that any adverse impacts are significantly reduced. Nonetheless, best practice management is reinforced by the assessing officer by recommended management plans to ensure this occurs for the life of the development.

Based on the above assessment, it is concluded that the proposed development if managed accordingly, will have no significant detrimental impacts on the amenity of the surrounding area and will be consistent with orderly and proper planning under the applicable planning framework. Therefore, the development application is recommended for approval subject to relevant conditions.

Alternatives

Nil




# SOLAR FACILITY

## Cataby, Western Australia

## Development Application Compliance Report

PWR. Hybrid

June 2023

*Document Number CATASP-G-RPT-0001, Revision 0*

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# 1 INTRODUCTION

This document provides an assessment against the anticipated planning requirements for a solar facility development proposal (the "**project**"), comprising approximately a 29 hectare (ha) development envelope with a 9.521 megawatt power photo voltaic solar array.

This report addresses the main planning and environmental legislation, as well as guidance requirements applicable to the type of development, in the Shire of Dandaragan. The document also itemises the planning framework from a Commonwealth, State, Regional and Local level and how the proposed development meets the relevant criteria.

A table providing the section reference in this document to each instrument addressed is provided below:

**Table 1.** List of Instruments

| Level of Government | Instrument | Section |
|---|---|---|
| **Commonwealth** | *Renewable Energy (Electricity) Act 2000* | 4.1.1 |
| | *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) | 4.1.2 |
| **State** | State Planning Strategy 2050 (SPS 2050) | 4.2.1 |
| | Statement of Planning Policy No. 2: Environment and Natural Resources (SPP2) | 4.2.2 |
| | State Planning Policy No. 2.5 – Rural Planning (SPP2.5) | 4.2.3 |
| | State Planning Policy No. 3.7 – Planning in Bushfire Prone Areas (SPP3.7) | 4.2.4 |
| | Western Australian Climate Change Policy | 4.2.5 |
| | Strategic Energy Initiative: Energy 2031 | 4.2.6 |
| | Position Statement: Renewable energy facilities | 4.2.7 |
| | *Environmental Protection Act 1986* | 4.2.8 |
| | *Environmental Protection (Noise) Regulations 1997* | 4.2.9 |
| | *Biodiversity Conservation Act 2016* | 4.2.10 |
| | *Biosecurity and Agriculture Management Act 2007* (BAM Act) | 4.2.11 |
| | *Aboriginal Heritage Act 1972* (AH Act) | 4.2.12 |
| | Visual Landscape Planning in Western Australia | 4.2.13 |
| **Regional** | Wheatbelt Regional Planning and Infrastructure Framework Parts 1 and 2 (WRPIF) | 4.3.1 |
| **Local (Shire of Dandaragan)** | Strategic Community Plan – Envision 2029 | 4.4.1 |
| | Envision 2029 – Economic and Tourism Development Strategy | 4.4.2 |
| | Local Planning Strategy | 4.4.3 |
| | Shire of Dandaragan Local Planning Scheme No. 7 (LPS No.7) | 4.4.4 |
| **Industry Guidelines/ Other Instruments** | SWIS Demand Assessment 2023 to 2042 | 4.5 |

# 2 PROJECT DESCRIPTION

## 2.1 Cataby solar facility project

A 9.521 megawatt power (MWp) solar facility (**the facility**) to supply renewable energy is the subject of this Development Application submitted by PWR Hybrid (Cataby) Pty Ltd (**PWR**). The installation of a solar array of approximately 20 hectares with the 29 ha development envelope will comprise (refer to **Figure 1**):

- 192 tracker rows
- East / West tracker with 60° tilt and 8m pitch
- PV modules model – JKM570N-72HL4-BDV
- PV modules power 570Wp
- Total PV modules 16704
- 2 x SMA inverters SC 4400UP
- Direct Current (DC) Power kWp 9521
- Alternating Current (AC) Power Kilovolt Amps (kVA) 8800
- Ancillary components: control room, transformers, underground cabling, access road, hardstand for works (maintenance of solar array etc), substation compound (metering building), meteorological station, fencing and transmission system connecting into the Cataby Mine Site substation.

The intention of the solar array is to provide the Cataby area with a renewables power resource with the foundation customer being Iluka Resources Limited (Iluka) Cataby Mine site for the Life of Mine (LoM) until approximately 2032 and the public grid long term. This will reduce the load on the public electricity network locally in the Cataby and Dandaragan area.

The proposed life of the project is 25 years. Once Iluka has ceased mining operations at Cataby, the electricity generated shall be offered to the open market at the time. Therefore, the solar array will not become a standard asset, upon mining operations ceasing, but be integrated and operate in the electricity supply market. The land after 25 years will be returned to the existing agricultural landuse under the "Rural" zoning.

### 2.1.1 Energy supply and the existing power grid

WA's South West could require up to 51 gigawatts of new energy generation and storage capacity to meet the needs of industry over the next 20 years, a state government study has concluded. (*https://www.businessnews.com.au/article/SW-electricity-network-to-grow-ten-fold*)

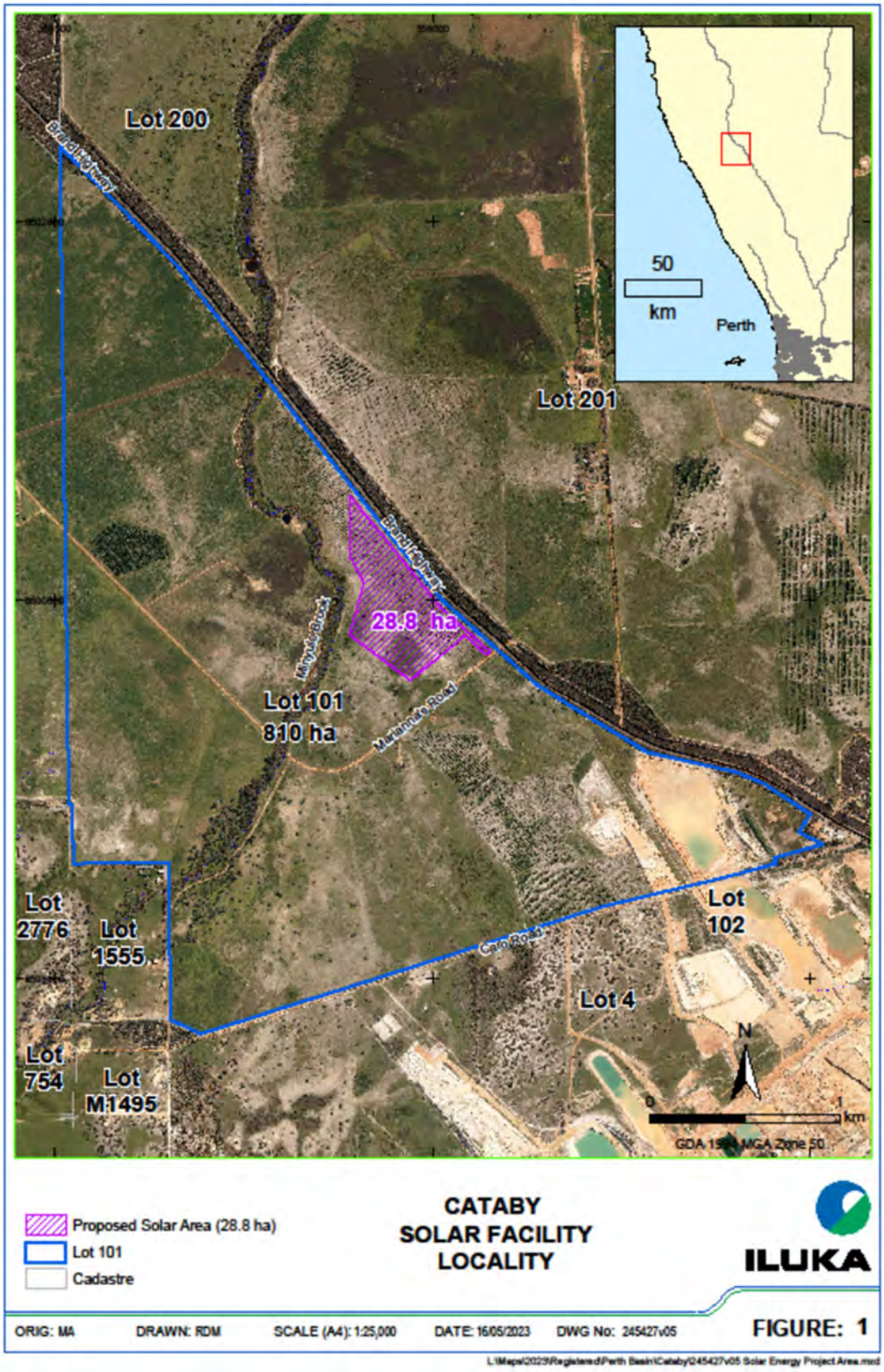



**Figure 1:** Proposed Solar Facility (Locality)

## 2.2 The site

The project site is located approximately 150 kilometres (km) North of Perth, and 35 kms to the South West of the Dandaragan townsite and 5 kms to the North of Cataby. The site is to the West of the Brand Highway off Marianna's Road, Cataby (refer to **Figure 2**). The site is utilised for agricultural purposes and is covered with tagasaste (tree lucerne), grasses and some *Eucalyptus todtiana* trees. The land is zoned "Rural" under the Shire of Dandaragan's Local Planning Scheme No. 7 and has been historically used for pasture/ cropping agricultural activities. The proposal requires approvals as a "Special" or "Undefined" use under the LPS No. 7 and referral to the Mid-West/Wheatbelt Development Assessment Panel due to the value (over $10 million), size of the proposed development and potential impact to the environment and community. A gas pipeline is located in the Cataby area, however, it is over two (2) kms away from the project site and will not be impacted due to distance, and therefore excluded from assessment.

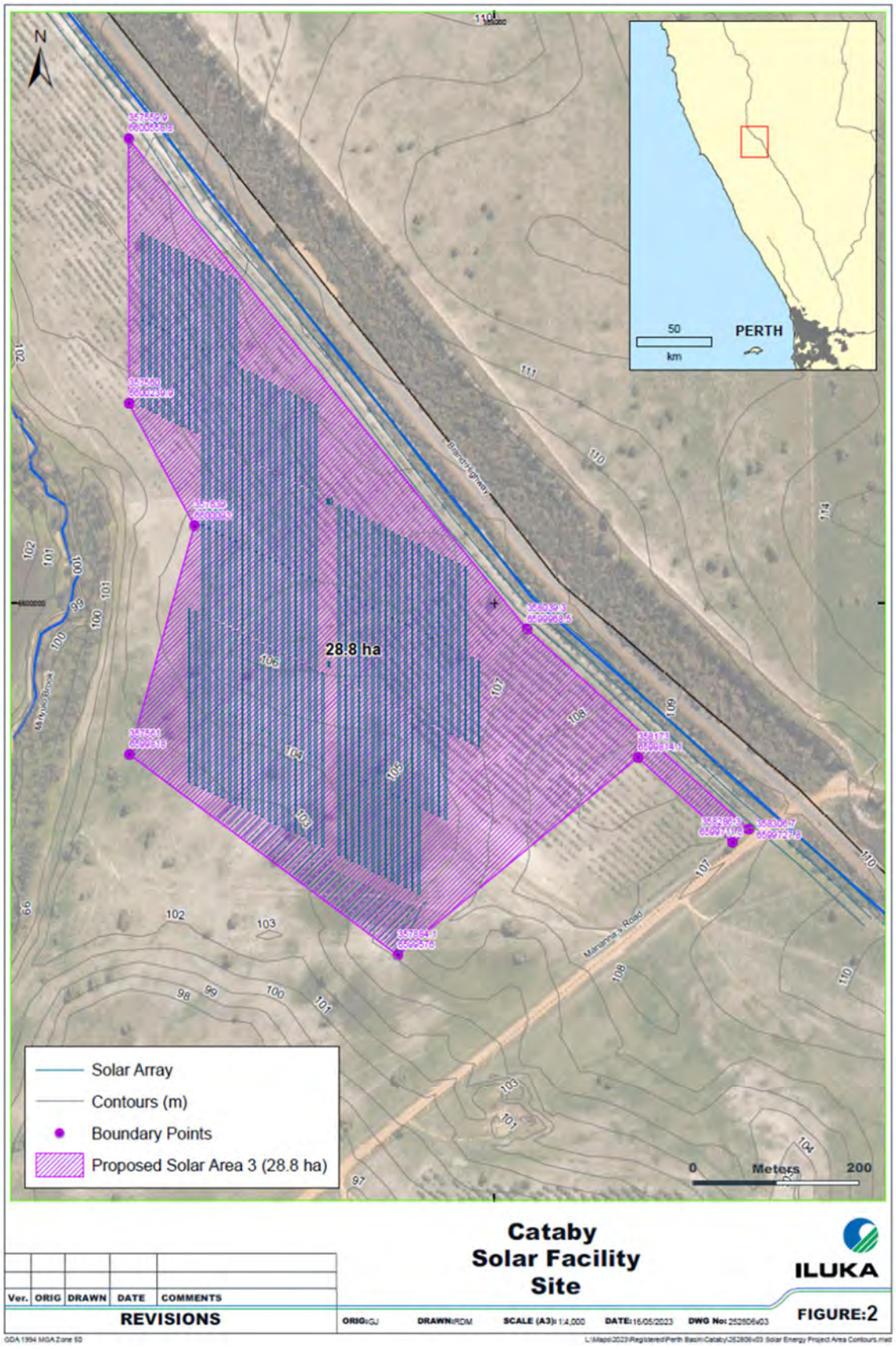



**Figure 2:** Proposed Solar Facility (Site)

## 2.3 Land description

The site the subject of this Development Application, is located at 11019 Brand Highway, Cataby Western Australia (WA) and prescribed as part of Lot 101 Diagram 66701, Volume 1700 Folio 771. A Western Power corridor is located along the allotment parallel to Brand Highway for the supply and distribution of electricity in the area.

## 2.4 Tenure

The land is wholly owned in fee simple by Iluka Resources Limited (ACN 008 675 018) and has been leased to private operators in the past for the purpose of agricultural uses such as the agistment of cattle and sheep.

The part of the land required for the project has been leased from Iluka to PWR Hybrid (Cataby) Pty Ltd (ABN 57 658 938 375). PWR will operate the solar facility as a independent entity to supply the electricity to the Cataby area. The remaining part of the land is leased to a third party for agricultural purposes.

Western Power has a corridor adjacent to the site buffering the Brand Highway, for the mains supply to the surrounding area. This area will not be adversely affected by the project and a 10m setback has been provided.

Therefore, there is limited risk in terms of the number of stakeholders and tenure, primarily being between Iluka (Landowner and Lessor) and PWR (Lessee). The third party continues to lease the balance of the land not required for the project and has been consulted.

## 2.5 Project factors and aspects

The following project aspects have been considered and addressed within the Development Application.

**Table 2.** Project aspects/factors addressed in Development Application

| Factor | Project Aspect |
|---|---|
| Solar Farm | |
| Siting | 11019 Brand Highway Cataby Part of Lot 101 Diagram 66701. Approximately 35 kilometres (km) South West of the Dandaragan townsite and 5 kms to the North of Cataby, WA. Bounded by Brand Highway Cataby to the East, Marianna's Road to the South and West and Minyulo Brook to the North. |
| Site Area | Part of one allotment only (Lot 101) and approximately 29 hectares (ha) with 20 ha comprising the solar array |
| Size of Array | Approximately 20ha |
| Layout | Refer to **Figure 2.** The 9.521MWp solar facility consists of bifacial PV modules and a single axis tracking system which adjusts the position of the solar PV module along an axis to follow the sun's changing position. In addition, there are 2 x 4.4MVA inverter stations with transformers. The transformer steps up power to 33kV which is the exported to the connection point via an underground cable network. There is also a control room, meteorological station on the site which has a fence around the perimeter. |
| Design/ Configuration | Please refer to lateral view in **Figure 3.** |
| Panel attributes (design and size) | Please refer to the *Jinko Specification sheet* **at Appendix A.** |
| Mining Tenement | The land is situated within the M70/760 Mining Tenement held by Iluka. The proposed development will operate entirely independently of this mining tenure under a private leasing arrangement. The land is not within the Development Envelope approved by Department of Mining Industry Regulation and Safety (DMIRS) nor Environmental Protection Authority (EPA). The land, although within the tenement, will not operate nor be a part of the mine site, nor will it rely on any of the approvals relevant to the mining tenure. |
| Site | |
| Access Road/s | Marianna's Road, Cataby off Brand Highway – an ungazetted rural road. No direct access from Brand Highway required. |
| Features | 20 hectare Solar Array (as above)<br>2 x MVPS (Inverter and transformers)<br>Control room<br>Up to 3kms of gravel capped road for access from Marianna's Road entry/exit the site<br>1 site access entry/exit off Marianna's Road, Cataby (refer to **Figure 3**)<br>Underground power cable and communications<br>New fencing and gate<br>Two laydown areas (parking) and maintenance/construction<br>No storage at this time. |
| Extent of Clearing | Approximately 25 hectares (20 ha for the solar array). No native vegetation is in the area to be cleared for the project. Therefore, there is no direct impact on native flora or vegetation. |

| Factor | Project Aspect |
|---|---|
| Construction Works | Clearing of agricultural land with removal of tagasaste and associated grass with *Eucalyptus todtiana* vegetation (if required). Minimal contouring of land; earthworks with seeding or planting to provide a vegetative ground cover with erection of array and supporting services (access road). Specifically:<br>• New access road (compacted gravel single lane)<br>• Earthworks and preparation of the site including array area and laydown areas<br>• Erection of reinforced foundations<br>• Delivery of solar panels to cleared area (laydown area)<br>• Assembly of the solar array using cranes<br>• Installation of underground electrical services between the array and substation to Iluka Cataby Mine site<br>• Outbuildings for construction and maintenance as and if required (temporary) |
| Environmental/ Cultural | |
| Aboriginal cultural heritage | No potential impact to Aboriginal cultural heritage expected. Minyulo Brook is a Registered Site 28326 under the *Aboriginal Heritage Act 1972,* however, the landowner has, in consultation with the Yued Traditional Owners, provisioned a 100m buffer from the brook for the project (to prevent flooding as well as protect the registered site). Preliminary consultation has also been undertaken with the Yued community re the solar facility with support expressed from the Yued Corporation/ South West Aboriginal Land and Sea Council. Refer to section 4.2.12. |
| Flora and Vegetation | No identified significant species of flora or vegetation were found on site. The site is completely degraded and primarily comprises tagasaste and grasses, weeds and approximately 15 *Eucalyptus (Euc.) todtiana* trees known as prickly bark or coastal blackbutt. The *Euc. todtiana* are not threatened. (Umwelt Pty Ltd 2023). Refer to section 3.2.3, 4.2.8 and 4.2.10. |
| Fauna | No fauna of significance are located on site. The project site is outside the areas of Carnaby's Cockatoo foraging and breeding habitat in the Cataby area. Flora and vegetation in the paddock does not provide habitat for Carnaby's Cockatoos. (Kirkby and Johnstone 2022). Refer to section 3.2.4 and 4.2.8. |
| Water - Surface | Modelling for Surface Water 2021 shows the possibility of some overland flows from East to West. 1% Annual Exceedance Probability (AEP) mitigation and management measures will be integrated and implemented in the area with the landowner for the Cataby Mine site. (Golder and Associates 2022). Refer top section 3.2.5 and 4.2.8. |
| Water – Groundwater | No groundwater issues are anticipated. Clearing of land may elevate the groundwater table but will be monitored with the landowner if required. Refer to sections 3.2.5 and 4.2.8. |
| Soil/ Geology | The land is gently undulating sloping from 103 to 109m AHD, with sandy silty soils to a depth of 1.7-2.1m with Ferricrete to a depth 2.1-5.4m. There is no identified Possible Acid Sulfate Soil (PASS) and therefore nil to minimal risk of occurrence. (Soil and Water 2012, Iluka Cataby Comms 29 April 2023). Refer to section 3.2.2. |
| Waste | Only waste expected to be generated is in the construction phase (from packaging of panels etc) and will be disposed of appropriately. |

| Factor | Project Aspect |
|---|---|
| Air - Dust | No expected generation of dust except at earthworks/ construction stage of the project. The proposal is to provide a vegetative cover to prevent generation of dust throughout the life of the project. Cumulative dust monitoring in the area is proposed with the landowner to ensure no adverse effects to the environment and community overall, especially at the earthworks and construction phases. |
| Air - Noise | No noise expected except at construction stage of the project. Cumulative noise monitoring in the area is proposed with the landowner to ensure no adverse effects to the environment and community overall at the earthworks and construction phases. |
| Infrastructure/ Services | |
| Traffic/ Access | Traffic is expected to be minimal except during clearing/ construction phase of the project. Access will be from Marianna's Road only (no direct access from Brand Highway). |
| Stormwater drainage | Surface water flows will be diverted to the natural water source (Minyulo Brook) by installing mitigation and management measures with the landowner to provide adequate drainage. Refer to section 3.2.5. |
| Wastewater/ Sewerage | Not applicable no permanent workforce. Visitors and workers to site will utilise alternative facilities. |
| Electricity | Not applicable (supplier of electricity with no need to connect to other services). A connection to Iluka's substation will be provided from the solar facility. |
| Water Supply | Not applicable no permanent workforce. Visitors and workers to site will utilise alternative facilities. |
| Gas supply | Not applicable. A gas pipeline is located in the area is over 2 kms from the site and therefore will not be impacted by the project due to distance. Gas supply is not required for the project. |

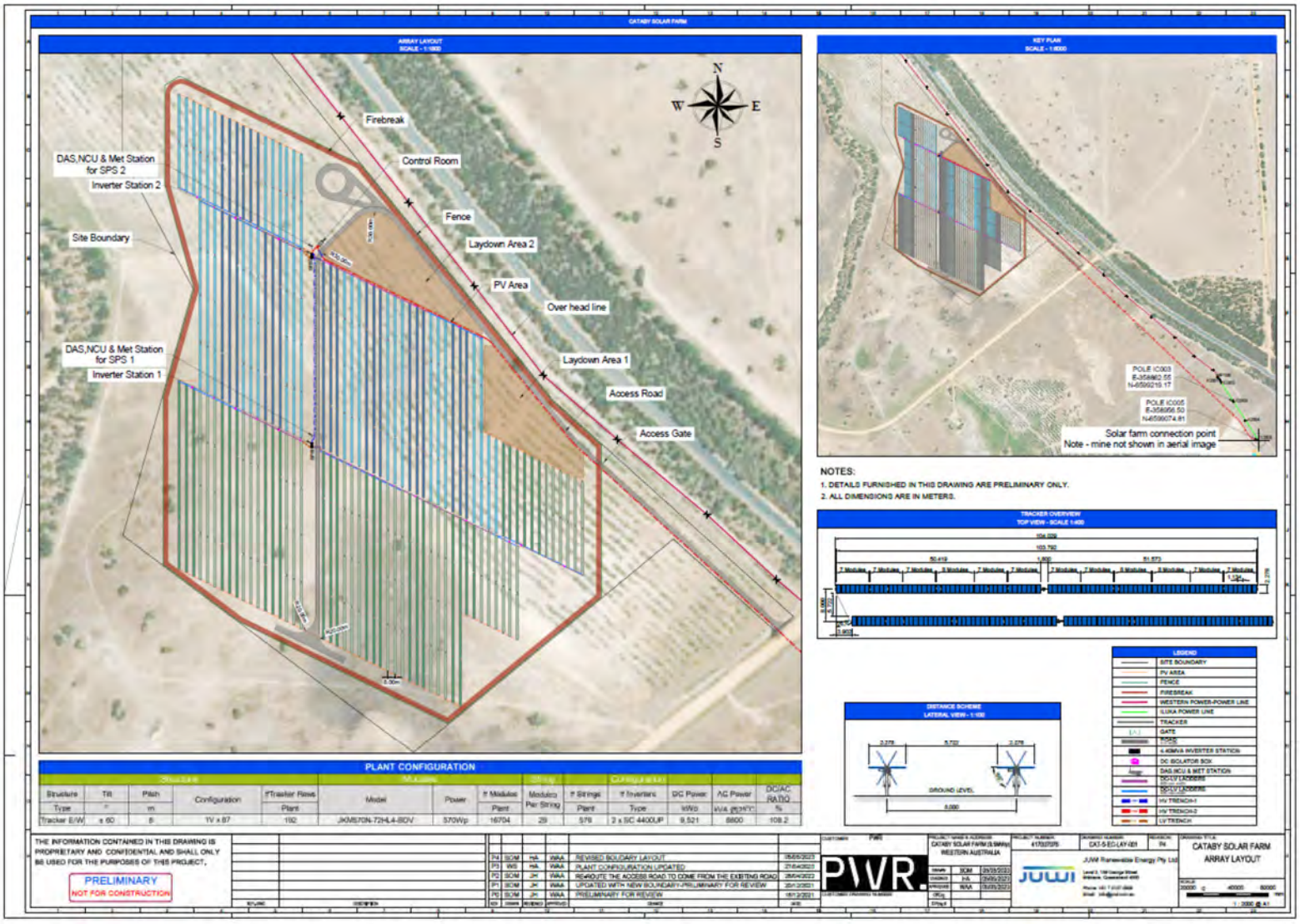



**Figure 3:** Proposed Solar Facility (Features)

# 3 EXISTING ENVIRONMENT

## 3.1 Significant features

The site is bounded by Brand Highway to the East, Marianna's Road to the South/West and Minyulo Brook to the North. Internally, there is corridor for Western Power lines as discussed in Section 2.3.

The significant features are illustrated in **Plate A** and include:



**Plate A significant features**
(Brand Highway to the right, Marianna's Road in foreground, Minyulo Brook native vegetation top photo)

### 3.1.1 Minyulo Brook

Minyulo Brook is an ephemeral and endorheic stream, which flows primarily in winter and is dry during summer. The site is registered as a place of Aboriginal cultural heritage significance under the *Aboriginal Heritage Act 1972* (registered Place 28326 primarily as a birthing place). The brook with a provisioned 100 metre buffer from the edge of the bank to the project area will protect the Aboriginal cultural heritage values and also retain flows of surface water in the brook. It will also prevent inundation of a 1% Annual Exceedance Probability (AEP) flood event to the project area. This is further discussed in sections 4.2.8 and 4.2.12.



**Plate B View from Minyulo Brook to the project site**



**Plate C View from the project site to Minyulo Brook**

### 3.1.2 Brand Highway

The Brand Highway lies to the East of the site. The vegetation of the Brand Highway is comprised primarily of native vegetation. No disturbance of the vegetation is proposed in this project. No access is proposed directly into the site from Brand Highway. Brand Highway is the major arterial to the North from Perth to Geraldton. No significant increase in traffic movements is expected over the life of the project as there is no permanent workforce travelling to and from site (refer to section 4.4.4 for further discussion).



**Plate D View from Brand Highway into the site**



**Plate E View from the site to Brand Highway (fence line and road verge vegetation)**

### 3.1.3 Marianna's Road

Marianna's Road is a non-gazetted road, dual carriageway, comprising compacted gravel and capping. The road provides access to adjoining farmers and enterprises, as well as the Cataby Mine Site. The road is in the area encompassing the site (whole of Lot 101 on Diagram 66701). The landowner manages access and maintenance of the road. An exclusive access is proposed from Marianna's Road directly into the project site (refer to **Figure 2**). This will ensure that any traffic does not cause any potential conflicts with traffic on Brand Highway. Refer to section 4.4.4 for further discussion.



**Plate F View from Marianna's Road into the site**



**Plate G View from the site to Marianna's Road**

### 3.1.4 Electricity corridor

As per sections 2.3 and 2.4, an electricity corridor runs adjacent to Brand Highway within Lot 101. The corridor is administered and managed by Western Power. The view along the corridor with the site is shown in Plates H and I:



**Plate H View along the corridor to the site**



**Plate I View from the corridor into the project site**

## 3.2 Site characteristics

### 3.2.1 Vistas

As previously mentioned in section 2.2, the site is a paddock, very degraded environment comprising tagasaste (tree lucerne), grasses and *Eucalyptus todtiana* which is not a threatened species. Views are, primarily, to and from Brand Highway, Minyulo Brook and Marianna's Road, and Electricity corridor as per **Plates A-I**. A visual assessment and description of the vistas is detailed at section 4.2.13.

### 3.2.2 Topography, contours and soils

**Topography**

The project site is gently undulating and slopes westerly from Brand Highway, from approximately 109 metres (m) Australian Height Datum (AHD) to 103m AHD, a 1.5% slope. Refer to **Figure 4.**

**Soils**

A geotechnical assessment of the site was undertaken (Golder 2022b) to provide a description of the surface and subsurface conditions for the construction of the solar facility. From the Moora sheet of the Geological Survey of Western Australia (GSWA) the area is predominantly Bassendean Sand (Qpb) – leached dunes of quartz sand comprising Alluvium (Qva)- clay silt sand and Colluvium - quartz sand soil. The depths of the soil are between 1.7 and 2.1metres (m). The soils are broadly generalised as Sandy/Silty with Ferricrete at a depth of 2.1 to 5.4m (Golder 2022b p7). The soil profile comprised coarse sand to fine sand to coarse silt. Further detail on the soil parameters including moisture content, particle size, shrinkage, maximum dry density, pH, Sulfate and chloride, electrical sensitivity are at **Appendix B.** From studies undertaken in the area (Soil Water 2003) there is no possibility of Acid Sulfate Soils (ASS) occurring in the project area. The nearest location for any identified Possible Acid Sulfate Soil (PASS) is South of the project area. Therefore there no to a very low risk of PASS. A gravel or similar stable surface was recommended with the depths of pilings accordingly for the solar panels.

**Soil Landscape System**

*The Study Area is located in the Swan Coastal Plain Subregion (which is broadly equivalent to the Swan Coastal Plain IBRA Bioregion) as defined by Beard (1990). The Swan Coastal Plain Subregion consists of Mesozoic to recent sediments of the Perth Basin. It is a coastal plain that is low-lying, often swampy, and contains sandhills. The soils are mainly recent sands or swamp deposits. The region also consists of dissects country rising to the duricrusted Dandaragan plateau on Mesozoic, mainly yellow sandy soils (Beard 1990).*

*The Study Area occurs within the Bassendean and Yeermullah Soil-Landscape Zones of the Swan Province. The Bassendean Zone is described as consisting of 'mid-Pleistocene Bassendean sand and fixed dunes inland from the coastal dune zone, with non-calcareous sands and podsolised soils with low-lying wet areas'; the Yeermullah Zone is described as 'colluvial slopes and some plateau remnants, very gently to gently inclined hillslopes and sand filled minor valleys; pale and yellow deep sands, pale sandy gravels, shallow gravel over duricrust, some sandy duplexes and sandy earths' (Purdie et al., 2004) (Figure 1.2). Two sub-systems occur within the Study Area, as described in Table 1.1.* (Umwelt 2023 p4-5). Refer to **Figure 5.**

**Table 1.1 Soil Landscape Subsystems of the Study Area**

| Subsystem and Name | | Description | Area in Study Area (ha) |
|---|---|---|---|
| 212Bs_1 | Bassendean 1 subsystem | Undulating to flat sandplain and minor swamps; pale to yellow deep sands | 70.5 |
| 224Ye_3 | Yeermullah3 subsystem | colluvial slopes and some plateau remnants, very gently to gently inclined hillslopes and sand filled minor valleys; pale and yellow deep sands, pale sandy gravels, shallow gravel over duricrust, some sandy duplexes and sandy earths | 13.6 |

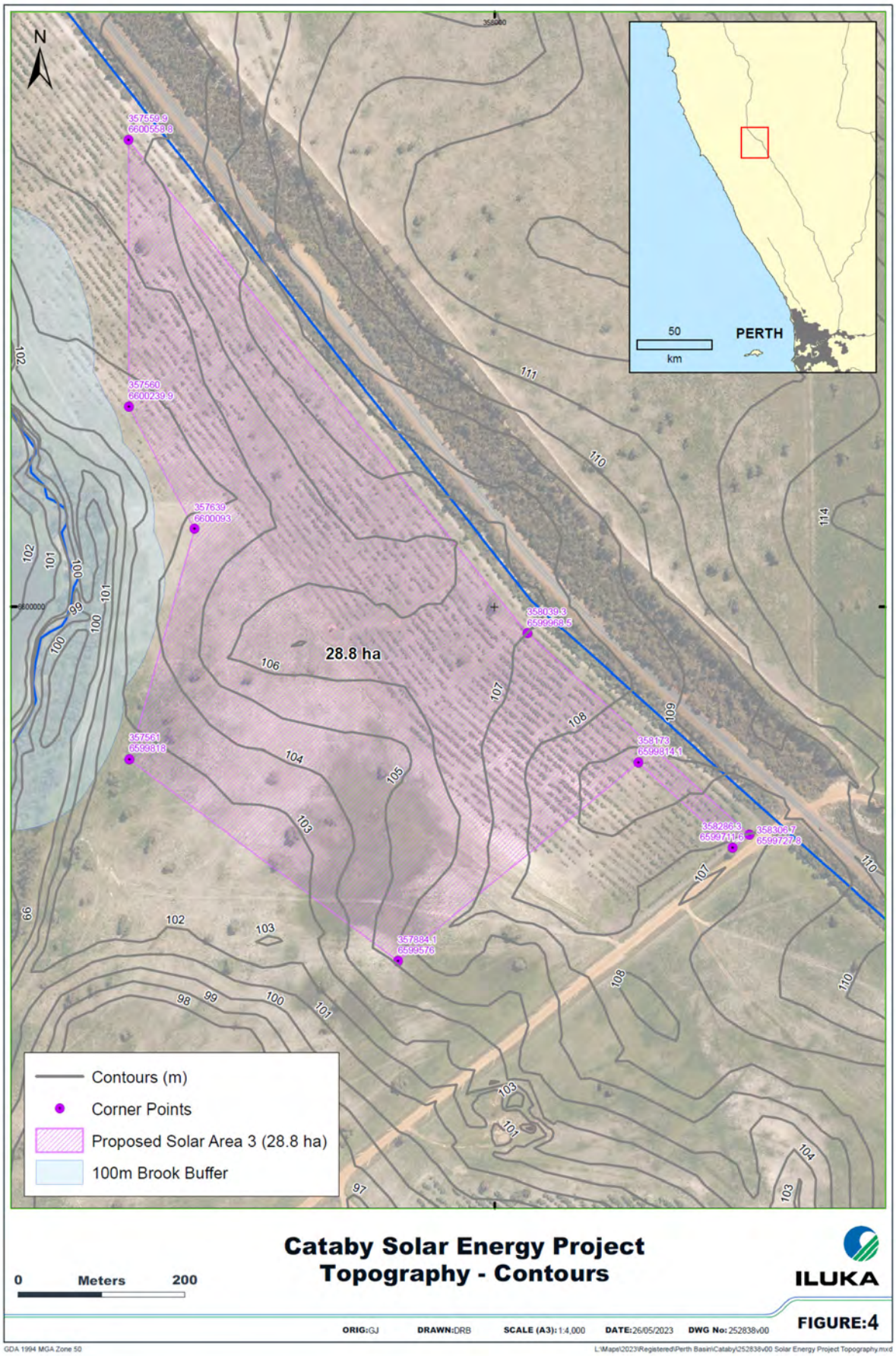



**Figure 4:** Topography – Contour Plan

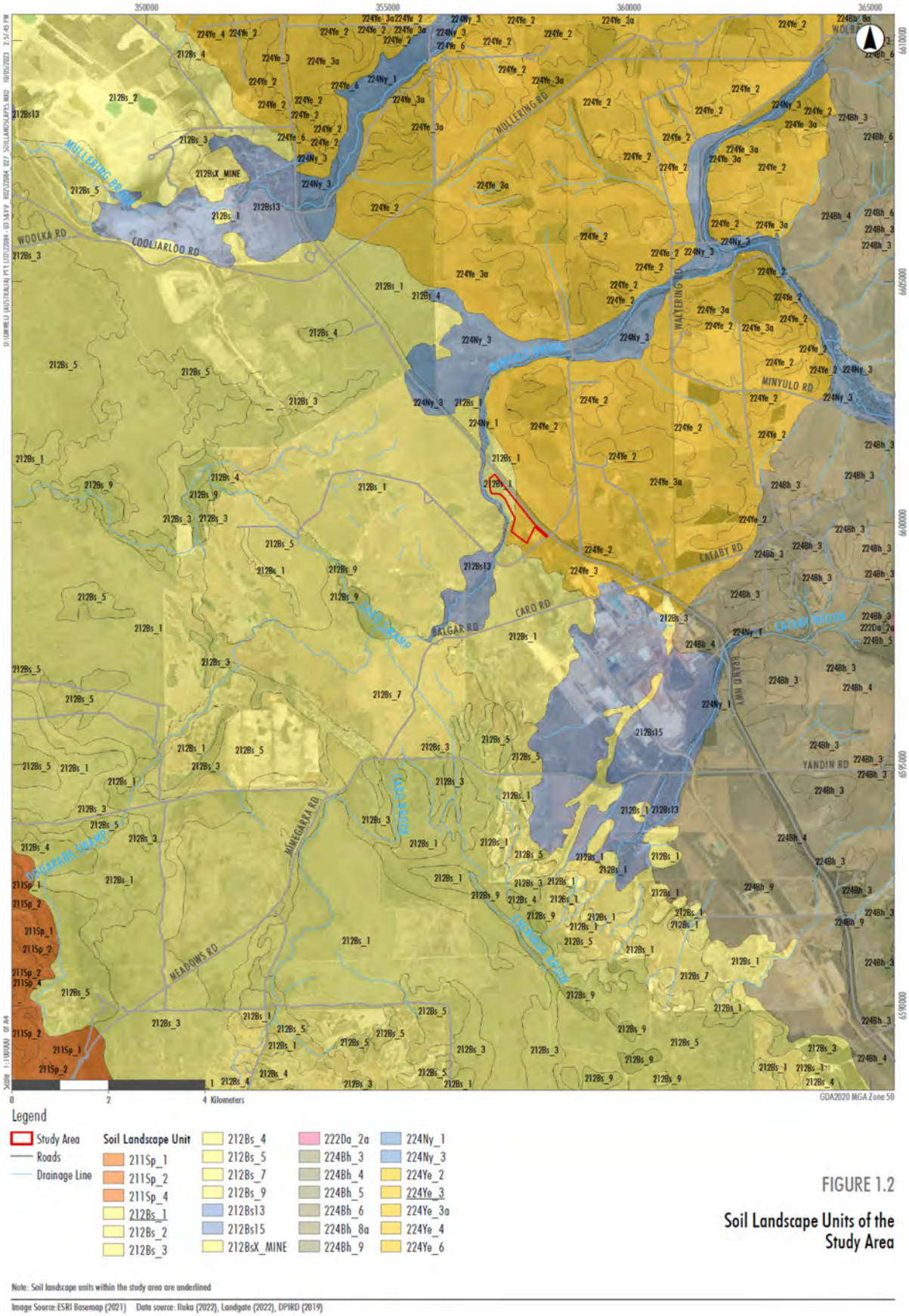



**Figure 5:** Soil Landscape Unit (Umwelt 2023)

### 3.2.3 Flora and vegetation

A Flora and vegetation survey was conducted of the project area in Spring 2021-2022 (refer to **Appendix C**).

**Regional vegetation**

*The Study Area is located in the Swan Coastal Plain IBRA region, specifically within the SWA02 Perth subregion (Commonwealth of Australia 2012). The Perth subregion comprises mainly of a low lying coastal plain, mainly covered with woodlands dominated by Banksia or Tuart on sandy soils, Casuarina obesa on outwash plains, and paperbark in swampy areas (Mitchell et al., 2002). The vegetation of Western Australia as it was presumed to have existed prior to European settlement has been mapped at a scale of 1:250,000 as vegetation system associations, with the Pre-European Vegetation spatial database subsequently created (Beard et al., 2013).*

*The Study Area lies entirely in the Bassendean 1030 vegetation system association (Table 4.1, Figure 4.1) of which 70% remains of its pre-European extent within the SWA02 IBRA sub-region. Of this remaining extent, 14% is protected in conservation estate.* (Umwelt 2023 p12-13).

**Table 4.1 Vegetation System Associations Occurring in the Study Area**

| Vegetation System Association | Description | Current Extent (ha) | Percentage of Pre-European Extent Remaining | Percentage of Current Extent Protected for Conservation |
|---|---|---|---|---|
| Bassendean_1030 | Low woodland; *Banksia attenuata* & *B. menziesii* | 79, 560.88 | 69.66 | 13.86 |

***The Study Area contains Cleared Lands, including C1 (remnant <u>Eucalyptus todtiana</u> over mixed introduced understorey) and C2 (*Chamaecytisus palmensis (Tagasaste) plantation or other agricultural crops). The vegetation condition of these areas is Completely Degraded (EPA 2016a).*** (Umwelt 2023 p19-22). Refer to **Figures 6 and 7**.

**Table 4.3 Vegetation Types Within the Study Area**

| Vegetation Type (VT) | Summary | Photo |
|---|---|---|
| C1 | Cleared paddocks consisting of Low Isolated trees of *Eucalyptus todtiana* over low grassland of introduced taxa<br><br>Total Area mapped: 11.2 (28.0 % of Study Area)<br><br>Vegetation Condition: Completely Degraded<br><br>C1 consists of remnant trees of *Eucalyptus todtiana* over introduced taxa. |  <br>  |

| Vegetation Type (VT) | Summary | Photo |
|---|---|---|
| C2 | Plantation of **Chamaecytisus palmensis* or other agricultural crops, over low grassland of introduced taxa, with isolated trees of *Eucalyptus todtiana*<br><br>Total Area mapped: 28.9 ha (72.0 % of Study Area)<br><br>Vegetation Condition: Completely Degraded<br><br>C2 consists of rows of planted Tagasaste or monoculture agricultural crops, with occasional remnant isolated *Eucalyptus todtiana*, over introduced taxa. |  <br>  |

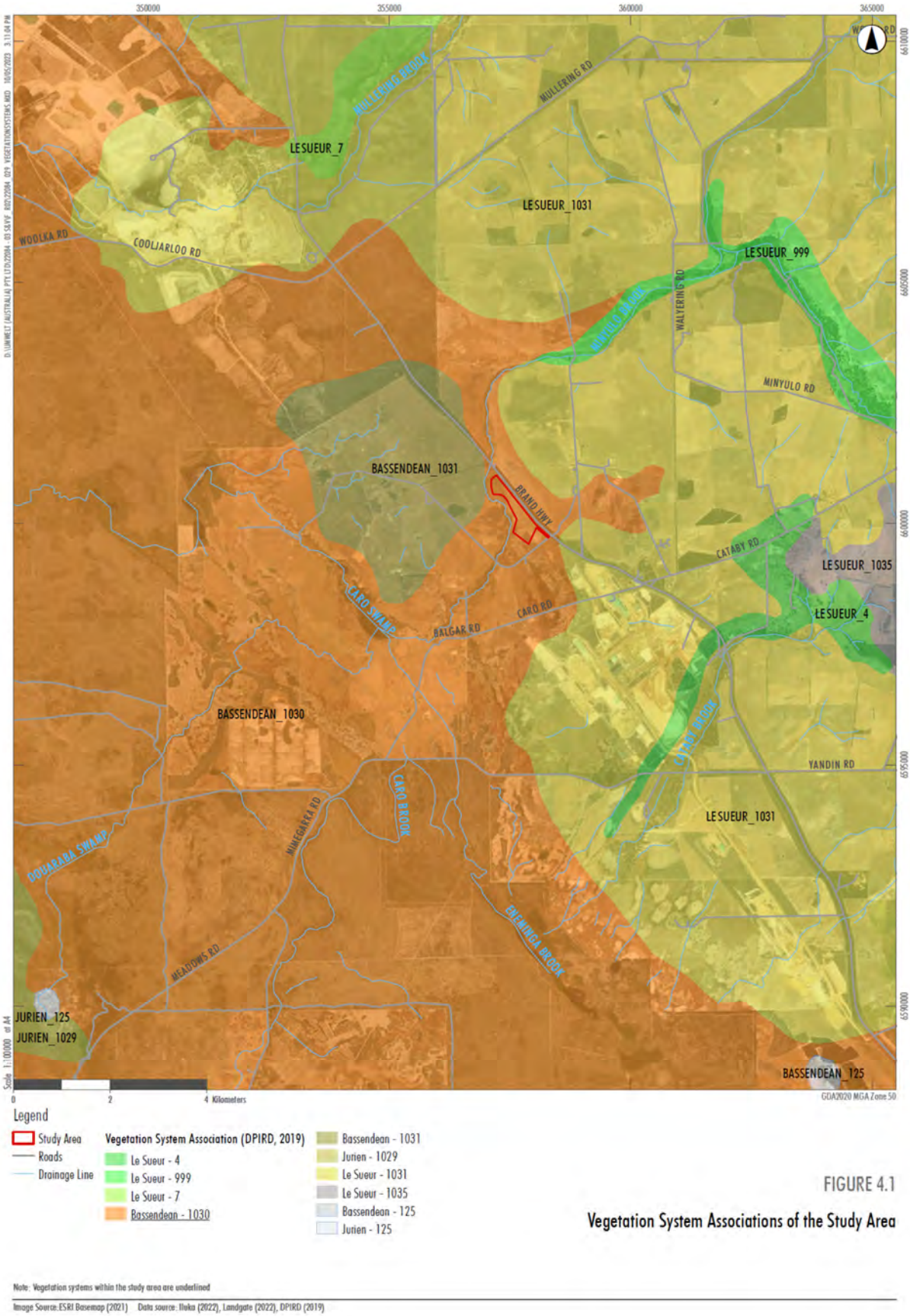



**Figure 6:** Vegetation System Association (Umwelt 2023)

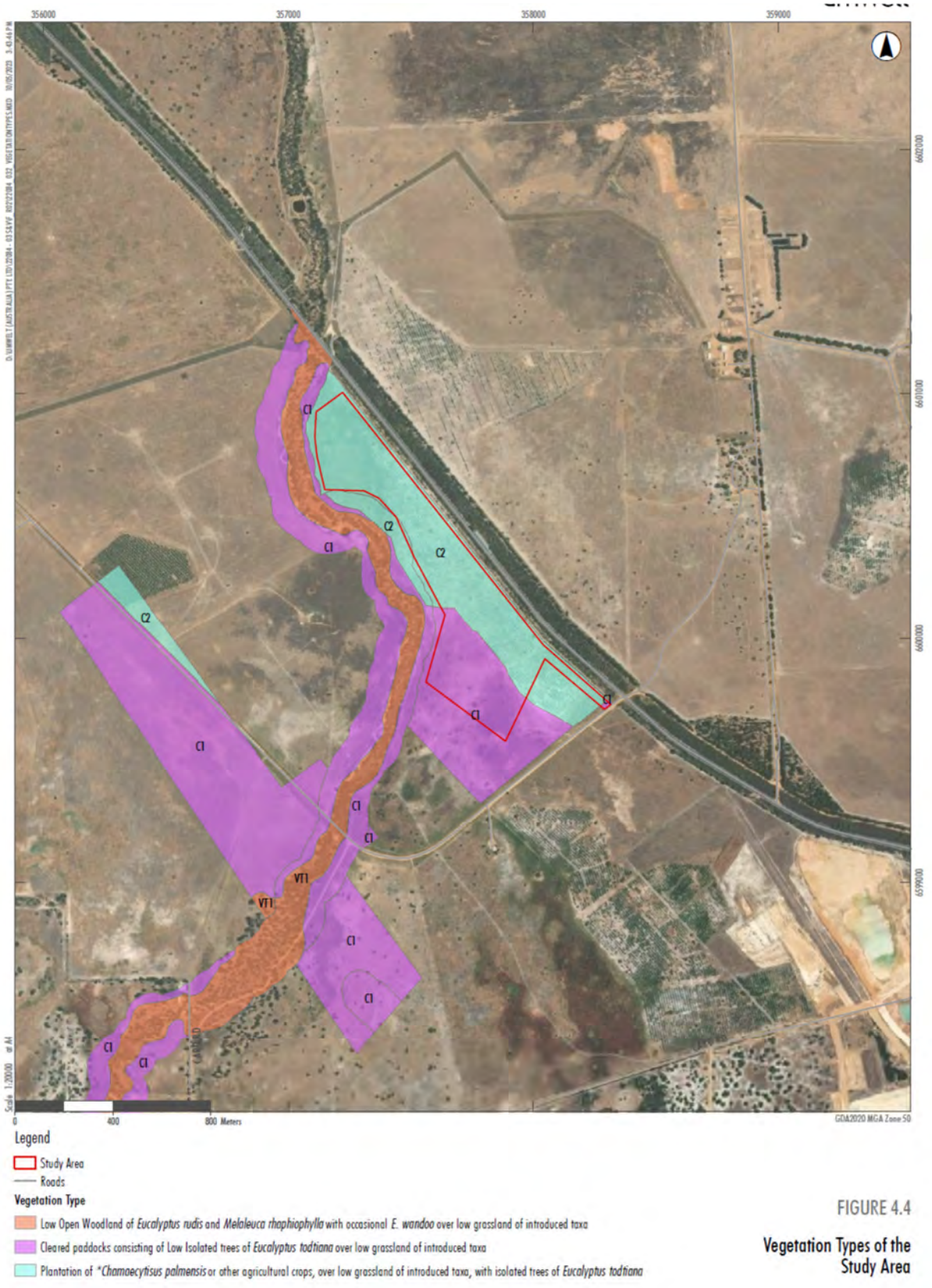



**Figure 7:** Vegetation Types (Umwelt 2023)

**Significant Flora**

In relation to significant flora the searches of the DBCA WA Herbarium 66 and Commonwealth's DAWE SPRAT Database 16 flora taxa were known to occur in the area.

***From the database searches, no known listed significant flora are known to occur within the Study Area.*** (Umwelt 2023, p14). Refer to **Figure 8**.

*"The only native taxon recorded in the Study Area was Eucalyptus todtiana, with all other taxa consisting of introduced taxa including the planted Tagasaste (Chamaecytisus palmensis)….*

***No significant flora taxa were recorded within the Study Area during the Reconnaissance survey in 2021. Suitable habitat does not occur within the Study Area for the significant taxa*** *identified within the Desktop Study….*

*No Weeds of National Significance (WoNS) were recorded in the Study Area. One Declared Weed as per the Biosecurity and Agriculture Management Act 2016 (BAM Act) was recorded:*

• *Echium plantagineum (Paterson's Curse): Declared Pest S22(2), no control category for the Whole of State.*

*Of note is the record of *Brassica fruticulosa, a weed currently known in Western Australia only from records in the Perth Metropolitan Region (WA Herb 1998-)* (Umwelt 2023 p19), It is also noted that *Eucalyptus todtiana* is not threatened as a species *(https://florabase.dpaw.wa.gov.au/browse/profile/5790).*

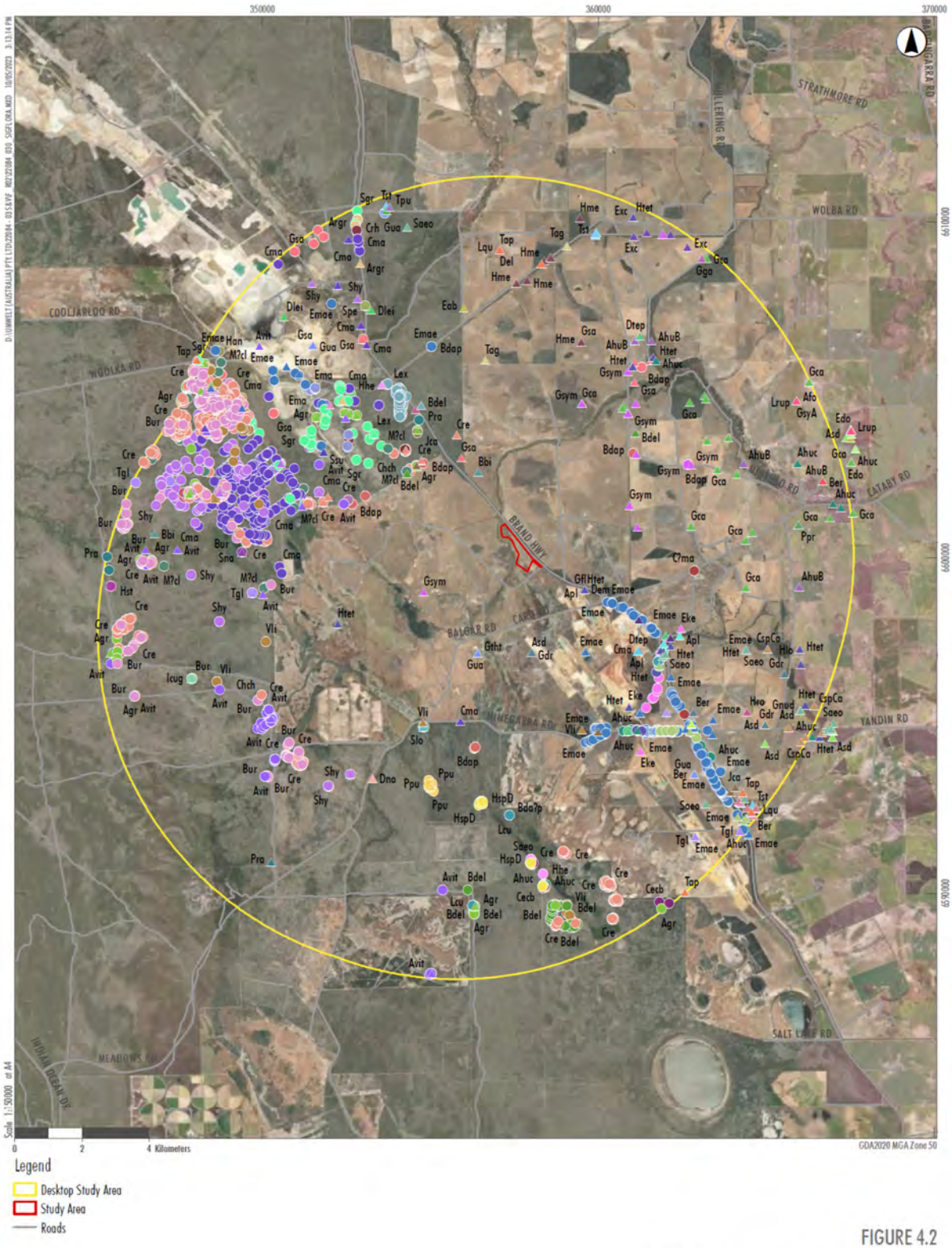



FIGURE 4.2

Significant Flora of the Desktop Study Area

Image Source: ESRI Basemap (2021) Data source: Illuka (2022), DBCA (2021), Umwelt (2022), Landgate (2022)

**Figure 8:** Significant Flora (Umwelt 2023)

### Significant Vegetation

Threatened and Priority Ecological Communities (TEC and PECs) searches were undertaken for the area. The two communities relevant to the area are shown below and at **Figure 9**:

**Table 4.2 Significant Vegetation Known from Within the Desktop Study Area**

| Community | Conservation Status (WA) | EPBC Act Ranking | Source |
|---|---|---|---|
| Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain | Priority 3 (PEC) | Critically Endangered (TEC) | DAWE (TEC may occur in the desktop study area) |
| Banksia Woodlands of the Swan Coastal Plain | Priority 3 (PEC) | Endangered (TEC) | DBCA, DAWE (TEC is likely to occur in the desktop study area) |

***No significant vegetation was recorded within the Study Area during the Reconnaissance survey of 2021****. The vegetation of the Study Area represents neither the 'Banksia Woodlands of the Swan Coastal Plain' TEC (EPBC Act) or PEC (BC Act), or the 'Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain' TEC (EPBC Act) or PEC (BC Act).* (Umwelt 2023 p17).

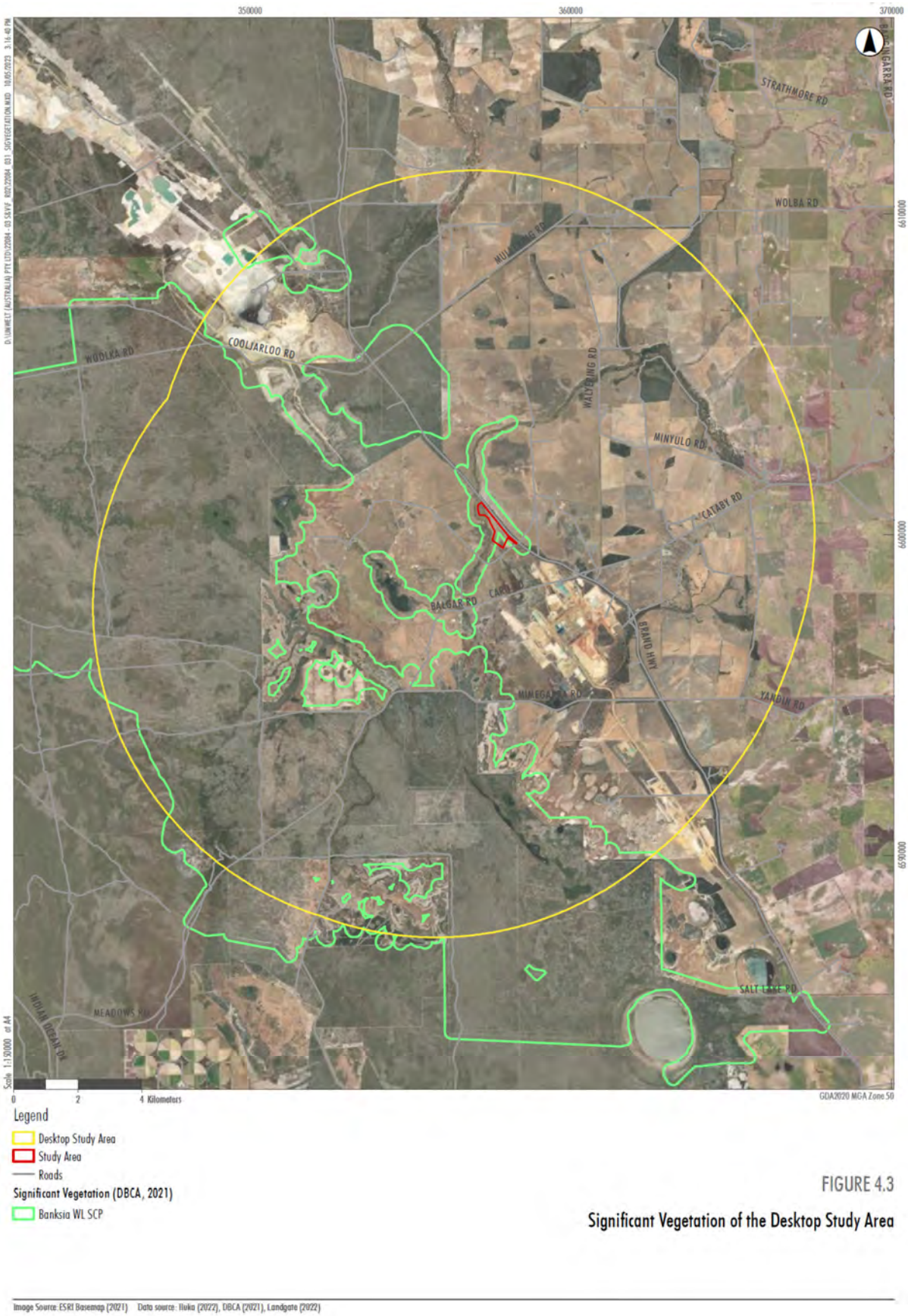



**Figure 9:** Significant Vegetation (Umwelt 2023)

### 3.2.4 Terrestrial fauna

Fauna located in the general area applicable to the project include Carnaby's Black Cockatoos (herein referred to as Carnaby's Cockatoos) and Aquatic fauna.

**Carnaby's Cockatoos**

Carnaby's Cockatoo is a species listed as Endangered under both the Commonwealth of Australia's *Environmental Protection Biodiversity and Conservation Act 1999* (EPBC Act) and the Western Australian *Biodiversity and Conservation Act 2016* previously the *Wildlife Conservation Act 1950*. A study of the Minyulo area (Johnstone R.E. and Kirkby T. 2021 **Appendix D**) concluded:

*We located one pair of Carnaby's Cockatoos breeding in a Wandoo near Minyulo Bridge, several possible nest hollows and a small number ( 7) large well chewed hollows suitable for cockatoos ( but these were most probably used by Western Long-billed Corellas and Galahs that are common in this area)….*

*We found very little evidence of Carnaby's Cockatoos foraging in the survey area except in the Banksia woodland and heath near Minyulo Bridge. In 2008 we recorded a flock of 60 birds in road verge near Minyulo Bridge and in 2010 recorded a pair in verge near Minyulo Brook, so the Banksia verge vegetation appears to be important foraging habitat for the Cataby breeding population.*

*Most of the southern area … was farmland with scattered large trees of Eucalyptus todtiana. Although listed as a food for Carnaby's Cockatoos there is little evidence that Carnaby's Cockatoos forage on E. todtiana and historical records may relate to birds bill cleaning on stems and branches.*

*No roost sites were located in the project area.* (Johnstone R.E. and Kirkby T. 2021, p4).

**There are *Eucalyptus todtiana* located within the paddock area of the project, which do not have any evidence of Carnaby's Cockatoos which is consistent with Johnstone and Kirkby's survey. Therefore, the trees are not likely to be habitat for the Carnaby's Cockatoos in the area. With the low number of trees being cleared for the project (<15) and avoided where possible, it is very unlikely to have any impact on the habitat nor the Carnaby's Cockatoos as a species.**

**Aquatic fauna**

Historic baseline aquatic surveys of surface water ecosystem health were commissioned by the landowner in 2003 (Streamtec) and 2011 (Wetland Research Management 2021 (**Appendix E**)). Both of these studies focused on the Minyulo and Cataby Brooks. As such, baseline data was limited to these systems in the past. Wetland Research Management (WRM) conducted an additional aquatic survey in September 2021. This study incorporated some of the previous baseline sites and extended to include new baseline sites beyond the Minyulo and Cataby Brooks. The new baseline sites include Emu Lake (EMU1), Caro Swamp (CL1 and CL2), Native Dog Swamp (NDS) and Eneminga Swamps (EL1, EL2, EL3). Refer to **Figure 10** for locations.

The Minyulo Brook catchment discharges to wetland systems including Caro Swamp, Emu Lake and potentially Dog Hole but does not currently transect any disturbance areas at this time. So natural flows have been maintained, with only natural processes influencing any potential impact upon the integrity of the surface water ecosystems.

*Although species assemblages differed, neither brook was considered to support unique assemblages. As previously described by Streamtec (2003b), the macroinvertebrate fauna of both brooks was characterized by relatively high densities and moderate to low biodiversity; comparable to saline and/or disturbed streams in many rural areas throughout the south-west. The lower species richness was attributed to the ephemeral nature of the brooks coupled with the degraded habitat condition due to land clearing (pp11). Cataby and Minyulo brooks are highly seasonal systems that are extremely degraded due to disturbance of their riparian zones (vegetation clearing, livestock access, weed infested, erosion prone), loss of in-stream habitat and elevated nitrogen nutrient levels. Based on the current survey and survey in 2003, neither Cataby nor Minyulo Brook appear to support aquatic communities of high ecological value. No fish or crayfish species of conservation significance were recorded, or are likely to occur, and no rare or restricted macroinvertebrate species have been recorded. Known south-west regional endemics constitute only around 6% of the total macroinvertebrate fauna taken from the creeks."* WRM 2012 p12.

*"Waters appeared highly tannin-stained, with generally neutral to basic pH (pH 7.24 – 8.31), and low to brackish conductivity (388 – 3330 □S/cm) and variable dissolved oxygen (46.1 – 118.5 % saturation). Conductivity in Minyulo Brook, including Caro Swamp and Emu Lakes was also relatively high compared to Eneminga Swamps and Native Dog Swamp (Table 2). The higher conductivity was possibly due to past and current pastoral practices, though it may also reflect upwelling of saline groundwater at this location. Conductivity at Minyulo Brook, Caro Swamp and Emu Lake sites exceeded the ANZG (2018) DGV in 2021 (Appendix 2), while pH and dissolved oxygen was outside of the DGV range at a number of sites (Table 2). Exceedance of DGVs for stressors, such as conductivity, pH and dissolved oxygen, was not unexpected. ANZG (2018) note that it was not possible to develop universal DGVs for stressors that apply equally to all regions of Australia and recommend that site-specific guidelines are developed wherever possible.* WRM 2021 p14.

**Although the aquatic fauna ecosystems are within a degraded habitat and saline to brackish waters, maintaining surface (overland) flows to Minyulo Brook and the receptors is required to not potentially adversely affect aquatic ecosystem health when water is present.**

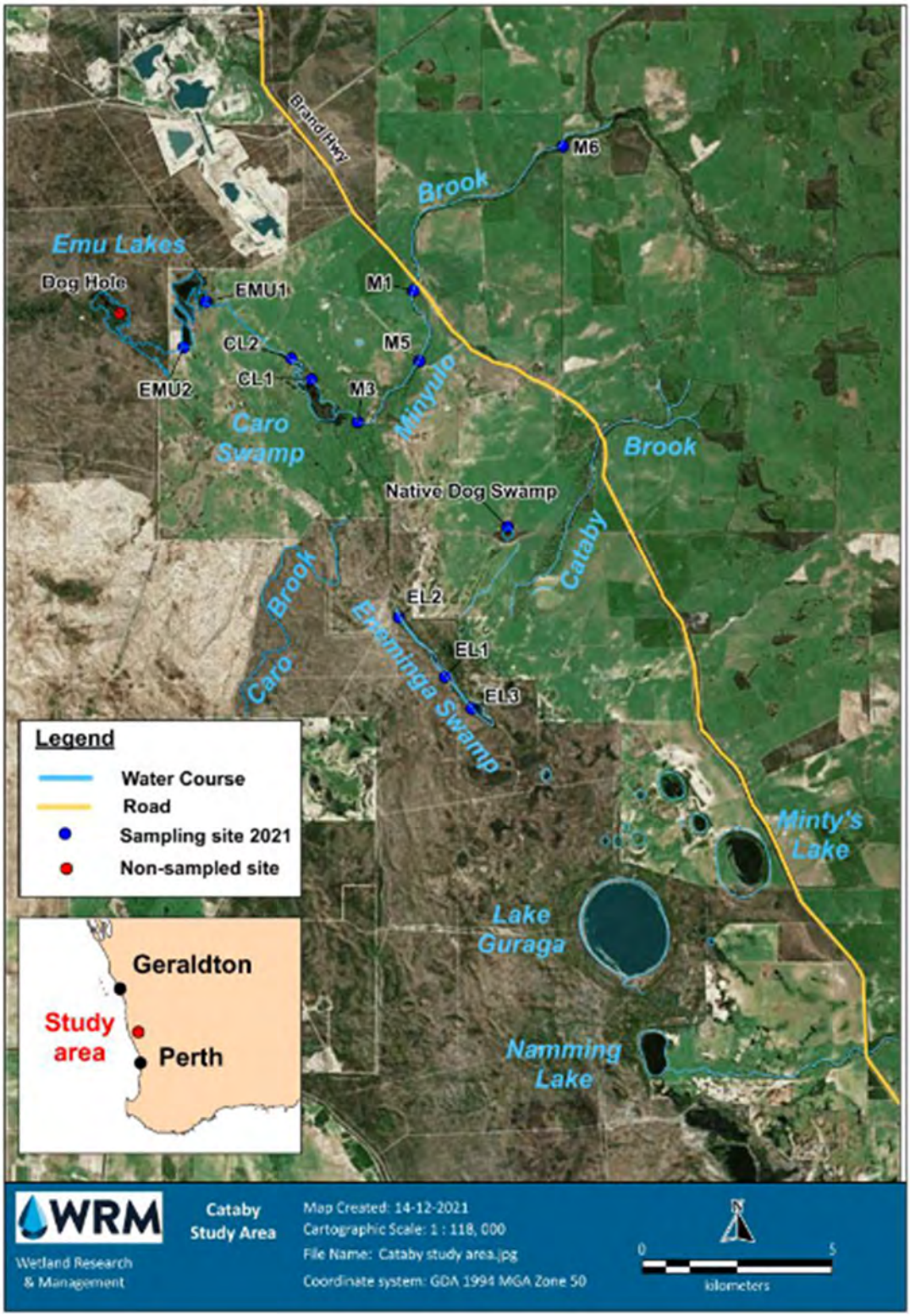



**Figure 10:** Water features

### 3.2.5 Inland waters

A surface water assessment of the Cataby Mine site conducted in 2022, identified at an overview level potential flood risk areas and mitigation/ management measures. The solar facility site is contained within the assessment area and to facilitate an integrated approach mitigation and management measures will be installed as per appropriate design such bunds, drains, culverts, sump and pump prior to rain season (winter) 2024. The management measures are to ensure that surface water (overland) flows to Minyulo Brook and receptor at Caro Swamp are maintained where possible (Golder 2022a). This includes diverting water flows around the solar facility area to ensure it is not flooded and does not contribute to flooding of other surrounding areas.

Groundwater was not encountered within the likely depth of the proposed for the footings for the solar facility. Although there is a possibility groundwater could perch after significant rainfall events. (Golder 2022b). The landowner monitors groundwater levels in the area to avoid, mitigate and manage any potential impacts. It is unlikely that the solar facility will have an impact on groundwater with no direct disturbance to the water table and minimal disturbance at the surface, with vegetative cover.

### 3.2.6 Existing landuses

The subject land is currently utilised for agricultural purposes according to the "Rural" zoning as per the Shire of Dandaragan Local Planning Scheme No. 7 **(Figure 11).** The land is covered with tagasaste, other grasses and *Eucalyptus todtiana* (refer to **Plates J-L**). A solar facility is not defined as a landuse in the Shire of Dandaragan's LPS No. 7. Refer to section 4.4 for the assessment of the project under the Shire's local planning instruments.



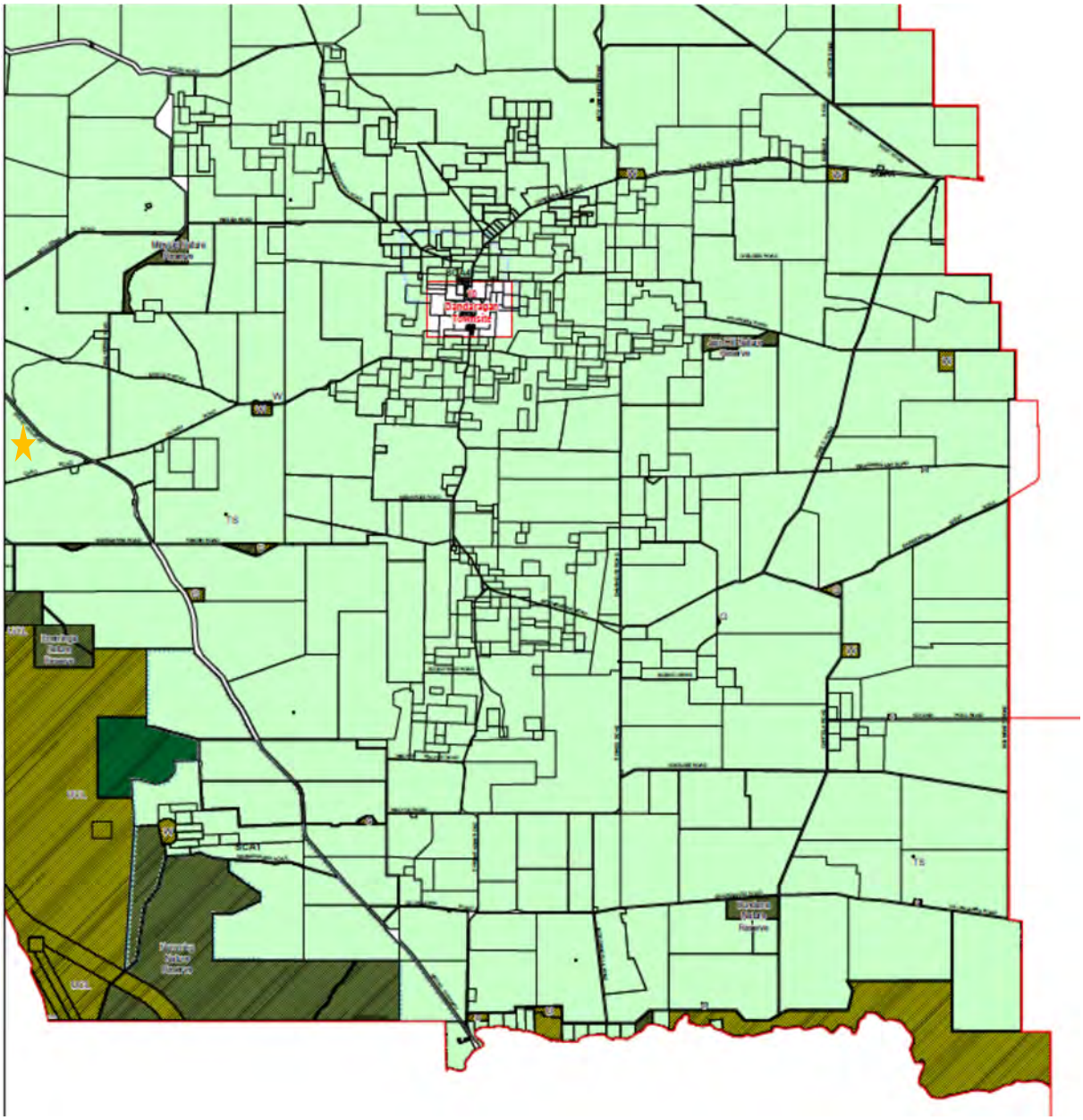
**Plate J Tagasaste**



**Plate K Grasses**



**Plate L *Eucalyptus todtiana***



**Solar facility site location**

**Figure 11:** Shire of Dandaragan LPS No 7 (Shire of Dandaragan 2006 (Map 4 of 10)) and Site Location


LEGEND
LOCAL SCHEME RESERVES
Conservation
Local Road
Parks and Recreation
Public Purposes
Public Purposes : Air Safety Marker Site
Public Purposes : Camping
Public Purposes : Camping and Conservation of Flora
Public Purposes : Cemetery
Public Purposes : Church
Public Purposes : Commonwealth
Public Purposes : Communications Facility
Public Purposes : Education Purposes
Public Purposes : Emergency Services
Public Purposes : Equestrian Purposes
Public Purposes : Gravel
Public Purposes : Infrastructure Services
Public Purposes : Landing Ground
Public Purposes : Local Government
Public Purposes : Rest Area
Public Purposes : Rubbish Disposal
Public Purposes : School
Public Purposes : Trigonometrical Station
Public Purposes : Unvested Crown Land
Public Purposes : Utility
Public Purposes : Water
Public Purposes : Watering Place
LOCAL SCHEME ZONES
Commercial
Harbour
Industrial
Marine Services
Ocean
RC
Regional Centre
Residential
Rural
Rural Residential
Rural Smallholdings
Special Development
Special Use
APR
Special Use : Aged Persons Accommodation
SA
Special Use : Special Accommodation
Tourist
OTHER CATEGORIES
(see scheme text for additional information)
Scheme Area Boundary
Local Government Boundary
R Codes
A1
Additional Uses
R1
Restricted Uses
Rural Residential Area
SU1
Special Use Area
SCA1
Bassendean Sands
SCA2
Wastewater Infrastructure
SCA3
Coastal Hazard Risk Area
SCA4
Public Drinking Water Source Area
SDI
Special Development Area
No Zone
Waterbodies
VERSION No 1
Shire of Dandaragan
Local Planning Scheme No. 7
( District Scheme )

# 4 PLANNING FRAMEWORK

The following provides the Planning framework and compliance assessment against each relevant instrument and/or requirement.

## 4.1 COMMONWEALTH INSTRUMENTS

### *4.1.1 Renewable Energy (Electricity) Act 2000*

**Renewable Energy Target**

*The Renewable Energy Target is an Australian Government scheme designed to reduce emissions of greenhouse gases in the electricity sector and encourage the additional generation of electricity from sustainable and renewable sources. (https://www.cleanenergyregulator.gov.au/RET, 16.04.2023)*

**RE(E) Act**

The Act and regulations provide for the .. *establishment and administration of a scheme to encourage additional electricity generation from renewable energy sources, and for related purposes. (RE(E) Act 2000 p1)* and also provides a certificate program. *The Renewable Energy Target works by allowing both large-scale power stations and the owners of small-scale systems to create large-scale generation certificates and small-scale technology certificates for every megawatt hour of powerr they generate. Certificates are then purchased by electricity retailers (who supply electricity to householders and businesses) and submitted to the Clean Energy Regulator to meet the retailers' legal obligations under the Renewable Energy Target. This creates a market which provides financial incentives to both large-scale renewable energy power stations and the owners of small-scale renewable energy systems.*

*Small-scale technology certificates can be created following the installation of an eligible system, and are calculated based on the amount of electricity a system produces or replaces (that is, electricity from non-renewable sources). (https://www.cleanenergyregulator.gov.au/RET/About-the-Renewable-Energy-Target 16.04.2023).*

**Table 3.** RE(E) Act Evaluation

| Objective | Project Evaluation |
|---|---|
| The objects of this Act are:<br><br>*(a) to encourage the additional generation of electricity from renewable sources; and* | The project will provide additional generation of electricity from a renewable source (solar). |
| *(b) to reduce emissions of greenhouse gases in the electricity sector; and* | The project will reduce emissions of Greenhouse Gas (GHG) (from sources such as coal). |
| *(c) to ensure that renewable energy sources are ecologically sustainable.* | Solar generation is an ecologically sustainable source of energy. |

**Compliance Evaluation**

**COMPLIES:** The project will provide generation of power from a renewable energy source; reduce GHGs in the electricity sector and provide a source of energy that is ecologically sustainable. This is important in achieving overall targets in the future.

### 4.1.2 *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act)

The EPBC Act protects Matters of National Environmental Significance (MNES) for the whole of Australia, The MNES that apply to the Cataby area are:

- Threatened Species - Carnaby's Black Cockatoo (and habitat) and
- Threatened Ecological Communities - Banksia Woodland of the Swan Coastal Plain.

The following evaluation has been conducted in relation to the MNES and the activity as a potential Controlled Action. The Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) administers the EPBC Act and if there is a potential for significant impact upon a MNES a referral is required to be submitted to the Department for approval by the Minister.

**Table 4.** EPBC Act Evaluation

| Factor | Project Evaluation |
|---|---|
| **Matters of National Environmental Significance** | |
| Banksia Woodland of the Swan Coastal Plain | There is no banksia woodland on the project site. The proposed site is a cleared paddock and does not contain any vegetation, flora species or habitat of significance and is not representative of Banksia woodland. Therefore, there is no impact (refer to section 3.2.3 and **Appendix C** Flora and Vegetation Survey (Umwelt 2023)). |
| Black Carnaby's Cockatoo and habitat | There is no Carnaby's Cockatoo habitat on the project site. The proposed site is a cleared paddock. Therefore, there is no Impact (refer to Umwelt 2023 and **Appendix C**); Carnaby's Cockatoo report at **Appendix D** (RE Johnstone and T Kirkby 2022). |
| **Controlled Action** | |
| Likelihood to have a significant impact on MNES | Therefore, the project has no likelihood to have a significant impact on MNES. |

**Compliance Evaluation**

**COMPLIES:** The project is not a controlled action and will not impact MNES. A referral is not required to the Commonwealth Department of Climate Change, Energy, the Environment and Water.

## 4.2 STATE INSTRUMENTS

### 4.2.1 State Planning Strategy 2050 (SPS 2050)

The State Planning Strategy 2050 provides an overarching direction for landuse planning in Western Australia, informing regional and local planning instruments. Energy and particularly renewable energy initiatives are promoted within the strategy. Relevant directions are:

**Table 5.** State Planning Strategy 2050 Evaluation

| Strategic Direction | Project Evaluation |
|---|---|
| Energy – enabling secure, reliable, competitive and clean energy that meets the State's growing demand | The solar facility will provide clean energy to the market and contribute to alleviating the demand on the existing local network. |
| Land availability – ensuring the sustainable supply, use and development of land with a strong presumption in favour of the sustainability of prime agriculture land | The land will be returned after the 25 year project life to the land use of agriculture ("rural" zoning is retained) on the conclusion of the solar facility project. |

**Compliance Evaluation**

**COMPLIES:** The project will provide clean energy from a renewable source to the market long term and alleviate demand on the local network in the short term; reduce GHGs in the electricity sector and provide a source of energy that is ecologically sustainable. Therefore, the project is aligned with the directions in the Strategy.

### 4.2.2 Statement of Planning Policy No. 2: Environment and Natural Resources (SPP2)

The SPP2 provides for the conservation and protection of the environment and biodiversity as well as sustainable management of resources in Western Australia. The key objectives are to:

- *to integrate environment and natural resource management with broader land use planning and decision-making*
- *to protect, conserve and enhance the natural environment; and*
- *to promote and assist in the wise and sustainable use and management of natural resources*

(Western Australian Planning Commission, SPP2, 10 June 2003, Government Gazette WA, p2050)

The policy measures itemised in the State Planning Policy relevant to the project are:

- General Measures (Section 4.2.11 AH Act and 4.2.13 Visual Amenity)

  *(i) Avoid development that may result in unacceptable environmental damage.*
  *(ii) Actively seek opportunities for improved environmental outcomes including support for development which provides for environmental restoration or enhancement.*
  *(iii) Take account of the availability and condition of natural resources, based on best available information at the time.*
  *(iv) Protect significant natural, Indigenous and cultural features, including sites and features significant as habitats and for their floral, cultural, built, archaeological, ethnographic, geological, geomorphological, visual or wilderness values.*
  *(v) Take into account the potential for economic, environmental and social (including cultural) effects on natural resources.*
  *(vi) Recognise that certain natural resources, including biological resources, are restricted to particular areas and that these geographical areas or land types may need to be identified accordingly and appropriate provision made to protect the areas for the use of those resources.*
  *(vii) Take account of the potential for on-site and off-site impacts of land use on the environment, natural resources and natural systems.*
  *(x) Support conservation, protection and management of native remnant vegetation where possible, to enhance soil and land quality, water quality, biodiversity, fauna habitat, landscape, amenity values and ecosystem function.*

In relation to the above refer to sections for further detail:

- Water Resources (section 4.2.8 EPA Act)
- Air Quality (section 4.2.8 EPA Act)
- Soil and Land Quality (section 4.2.8 EPA Act)
- Biodiversity (sections 4.2.8 EPA Act and 4.2.10 BC Act)
- Agricultural Land and Rangelands (section 4.2.3 SPP2.5)
- Minerals, Petroleum and Basic Raw Materials (Not applicable)
- Marine Resources and Aquaculture (Not applicable)
- Landscapes (section 4.2.13)
- Greenhouse Gas Emissions and Energy Efficiency (refer to **Table 6**).

**Table 6.** State Planning Policy No. 2 Evaluation

| Policy measure/ Objective | Project Evaluation |
|---|---|
| 5.10 Greenhouse Gas Emissions and Energy Efficiency | |
| (iii) Support the use of alternative energy generation, including renewable energy, where appropriate. (SPP2, 2003) | The proposed development comprises solar renewable power generation and is consistent with SPP2. The siting has been selected to avoid and minimise any potential impacts on ecological factors, conserving biodiversity, and minimising any potential visual impact to the community. |

**Compliance Evaluation**

**COMPLIES:** The project is in accordance with the policy measure in relation to GHG emissions and energy efficiency and avoiding and minimising potential impacts to the environment, landscape and agricultural land as detailed further in this document.

### 4.2.3 State Planning Policy No. 2.5 – Rural Planning (SPP2.5)

The SPP2.5 focuses on the protection and preservation of rural land assets in WA and ensuring broad landuse compatibility. The key objectives are to:

*(a) support existing, expanded and future primary production through the protection of rural land, particularly priority agricultural land and land required for animal premises and/or the production of food;*
*(b) provide investment security for existing, expanded and future primary production and promote economic growth and regional development on rural land for rural land uses;*
*(c) outside of the Perth and Peel planning regions, secure significant basic raw material resources and provide for their extraction;*
*(d) provide a planning framework that comprehensively considers rural land and land uses, and facilitates consistent and timely decision-making;*
*(e) avoid and minimise land use conflicts;*
*(f) promote sustainable settlement in, and adjacent to, existing urban areas; and*
*(g) protect and sustainably manage environmental, landscape and water resource assets.*(p4)

The following reviews the above objectives relevant to the project.

**Table 7.** State Planning Policy No. 2.5 Evaluation

| Attribute | Project Evaluation |
|---|---|
| Protection of rural land and landuses, avoiding landuse conflict | The site is located on land zoned "Rural" under the Local Planning Scheme No. 7 (LPS No.7) in the Shire of Dandaragan. The land is under a Mining Tenement and owned by Iluka and leased to the provider (PWR Hybrid) of the solar facility. Previously the land was leased for agricultural purposes to surrounding landholders primarily for agistment purposes and utilised intermittently. The loss of the 29 hectares of leased land has been provisioned elsewhere in the area to minimise any potential loss of agricultural production. Areas itemised for mining or potential mining are exempt from the Policy (p1) but is addressed in this document as the use is inconsistent with the "Rural" zoning in the LPS No. 7.<br><br>The solar facility will be surrounded by the paddock and mining activities to the South, North and West, and to the East by the Brand Highway. Therefore, there will be no impact on adjoining agricultural land or production. |

**Compliance Evaluation**

**COMPLIES:** Although an area of land is allocated for the solar array, the project will not adversely affect surrounding rural land or rural landuses. The land was intended for mining activities and then rehabilitation to agriculture (exempt from the policy). On completion of the solar project the land will revert to "agricultural" landuse under the "rural" zoning.

### 4.2.4 State Planning Policy No. 3.7 – Planning in Bushfire Prone Areas (SPP3.7)

The SPP3.7 provides a risk based management approach to landuse planning to minimise the potential impact of bushfires on the community, property and infrastructure by identifying bushfire prone areas. **Figure 12** illustrates the Bushfire Prone Areas in the Cataby area.

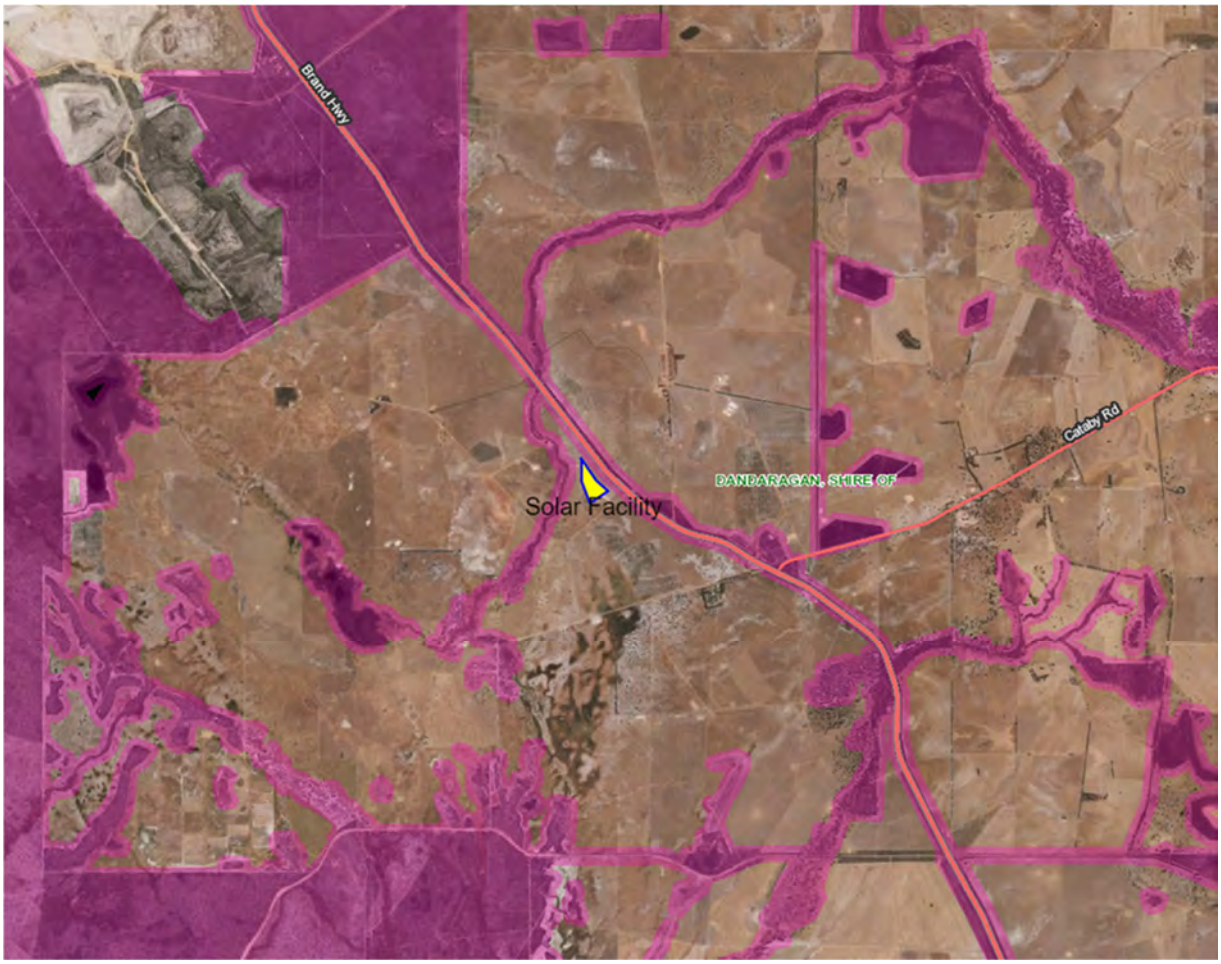



**Figure 12:** Bushfire Prone Areas in the Cataby area and solar facility location

**Table 8.** State Planning Policy No, 3.7 Evaluation

| Objective | Project Evaluation |
|---|---|
| Bushfire prone area and management | The site for the solar facility is not identified on the Map as a bushfire prone area and is not within 100m of the identified areas surrounding the proposed project. Minyulo Brook and Brand Highway adjacent to the site are identified as Bushfire Prone Areas. The site will effectively have firebreaks around it, 100m buffer to Minyulo Brook, firebreak between Brand Highway and the site (Western Power line corridor area, firebreak and setback of 10m) and Marianna's Road. The site itself is unlikely to ignite a fire and with effective firebreaks, it is unlikely that an event could occur and if so, a fire would have a low likelihood of spreading to the surrounding landholders (Iluka Mine site), vegetation or roads.<br>The activity of a solar array is not considered a vulnerable or high risk landuse. No personnel will be on site except at the construction phase and then for short visits for maintenance. Therefore no "habitable" buildings will be on site. So there is no threat to life within the site. Emergency services are located in close proximity with the Rural Fire and Emergency Services and Emergency Response Team at the Iluka mine site in the area. |

With preliminary consultation with the Shire of Dandaragan, advices were provided that in general Bushfire Attack Level (BAL) assessments are not of assistance with proposals that do no have any inhabitants (for example, workforce or residents) on site. (Shire of Dandaragan/ Iluka email correspondence 12.04.2022)

Planning Bulletin 111 also states that exemptions from SPP3.7 may be applied:

*..deemed provisions should be applied pragmatically by the decision maker. If the proposal does not…involve the occupation of employees on the site for a considerable amount of time, then there may not be a practicable reason to require a BAL assessment. Exemptions may apply to infrastructure including roads, telecommunications…..which do not involve employees on site for a considerable amount of time. (Western Australian Planning Commission 2016).*

The areas of concern identified as bushfire prone are native vegetation along Minyulo Brook and the Brand Highway. By providing effective buffers or fire breaks (e.g. 100m buffer to Minyulo Brook and Western Power corridor and setback of 10m from the boundary of the corridor) to these areas a safeguard will be in place. Therefore, the proposed development is considered as not within areas deemed "bushfire prone". The proposed solar facility as an asset does not propose to increase the bushfire threat by changing the landuse to solar facility from agriculture (cropping, grazing) by being within land owned and also with mining operations surrounding the project area will seek to minimise any bushfire risk to the environment, community, property and infrastructure.

**Compliance Evaluation**

**COMPLIES:** The project is not identified as within a Bushfire Prone Area and with management and firebreaks/buffers aims to avoid and to minimise potential impacts of bushfire on the community, property and infrastructure and the solar facility.

### 4.2.5 Western Australian Climate Change Policy

This Policy provides a framework to adapt to climate change and reduce GHGs. In relation to renewable energy the following relates to the project:

*For existing industries, renewables and energy storage offer significant potential to reduce emissions and energy costs, while helping industries gain a competitive advantage. Making the most of these opportunities will help us grow and restructure our economy, while reducing emissions and safeguarding our future prosperity.*

- *New jobs in clean industries in Western Australia.*
- *Greater adoption of low-carbon technologies in the resource and primary industry sectors.*
- *Global decarbonisation through export of renewable energy and reduced supply chain emissions.*
- *Enhanced economic diversification and resilience.(p14)*

***Energy Transformation Strategy***

*Implement the actions within the Distributed Energy Resources (DER) Roadmap, reform essential system services and capacity markets to maintain system security, and introduce constrained access that will enable more large-scale renewables to connect to the State's main grid.*

***Energy Policy WA***

*South West Interconnected System (SWIS) big battery*

*Install and commission a large battery to enable more renewable generation to be stored while maintaining system security in the SWIS.*

*Synergy*

*https://www.wa.gov.au/service/environment/business-and-community-assistance/government-emissions-interim-target*

**Table 9.** Western Australian Climate Change Policy Evaluation

| Objective | Project Evaluation |
|---|---|
| Reduce emissions/ GHGs | The project provides a renewable energy resource, reducing GHGs for the users and to the environment long term. |

**Compliance Evaluation**

**COMPLIES:** The project is consistent with the Western Australian Climate Change Policy in the provision of renewable energy and reducing GHGs within the community and to the environment. Long term with developments in SWIS storage the project has the potential to contribute the renewable energy generated to the overall community.

### 4.2.6 Strategic Energy Initiative: Energy 2031

This Strategic Initiative provides a vision in relation to energy and a framework overall to 2031. The key objectives are to:

*Vision for diverse and secure energy supply*

*By 2031, a significant and continually growing proportion of Western Australia's energy needs will be met from renewable energy sources. (p9)*

*Goals*

*1) Affordable energy: Western Australians have access to affordable energy that meets their needs.*
*2) Secure energy: Western Australia's energy supply is sufficient to meet demand over the longer term.*
*3) Reliable energy: Western Australia's energy supply is safe and of a consistently high quality and delivered with minimal disruption.*
*4) Cleaner energy: Western Australia's energy production and use demonstrates good environmental stewardship and minimises greenhouse emissions (p8)*

**Table 10.** State Energy Initiative Evaluation

| Objective | Project Evaluation |
|---|---|
| Goals | The project fulfills the goals of providing cleaner energy that is reliable and will enhance the existing network by reducing the load in the short term and potentially contribute to the public network for a period of 25 years. |

**Compliance Evaluation**

**COMPLIES:** The project is in accordance with the Strategic Energy Initiative in providing an alternative cleaner renewable energy source contributing to the future diversity and security of Western Australia's energy needs.

### 4.2.7 Position Statement: Renewable energy facilities (March 2020)

The position statement provides a renewable energy framework. The document supersedes the *Planning Bulletin 67 Guidelines for Wind Farm Development (2004).* The position statement is applicable to the preparation of development applications via the local planning network.

*Renewable energy can enhance local economies and easily connect into the network grid. The contribution that renewable energy facilities make to the reduction in carbon emissions is an important consideration for the growth of the industry, as well as the socio-economic benefits to the State. (p1)*

The key objectives are:

- *guide the establishment of renewable energy facilities to support the State Energy Transformation Strategy (March 2019)*
- *outline key planning and environmental considerations for the location, siting and design of renewable energy facilities*
- *promote the consistent consideration and assessment of renewable energy facilities*
- *facilitate appropriate development of renewable energy facilities while minimising any potential impact upon the environment, natural landscape, and urban areas*
- *encourage informed public engagement early in the renewable energy facility planning process.(p2)*

The position statement outlines considerations to be taken into account by the proponent of renewable facility such as a solar array. These are addressed in the **Table 11**.

**Table 11.** Position Statement: Renewable Energy Facilities Evaluation

| Objective | Project Evaluation |
|---|---|
| *facilitate appropriate development of renewable energy facilities while minimising any potential impact upon the environment, natural landscape, and urban areas* | The project site has been selected to avoid, minimise and manage any potential impact upon the environment and natural landscape. The location is not in an urban area. It is located in a rural cleared "paddock" and effectively screened to roads (Brand Highway) by existing native vegetation in the verge to ensure no impact on traffic. The landowner leasing the property to the proponent has been consulted throughout the design and implementation of the project. Refer to sections addressing:<br>• potential environmental impacts (sections 3.2.3, 3.2.4 and 4.2.8)<br>• potential heritage impacts (section 4.2.12)<br>• potential visual / native landscape including views, layout and measures taken to address any potential impacts (section 4.2.13)<br>• compatibility with landuse (sections 3.2.6, 4.4.1 and 4.4.2). |
| *Network connectivity* | A connection in close proximity (Iluka substation) has been identified to be utilised in this capacity. The proponent is working with Western Power re connectivity to minimise any impact on the network and facilitate the provision of a renewable energy resource. |
| *Enhance local economies and reduce carbon emissions* | The project will provide renewable power to the community (Iluka mine site primary customer to end of life of mine and then to the public network generally). This will ease pressure on the existing network in the area in the short term and potentially supply the South West Interconnected System (SWIS) in the future. |

| Objective | Project Evaluation |
|---|---|
| *Community consultation* | Community consultation with the local community has been undertaken with landholders and lessees in the area, Yued Corporation and local government authority (Shire of Dandaragan). In the process of assessment with the Shire of Dandaragan the Development Application will also be advertised. |
| *Life of the project* | The solar array will be constructed on leased land with earthworks/ construction noise limited to a short period (3-6 months) adjacent to the highway during daylight hours). There is no expected impact on the community.<br>The life of the project is expected to be 25 years upon which the lease will cease to operate and the solar facility be decommissioned with the land returned to agricultural landuse under the "rural" zoning. |

Please note: long term noise impact and public/aviation safety do not apply to a solar array and therefore have not been addressed in this submission.

**Compliance Evaluation**

**COMPLIES:** The project complies with the Position Statement by minimising any potential impacts to the environment, heritage, electricity network; and providing a renewable energy source to enhance the local community network and reduce carbon emissions.

### *4.2.8 Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act), Regulations and associated policies, guidelines etc provide for the conservation, preservation, protection, enhancement and management of the environment as well as the mitigation and management of any potential harm to the environment. The key environmental principles, factors and objectives are the basis for development assessment to ascertain if the proposal will have any potential environmental impact and determine any mitigation and management measures. These are evaluated in **Table 12**.

**Compliance Evaluation**

**COMPLIES:** The project will not have a significant impact on the environmental or social values in the area or on site.

**Table 12.** EP Act Evaluation

| Objective | Project Evaluation | | |
|---|---|---|---|
| **THEME/FACTOR** | **OBJECTIVE** | **SITE CHARACTERISTICS** | **RESPONSE/DISCUSSION** |
| **SEA** | | | N/A as project is located inland |
| **LAND** | | | |
| Flora and Vegetation | *To protect flora and vegetation so that biological diversity and ecological integrity are maintained.* | The site is located in a paddock which from an environmental perspective is "completely degraded". There are no significant vegetation, Threatened or Priority Ecological Communities, flora species or habitat recorded in the project area. There are less than 15 trees in the paddock area surveyed for the project. These consist of *Eucalyptus todtiana* which is not threatened as a species. | There will be no significant impact to flora and vegetation.<br><br>No impact on native vegetation is expected and there is no significant native vegetation in the project area. (Refer to section 3.2.3 and **Appendix C**). |
| Landforms | *To maintain the variety and integrity of distinctive physical landforms so that environmental values are protected.* | The site is a paddock which has been previously cleared with a few trees (*sp. Eucalyptus todtiana*). The land slopes from the East to the West. The land will be cleared and erosion minimised. The views from Brand Highway will be maintained (native vegetation in the verge and Western Power corridor in between).<br>The surrounding land is owned by Iluka and utilised as a mine site. Minyulo Brook is located to the North of the site and will not be impacted by the project. | There will be no significant impact to landforms.<br><br>There will be minimal disturbance of the landscape, clearing of the existing paddock vegetation (*tagasaste* and sedge grasses). Earthworks comprised of contouring the land, vegetative cover and construction of facility.<br><br>A Landscape and Visual Impact Assessment has been undertaken for the project and is discussed in section 4.2.13 of this report. |
| Terrestrial Environmental Quality | *To maintain the quality of land and soils so that environmental values are protected.* | The nearest location for any PASS is South of the project area. From studies undertaken in the area (Soil Water 2003) there is no possibility of Acid Sulfate Soils (ASS) occurring in the project area. | There will be no significant impact on terrestrial environmental quality.<br><br>The is no expected impact on the soils of the site area long term and also surrounding landscape. There is no, to a very low risk of PASS. Refer to section 3.2.2. |

| Objective | Project Evaluation | | |
|---|---|---|---|
| Terrestrial Fauna (Carnaby's Black Cockatoos) | *To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.* | Carnaby's Cockatoos forage, nest and breed in the general Cataby area. Within the vicinity of the project area, the birds are not evident. There is no habitat in the project area or in close proximity. | There will be no significant impact on terrestrial fauna.<br><br>No expected impact on Carnaby's Cockatoos. According to experts and study conducted in 2022 the Carnaby's are not evident in the project area (refer to Kirby and Johnstone 2022 **Appendix D**). There is no native vegetation suitable for use in the project area as Carnaby's Cockatoo habitat. Refer to section 3.2.4. |
| Terrestrial Fauna (Aquatic fauna) | *To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.* | Terrestrial fauna, that is aquatic fauna, are present within Minyulo Brook when the brook is flowing. | There will be no significant impact on terrestrial fauna.<br><br>The degraded habitat in saline to brackish waters for aquatic fauna when Minyulo Brook is flowing. No species of significance recorded.<br>No expected impact to aquatic fauna with surface water flows maintained to Minyulo Brook. Refer to section 3.2.4. |
| **WATER** | | | |
| Inland water - hydrological processes | *To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.* | Groundwater N/A.<br>Surface water:<br>Minyulo Brook is located in closest proximity to the project. Flows will be maintained to the brook with mitigation/ management measures put in place (e.g. bunding to maintain overland flows with the landowner. | There will be no significant impact on groundwater or surface water hydrological regimes.<br><br>Groundwater not expected to be impacted with minimal earthworks and disturbance to the landscape.<br><br>Surface water minimal impact with mitigation and management measures (for example, bunding, drains, culverts as applicable) to maintain overland flows to Minyulo Brook. The minimal disturbance of the landscape with the surface of solar array to be vegetated appropriately, will assist in maintaining flows and to minimise any sedimentation runoff. Refer to section 3.2.5 |

| Objective | Project Evaluation | | |
|---|---|---|---|
| Inland Water - Environmental Quality | *To maintain the quality of groundwater and surface water so that environmental values are protected.* | Groundwater N/A.<br>Surface water:<br>Minyulo Brook is located in closest proximity to the project. Water quality will be maintained to the brook and mitigation/ management measures put in place to maintain overland flows. | There will be no significant impact on groundwater or surface water quality.<br><br>Groundwater no expected impact. Monitoring of groundwater is conducted by the landowner.<br><br>Surface water minimal impact with mitigation and management measures (bunding, drains, culverts as applicable) to maintain overland flows to Minyulo Brook. Surface of solar array to be vegetated appropriately to avoid and minimise any sediment flows into the brook. Water quality monitoring conducted by landowner for Minyulo Brook. Refer to section 3.2.5. |
| **AIR** | | | |
| Air Quality - Dust | *To maintain air quality and minimise emissions so that environmental values are protected.* | Dust will be generated in the earthworks and construction phase only. No dust is expected to be generated throughout the rest of the life of the project. | There will be no significant impact to air quality.<br><br>Dust to be minimised on site in conjunction with the landowner, utilising water carts if required and monitoring winds and directions to not impact the Brand Highway nor adversely affect any applicable surrounding landholders. |
| **PEOPLE** | | | |
| Social Surroundings – Aboriginal Cultural Heritage | *To protect social surroundings from significant harm.* | Minyulo Brook is a Registered site under the *Aboriginal Heritage Act 1972.* | There will be no impact on Aboriginal cultural heritage.<br><br>The project area has been surveyed previously and no items of Aboriginal Cultural significance identified on the site. Minyulo Brook a registered site is in close proximity. The project is avoiding any impact to the brook through distance (at least 100m away from the brook) and minimising any impact to its values by maintaining water flows for the brook and associated vegetation. Refer to section 4.2.12. |

| Objective | Project Evaluation | | |
|---|---|---|---|
| Social Surroundings – Heritage | *To protect social surroundings from significant harm.* | There are no items of built or non-Indigenous heritage within the Cataby area. | NA. |
| Human Health – Noise | *To protect human health from significant harm.* | Noise will be generated in the earthworks and construction phase only. No ongoing significant noise is expected be generated throughout the rest of the life of the project. An inverter substation will be located on site and emits 65 dBA which is equivalent to normal conversation 3 metres apart, business office noise or inside a car when it is running. | There will be no significant impact to human health.<br><br>Noise will be minimised on site in conjunction with the landowner, utilising modelling and monitoring winds and directions to not adversely affect any applicable surrounding landholders.<br><br>Inverter Substation on site is not expected to emit noise that could adversely affect receptors in the area. Refer to **Appendix F** for specifications. |
| **CLEARING PRINCIPLES** | | | |
| Overall clearing principles: | TECs/ PECs | No TECs/ PECs in the area (Umwelt 2023). | No potential impact on TEC/PECs. Refer to section 3.2.3. |
| | Flora of Conservation significance | No flora of significance in the project area (Umwelt 2023). | No potential impact on flora of any significance. Refer to section 3.2.4. |
| | Threatened fauna and/or habitat | No threatened fauna or habitat in area. There is no habitat for or evidence of Carnaby's Cockatoos in the project area. | No potential for threatened fauna to be impacted. Refer to section 3.2.4. |
| | Threatened species and referrals | No threatened species in area. Carnaby's Cockatoos are located in the general area but not within the project area. | Not a controlled action for referral to the Commonwealth for Carnaby's Black Cockatoo (refer to section 4.1.2). |

### 4.2.9 Environmental Protection (Noise) Regulations 1997

These regulations provide the criteria for permitted noise emissions.

The site is situated between the Cataby mine site and Brand Highway. There is no expected impact on noise to the community. The nearest residential receptor is located approximately 1.5kms away from the site and across the road with Brand Highway in between. There is the possibility of noise being generated during earthworks and construction phase of the project. These works will be conducted during the day and monitored if required. Also refer to section 4.2.8.

**Compliance Evaluation**

**COMPLIES:** The project will not generate any noise operationally long term and will be monitored if required.

### *4.2.10 Biodiversity Conservation Act 2016*

The *Biodiversity Conservation Act 2016* (BC Act) provides for the conservation and protection of biodiversity and ecologically sustainable use of applicable areas. This instrument supersedes the *Wildlife Conservation Act 1950*.

**Table 13.** BC Act Evaluation

| Objective | Project Evaluation |
|---|---|
| Flora Threatened and Priority species | There are no flora, threatened or priority species located in the project area. Refer to sections 3.2.3 and 4.2.8. |
| Fauna Threatened and Priority species | No threatened fauna or priority species or habitat located in the project area. Carnaby's cockatoos are located in the general area but not in the project area. There is no habitat for Carnaby's Cockatoos in the project area. Refer to sections 3.2.4 and 4.2.8. |
| Vegetation units<br><br>Threated ecological communities (TECs)<br><br>Priority ecological communities (PECs) | No significant vegetation was recorded within the Study Area during a reconnaissance survey of 2021/2022. The vegetation of the Study Area represents neither the 'Banksia Woodlands of the Swan Coastal Plain' TEC (EPBC Act) or PEC (BC Act), or the 'Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain' TEC (EPBC Act) or PEC (BC Act).(Umwelt 2023). Refer to sections 3.2.3 and 4.2.8. |

**Compliance Evaluation**

**COMPLIES:** The project will not have an impact on any PECs or TECs nor any threatened species.

### 4.2.11 *Biosecurity and Agriculture Management Act 2007* (BAM Act)

The BAM Act provides for the management of the risk of plant and animal pests and diseases from entering, emerging, establishing or spreading in WA. This is so the community, environment and economy are protected. The *Biosecurity and Agriculture Management Act 2007* (BAM Act) is the regulatory framework for Western Australia's plant and animal pest and disease biosecurity, the use of agricultural and veterinary chemicals, and ensuring safe and quality agricultural produce.

**Compliance Evaluation**

**COMPLIES:** The project will not have an impact on biosecurity and agriculture. Materials imported will be subject to inspections, any quarantine and border control requirements to ensure no biosecurity/ agricultural risk is imported to Western Australia or the site. Weed, seed and dieback prevention and management on site will be conducted according to inspection and washing protocols as applicable for construction phase of the project as stipulated by the landowner.

### 4.2.12 *Aboriginal Heritage Act 1972* (AH Act)

The AH Act provides for the protection of Aboriginal cultural heritage in WA. A survey was conducted of the area in 2021 (Dortch and Cuthbert, 2021). The only site of Aboriginal heritage significance is Minyulo Brook which is Registered (No. 28236). The project is avoiding the brook by distance in the first instance (over 100m away) and the site will manage any surface water flows to ensure overland flows feeding the brook and vegetation is maintained and therefore not adversely affected. A scar tree is situated to the South of the project area (Register item 20227 Iluka Cataby 04 under assessment) and will not be impacted by the project. Consultation was undertaken with the Yued Corporation and South West Aboriginal Land and Sea Council members for the project where support was expressed especially as a renewable energy project (Meeting 2 May 2023 Iluka Cataby and Yued Implementation Committee). The *Aboriginal Cultural Heritage Act 2021* will come into effect 1 July 2023. With the project not impacting Aboriginal cultural heritage, it is very unlikely that provisions under the new legislation will apply.

**Compliance Evaluation**

**COMPLIES:** The project will not impact Aboriginal cultural heritage sites identified in the area. The site has been previously surveyed and no Aboriginal cultural heritage identified in the project area. The site of the solar array will not have any impact upon the Minyulo Brook (a registered site) nor a scar tree to the South. Consultation with the Yued Corporation has been undertaken and support for the project expressed.

### 4.2.13 Visual Landscape Planning in Western Australia

The Visual Landscape Planning in Western Australia – A manual for Evaluation, Assessment, Siting and Design (WAPC, 2007) commonly known as the Visual Landscape Planning, guides planners and project proponents to provide a consistent approach in evaluating the visual landscape and any potential impacts.

#### 4.2.13.1 VISUAL IMPACT ASSESSMENT

The project is assessed against the potential impacts to the visual landscape to ensure that its proposed siting is sympathetic to the landscape character and complies with relevant policies and regulatory requirements.

Please also refer to section 4.2.2 for evaluation against the SPP 2 Environment and Natural Resource Policy and section 4.2.3 SPP 2.5 Rural Planning, instruments.

*Visual Management Objectives/ Principles*

The visual management objectives/ principles applied from the guidelines are:

- Respect environmental, cultural and rural features and values. For example, retain valued remnant vegetation and cultural heritage areas.
- Review public infrastructure and other built form as well as functionality.
- Apply best practice siting and design.
- Implement a hierarchy to avoid (for example, by distance), minimise and then mitigate/manage any potential impacts.

*PROPOSED DEVELOPMENT*

The proposed development is to establish a solar facility on  site at Cataby Western Australia. This is further described in section 2 of this report. The development life is for 25 years and therefore pre and post development comparisons provided in this assessment as the development is unlikely to change over time. (Refer to **Plate M** for a simulation inside the solar facility site once developed).

*The Site Landscape and Values*

The site proposed for the solar facility is a paddock previously utilised for agricultural practices. The land is considered completely degraded with less than 15 *Eucalyptus todtiana* trees on the site. Tagasaste and grasses vegetation dominate most of the site. Please also refer to section 3.2.3 and 4.2.8 for a description of flora and vegetation and 3.2.4 fauna habitat and values.

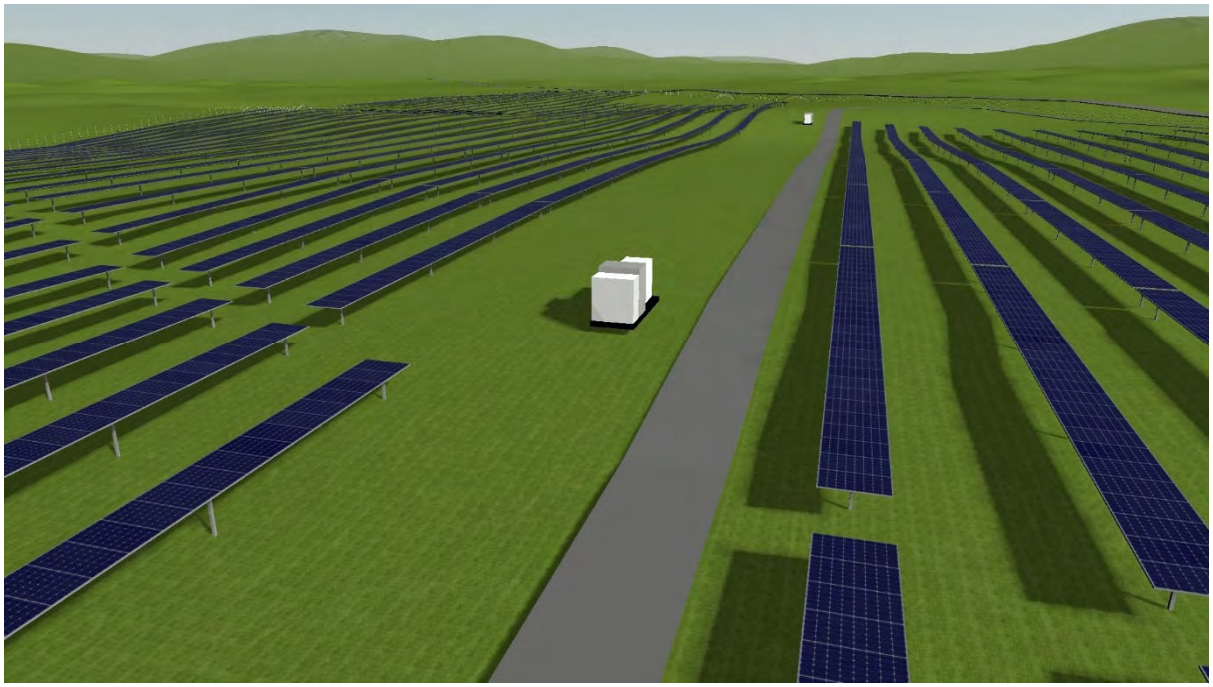


**Plate M Generated image of the proposed development on the site**

### *Siting and options for the project*

The site is zoned "Rural" under the Shire of Dandaragan's LPS No. 7. As per the Visual Landscape Planning guidelines for rural areas, with the selection of the site for the solar facility, the following applicable main visual components were considered:

- Natural environment and character
- Rural character
- Contouring
- Utilities
- Fencing
- Clearing, works and landscaping.

The facility was also sited to maximise the collection of solar energy through orientation and therefore the generation of the renewable resource whilst addressing the criteria in **Table 14.**

**Table 14.** Visual Criteria – Siting and Management

| Visual Component (Criterion) | Siting and management considerations |
|---|---|
| Natural environment and cultural character | The main natural environment in proximity to the project is Minyulo Brook which is also of Aboriginal cultural significance. The siting of the project has been situated at least 100m from the brook to avoid and minimise any potential impacts. This is further discussed in section 4.2.12. The environment of the site is considered completely degraded (Umwelt, 2023). |
| Rural character | The paddock is completely degraded land with single trees or a few trees together of *Eucalyptus todtiana* or commonly known as prickly bark and is "not threatened" under WA legislation (*https://florabase.dpaw.wa.gov.au/browse/profile/5790*). |

| Visual Component (Criterion) | Siting and management considerations |
|---|---|
| | With the project it is proposed to minimise the clearing of trees where possible (maximum potential impact 15 trees). The majority of the site is covered with tagasaste (tree lucerne) and grasses which will mostly be cleared.<br>Although the development will be of a different intensity to agriculture, it will not continually disturb the surface and therefore is unlikely to impact rural values.<br>The site is also surrounded by the immediate paddock and the landuse of mining to the North, South and West. |
| Contouring/ landform character | In considering the siting of the solar array and the panels themselves, the contouring of the site has been considered. In general the solar array will follow the existing contours so as to minimise any potential impact to the landform of the site and surrounding area. |
| Roads | The major road is the Brand Highway. The site is buffered from the highway by the verge of native vegetation and also a utility corridor.<br>Access is from Marianna's Road a rural gravel non-gazetted road. This access has been provided to minimise any potential impacts on traffic along the Brand Highway and also avoid any potential impact to native vegetation in the verge. |
| Utilities | A utility (electricity) corridor operated by Western Power is located between the project and the Brand Highway. A firebreak is also located along the corridor. A 10m setback has been provided between the corridor and the project. |
| Fencing | Existing farm fencing is located around the site. In considering the fencing required around the solar array, it is usual for fence of at least 6 feet (ft) with barbed wire to be constructed. With the project barbed wire will not be part of the 6 ft fence to minimise visual impact. |
| Clearing, works and landscaping | Clearing of the site will be of the vegetation (tagasaste, grasses and less than 15 *Eucalyptus todtiana* trees) in a completely degraded paddock landscape. It is proposed to follow the contours, to maintain the landform landscape and provide vegetative cover consistent with a paddock. The site is well setback from the roads, Minyulo Brook and neighbouring sites. Existing vegetation in the surrounding paddock to the project site will be retained where possible as a buffer to retain a "rural" character and minimise intrusion of the solar array on the immediate area. |

### *VISUAL LANDSCAPE CHARACTER*

The existing visual landscape character is illustrated below in **Plate N.**



**Plate N Aerial of solar facility site and major features**
**(Brand Highway to the right, Marianna's in the immediate foreground and Minyulo Brook green tree line)**

### *Description Of The Cataby Area*

The site is located in the Cataby area in the Mid-west / Wheatbelt region as illustrated in **Figures 1 and 2**. The Cataby area is comprised of agricultural landuses primarily with mineral sands mining (Iluka and Tronox further to the North). Cataby is a small outpost comprising two services stations and a hotel located on Brand Highway. Brand Highway is a primary distributor road connecting Perth (Muchea) to Geraldton and administered by Main Roads of Western Australia. The area is gently undulating with rolling hills to the East of the Brand Highway, sloping down to low lying areas dissected by water features (brooks) which flow into swamps over an extent of approximately 5-10 kilometres. The local hills are located approximately 2 kms to the East of the site with farm paddocks, vegetation (native and introduced) and roads in between effectively screening the area.

The Yandin lookout is the highest point in the local area and is over 10 kilometres from the site. The project site is barely visible from the lookout (refer to **Plate O** below). The highest features to the site are to the North toward Badgingarra over 25kms in distance from the solar facility site. The project site is unlikely to be visible to the naked eye, only through magnification.



**Plate O view from Yandin lookout**

## Key characteristics of the site and surrounds

The following section describes the key characteristics of the site and its immediate surrounds. **Plate P** shows an aerial of the site with the solar array visualisation.

### *Character units/ Key features*

The key character units and features of the site and surrounds are:

**Natural - Minyulo Brook** as comprising native vegetation that is degraded consisting of *Eucalyptus rudis*. The area is generally closed to the public as it is within a mining tenement area. Therefore, no viewing nor access is provided.

**Rural – agriculture – paddock (the project site)** not all of the paddock is allocated to the solar facility, so as a buffer, in general the rural (agricultural) values will be maintained where possible with a portion of the paddock becoming an active mining area in the future.

**Built – roads (Brand Highway and Marianna's Road)**
As mentioned previously the Brand Highway and Marianna's Road are the roads in close proximity to the project site.




**Plate P Simulation Aerial from the North**
**(Minyulo Brook tree line to the right, Marianna's Road top and Brand Highway to left)**

## *POTENTIAL VISUAL IMPACTS*

### *The Regional and District Landscape and Values*

The project has been reviewed looking at different geographical scales of visual amenity; including: the site and surrounds, local, district and regional. There are very few lookout points in the region and district to the site. From the Yandin lookout the site is not easily identified. Therefore, it can be ascertained that the solar facility will not be easily seen and therefore very unlikely to have an impact from a visual perspective at a regional and district landscape level. Overviews from a district and regional view perspective are shown at **Plates Q to S**.

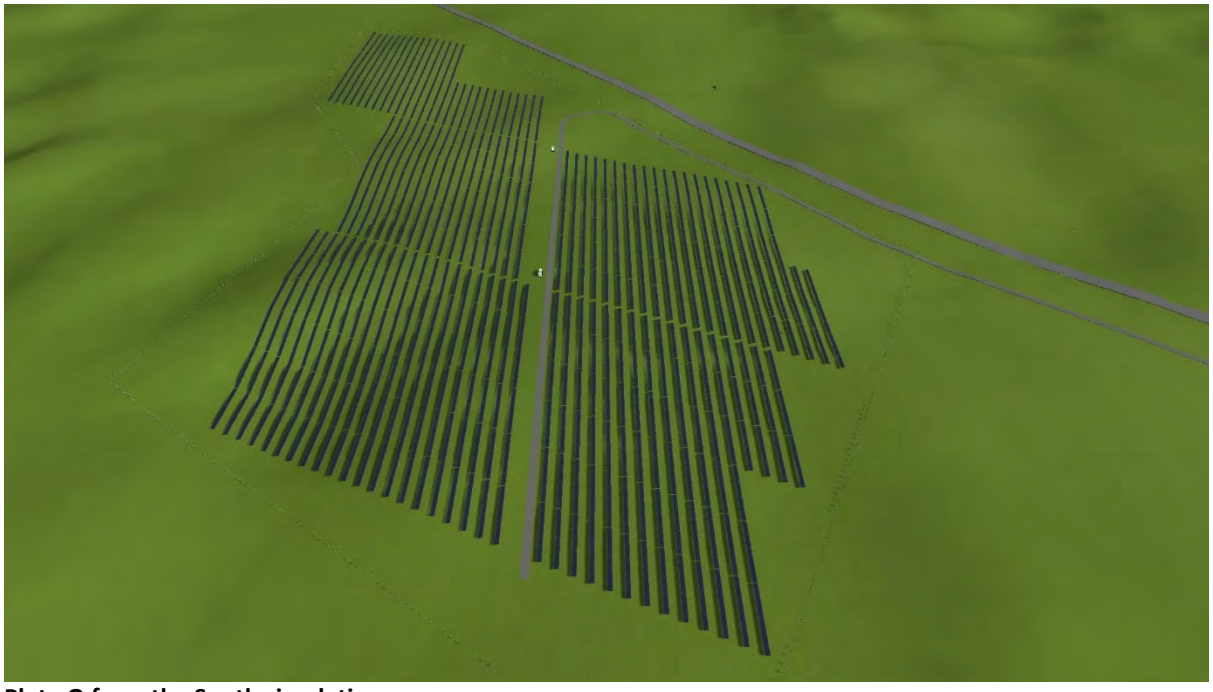


**Plate Q from the South simulation**

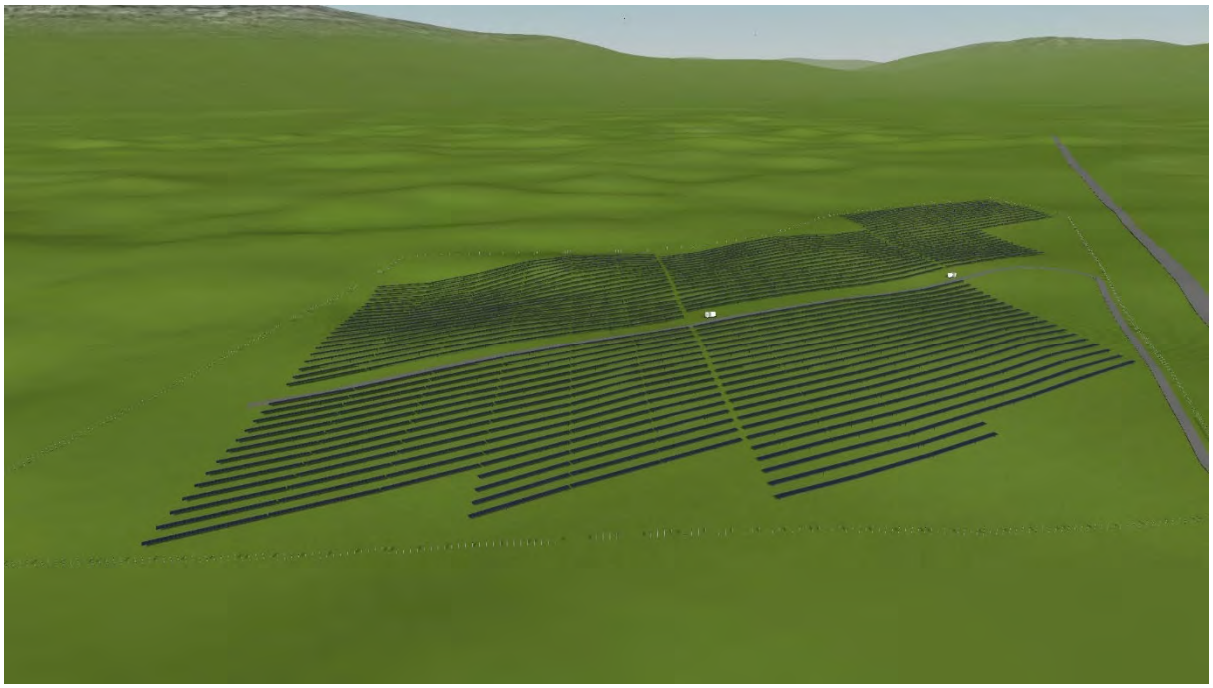


**Plate R from the East simulation**

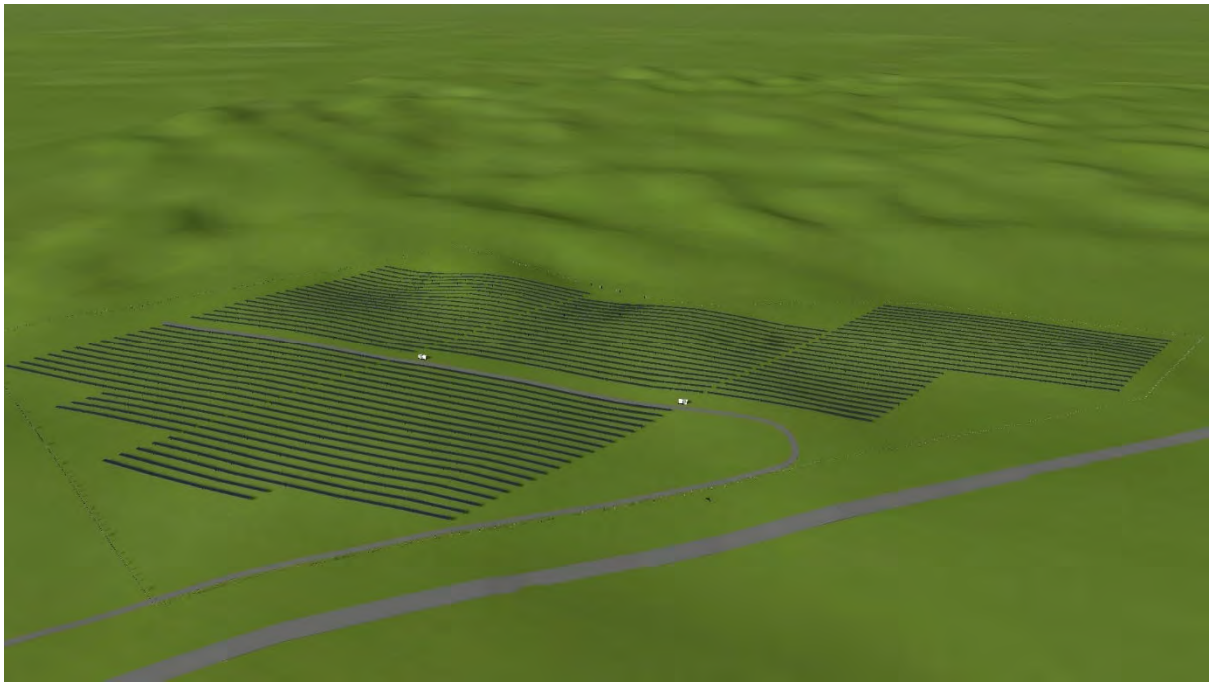


**Plate S from the North simulation**

### *The Site and Surrounding Landscape and Values*

The surrounding landscape is native vegetation of the Minyulo Brook, Brand Highway with associated native vegetation on along the roadside verge with an electricity corridor, and Marianna's Road an ungazetted road.

Baseline or before (pre-development) and after images (post-development) have been provided as context to illustrate the potential visual impact of the project on each view from each key surrounding area:

**Minyulo Brook (registered Aboriginal cultural site)**

The native vegetation of the brook is considered degraded (Umwelt 2023) but is ecologically and culturally of value. Refer to sections 3.2.1 and 4.2.12. The extent of the brook is shown in **Plate T.**



**Plate T Current aerial view of Minyulo Brook (tree line)**

**Pre-development vista:**

The vista from the brook currently into the project site (paddock) is shown in **Plate U** (100m buffer from brook to the project).



**Plate U Pre-development view from Minyulo Brook**

**Post- development vista:**

An artist's photo impression has been generated to show the potential visual impact of the solar array (**Plate V)**.



**Plate V Post-development view from Minyulo Brook (close up)**

**Potential visual impacts Minyulo Brook:**

There is no impact to the Minyulo Brook landscape and values from the project. The pre-development view currently from Minyulo Brook into the site is into a paddock with grasses, *Eucalyptus todtiana* and tagasaste vegetation. The post-development view will be a fence (for security) with the solar panels behind. It is proposed from this area to soften the view by planting vegetation along the fence line and work with the Yued community on projects with the landowner long term. The vista is less impacted due to the buffer of the 100m to the site from the brook, so that the view is in the distance.




**Plate W Simulation Aerial from the East looking toward Minyulo Brook**

**BRAND HIGHWAY**

A native vegetation verge separates the road from the boundary of the site, with an electricity corridor (Western Power). A setback of 10 metres is proposed from the electricity corridor and this means that the solar facility is more distant and therefore less intrusive on views to and from the Brand Highway.

**Pre-development vista:**
The vista from the Brand Highway currently into the project site (paddock) is shown at **Plate X.**



**Plate X Pre-development vista Brand Highway**

An artist's impression has been generated to show the potential visual impact is shown at **Plate Y**.



**Plate Y Post-development view Brand Highway**

Post development Aerial views are shown at **Plates Z to AC**

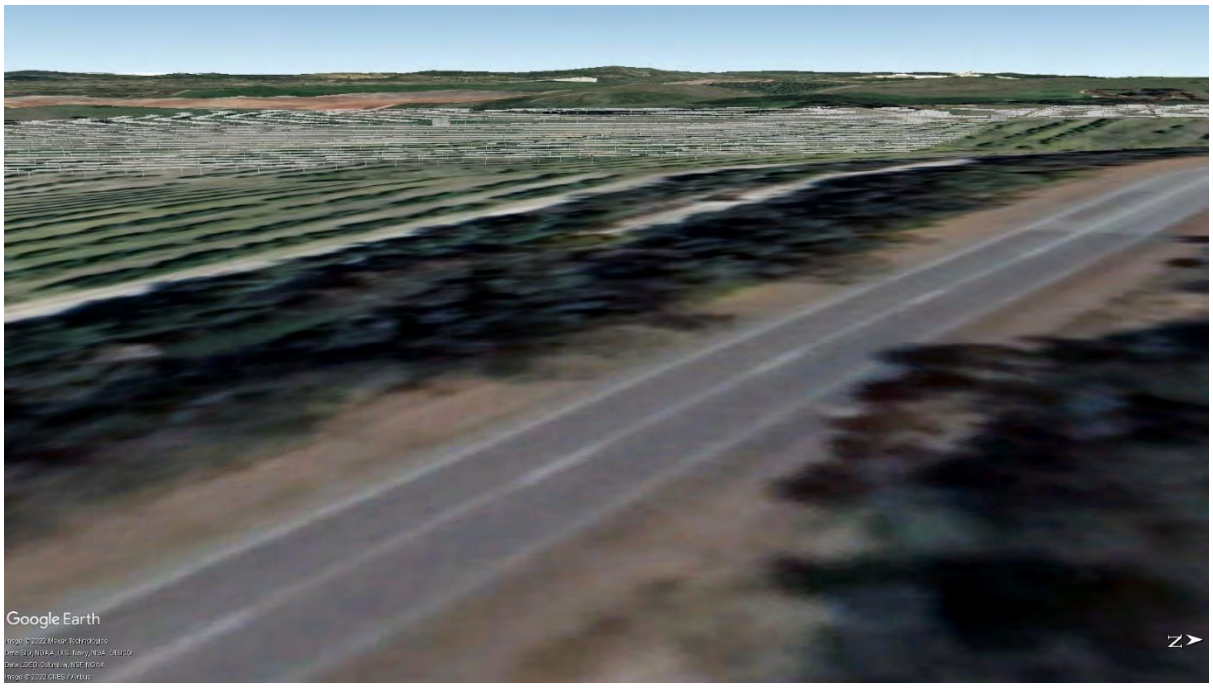



**Plate Z Aerial View from road (Brand Highway) facing East**

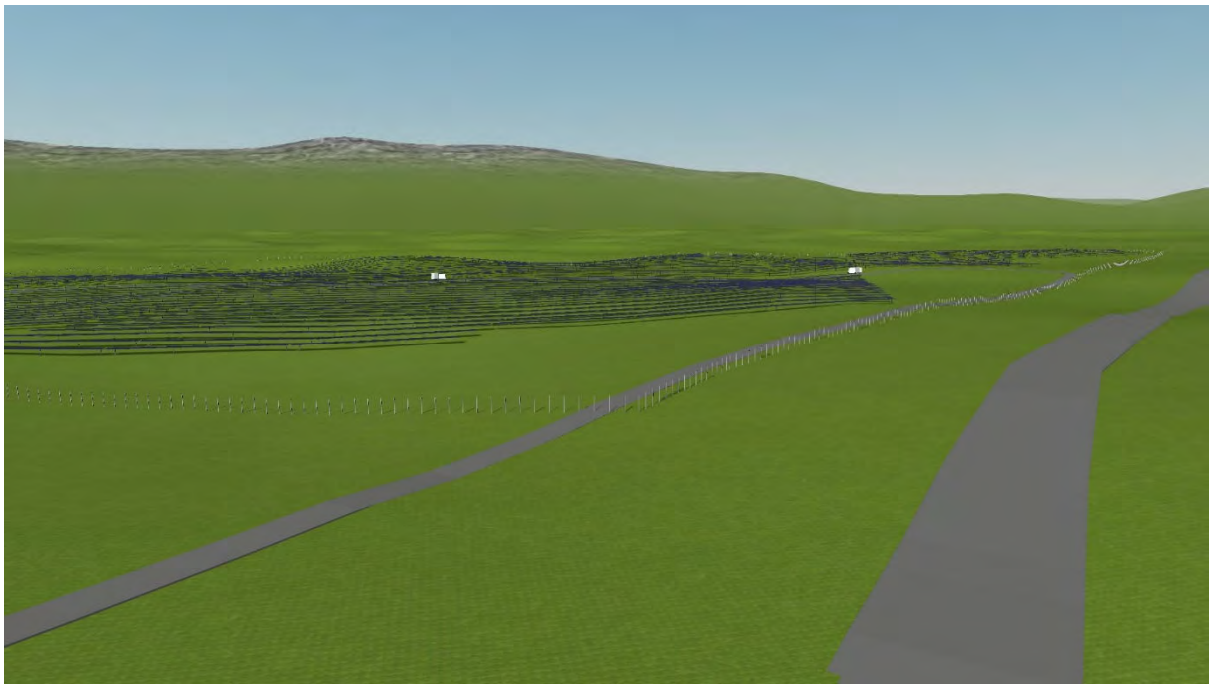


**Plate AA Aerial View from road (Brand Highway) facing East from Southern perspective**

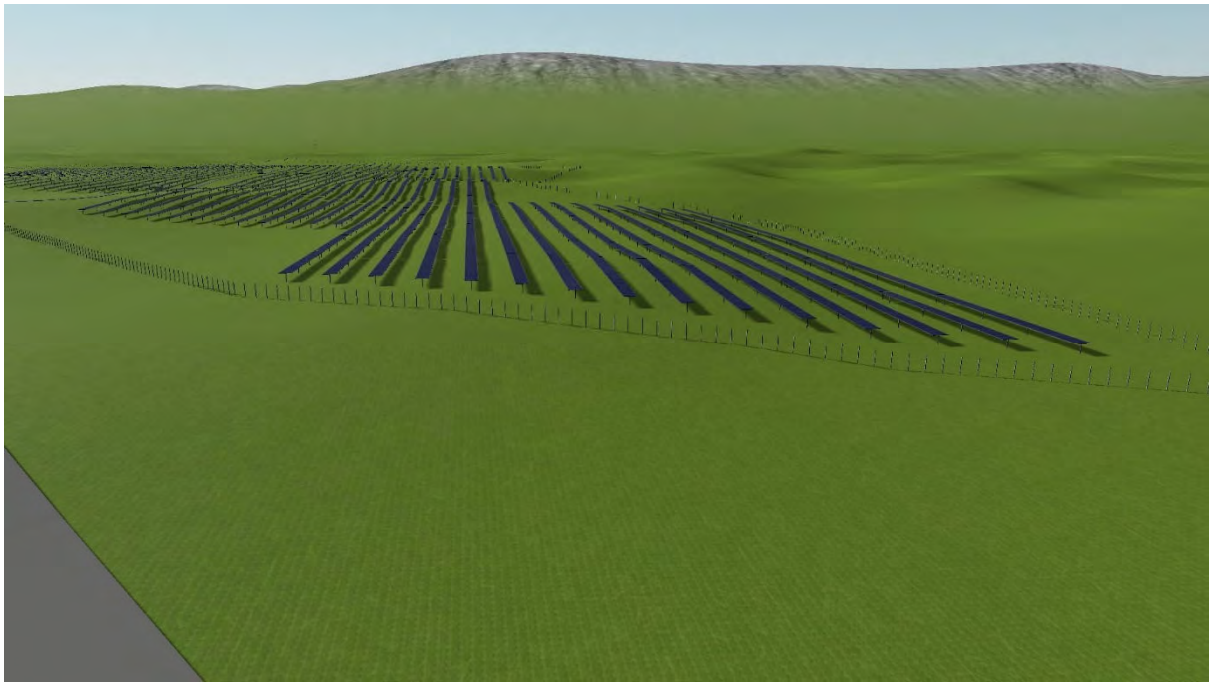


**Plate AB Aerial View from road (Brand Highway) facing East from Northern perspective**

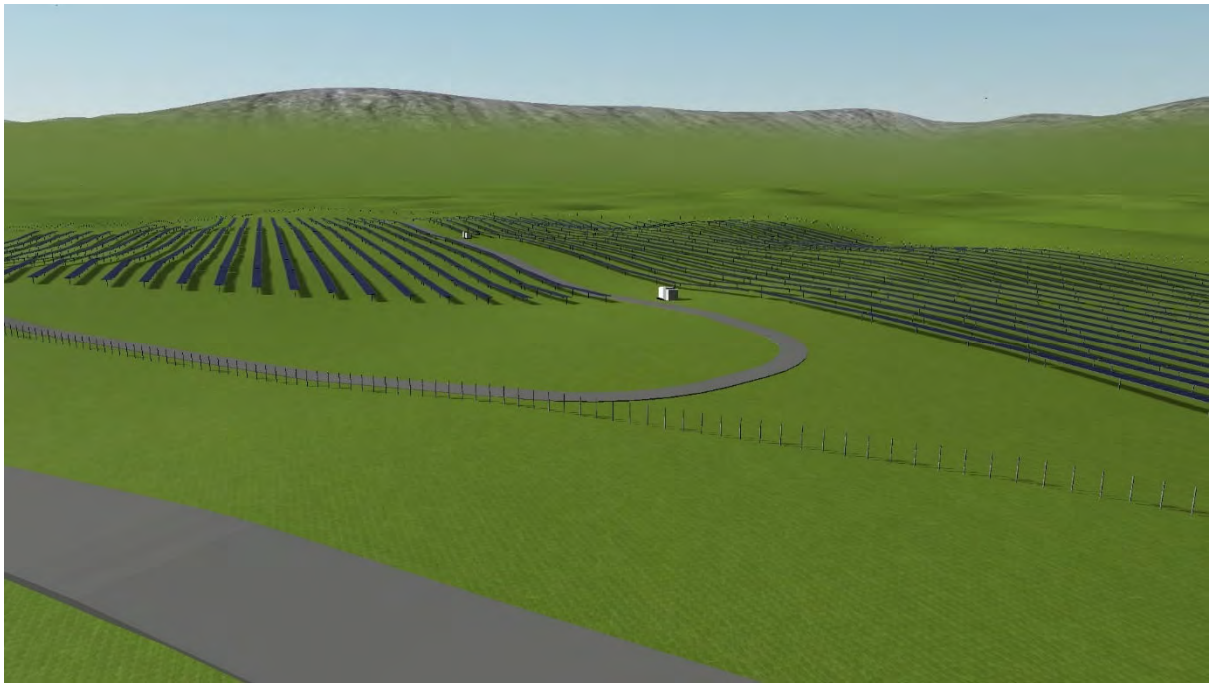


**Plate AC Aerial View from road (Brand Highway) facing South**

From the aerial views the landscape will not alter greatly as the solar array follows the contours of the existing paddock and integrates with the landscape.

***Potential visual impacts Brand Highway:***
From the pre and post development of the project vistas, the solar facility will be barely visible whilst driving along the road. The comparison of **Plates X-AC** illustrates that the top of the fence and the panels are difficult to differentiate from the existing vegetation and infrastructure. Therefore, it is illustrated that there will be minimal visual impact.

**Marianna's Road**

Pre-development vista:

The vista from the Marianna's Road currently into the project site (paddock) is shown in **Plate AD**



**Plate AD Pre-development vista from Marianna's Road**

Post development vistas:



**Plate AE Post-development vista from Marianna's Road**

***Potential visual impacts Marianna's Road:***
From the pre and post development of the project vistas, the solar facility will be evident with the top half of the fence line visible and panels less so whilst driving along the road. Therefore there will be minimal visual impact.

**Overall Simulations**

Further simulations are shown below in **Plates AF-AG**.

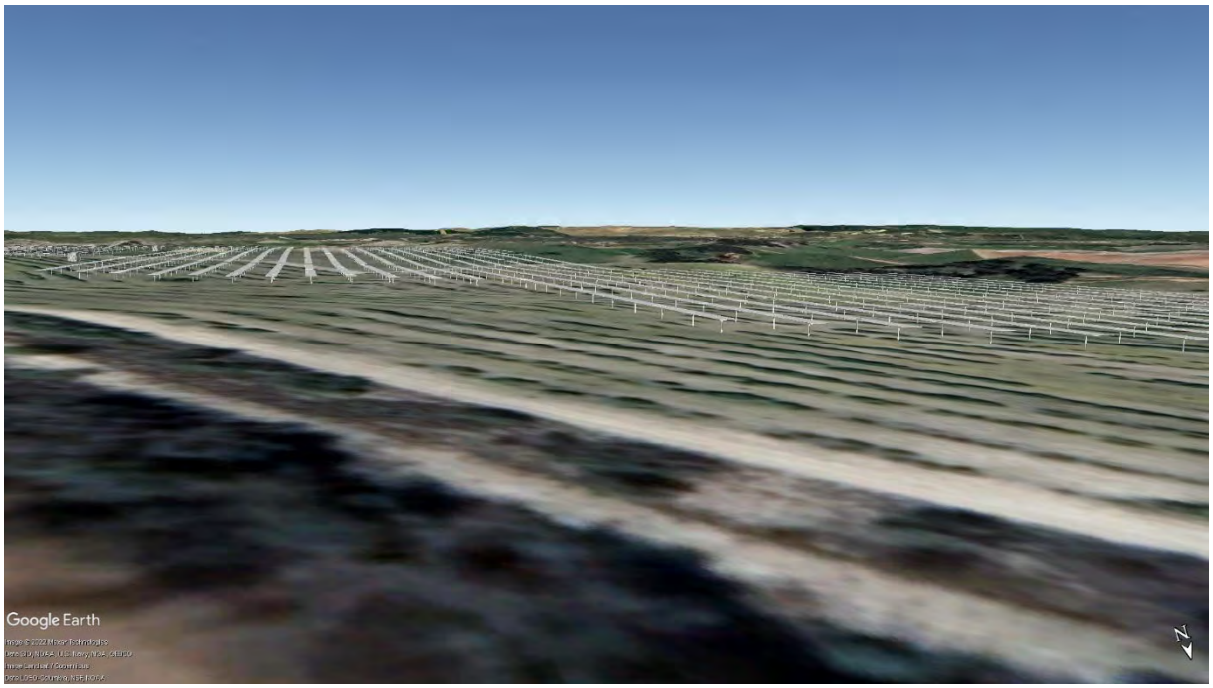



**Plate AF simulation of proposed project sitting within the landscape from the South**




**Plate AG simulation of proposed project sitting within the landscape from the South (showing surrounding paddock)**

## *VISUAL MANAGEMENT MEASURES*

**Distance and Buffers**
In the first instance siting of the project has been to maximise distance to any key feature and therefore avoid it. Setbacks and buffers are proposed to the solar facility to minimise any potential impacts to the surrounding areas, especially Minyulo Brook and the roads.

**Choice of infrastructure**
With the selection of fencing, barbed wire which is often usual practice has been excluded from the design. This softens the barrier to views in and out of the project site.

**Treatments**
Treatments to soften the potential visual impacts have been proposed for the project. This includes vegetation planting and/or screening where applicable along fence lines to soften the barrier of the fencing to natural landscapes especially the Minyulo Brook area to blend with the landscape.

## *RECOMMENDATIONS AND MONITORING*

In general in the overall landscape the project is unlikely to change the views and if so it will be minimal. The project is unlikely to change the overall character of the area and will not be prominent. With the proposed siting of the solar array and vistas in and out of the site, the project is minimising any visual impacts with the distance/ setbacks/ buffers from major features, choice of infrastructure and treatments proposed. During the construction process and 25 year life of the project, monitoring to ensure that vistas are maintained (through photography and drone imagery) with the management measures is proposed to be implemented and documented.

**Compliance Evaluation**

**COMPLIES:** The potential visually impact on the landscape with the development of the solar facility, is unlikely to impact the overall landscape and seeks to retain and avoid impacting natural environmental and cultural areas, and minimise any impact on infrastructure such as roads.

## 4.3 REGIONAL INSTRUMENTS

### 4.3.1 Wheatbelt Regional Planning and Infrastructure Framework Parts 1 and 2 (WRPIF)

The project is situated in the Shire of Dandaragan which is in the Wheatbelt region. The planning and infrastructure framework therefore applies. The WRPIF is considered a B2 document (regional strategy) under *State Planning Policy 1: State Planning Framework Policy*.

Vision:

*The Wheatbelt will have a diverse social and economic base, be a leader in innovation and create new opportunities that confirm it as a key contributor to the State's prosperity.(p10)*

The objectives of this framework are to:

***Liveable Communities objectives***

*Effective infrastructure and service delivery that:*
*• responds to local knowledge and values;*
*• accommodates the Wheatbelt's linkages to other regions;*
*• builds on the interconnectedness of settlements;*
*• assists and promote sustainable growth and cater for the needs of communities;*
*• recognises the current and changing demographics of the region; and*
*• seek to attract and retain a diverse population.*

***Vibrant Economy objectives***

*A diversified and adaptive economy that:*
*• increases its contribution to the Western Australian economy;*
*• benefits from innovation in the primary production sector; and*
*• enables diversification through the establishment and growth of new and innovative industries.*

***Valued Natural Amenity objective***

*Environmental and landscape values that support the social, cultural and economic development of the region, and are managed for current and future generations.*

**Energy in the Wheatbelt Region**

*The Wheatbelt is supplied with energy by Western Power's South West Interconnected System and serviced by the North and East Country load areas. The East Country load area covers the eastern Wheatbelt region. Growth in power demand was slow prior to 2007 and then experienced a significant increase due to mining and resource development in the area. The North Country load area services the northern area of the Wheatbelt, covering the coastal areas to 150 kilometres inland. The North Country network was designed to supply small distributed loads and as such, infrastructure limitations have resulted in insufficient capacity for large industrial customers to connect. To address the capacity limitations, Western Power has planned the Mid-West Energy Project. The project will create greater network capacity and support industry and mining growth along the line. For the Wheatbelt, this project may facilitate new power generation projects such as wind farms planned for the coastal area.*

*The geographic reach of the South West Interconnected System is vast, and supply can be variable in the extremes of the network. The large number of aged wooden power poles also creates ongoing management issues for suppliers, and replacement and maintenance programs are unable to deal with all of them.*

*The Wheatbelt offers an abundant source of renewable energy. The climatic and geographic conditions of the Wheatbelt are conducive to alternative energy generation such as wind, solar, geothermal and biomass generation. Renewable energy offers the capacity to reduce reliance on centrally distributed energy. A number of wind farms already exist, for example the Collgar Wind Farm near Merredin (the largest single stage wind-farm in the southern hemisphere) and Emu Downs near Cervantes, and there is potential to establish other alternative energy initiatives particularly in the coastal areas where energy demand is increasing.*

The project is located within the South West Interconnected System as shown at **Figure 13.**

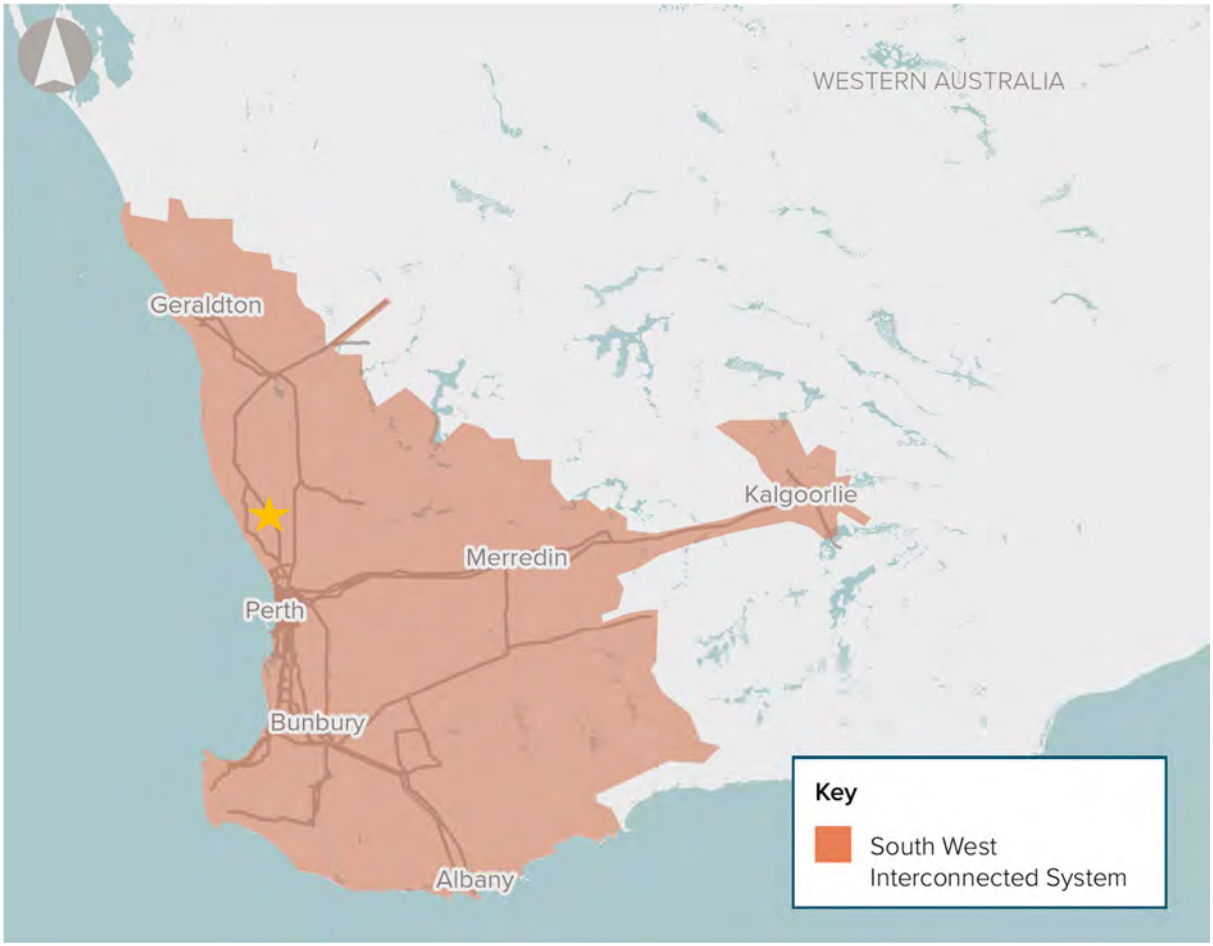



**Figure 13:** South West Interconnected System area

**Table 15.** WRPIF Evaluation

| Objective | Project Evaluation |
|---|---|
| Liveable communities | Site selection is based on respecting the values in the area from a cultural, rural and environmental perspective. |
| Vibrant economy | The project contributes to the renewable resource industry within the region |
| Valued Natural Amenity | The project supports overall sustainability of the region by avoiding and minimising any impact on social/cultural, economic and environmental/ landscape values in the area and region (refer also to section 4.2.13). |
| Energy | The project supports the aims of energy provision in the region by providing a renewable energy source to a major user in the local area. As mentioned the capacity to provide energy into the SWIS is limited at present and in the future may be supplied to the public on the open market. |

**Compliance Evaluation**

**COMPLIES:** The project links to contributing positively to a vibrant economy as well as providing (maintaining) valued natural amenity in the local area and therefore the region. By providing a renewable energy source this will reduce carbon emissions and reliability on non-renewable energy resources. The natural landscape and environment will not be adversely affected by the project.

The project will generate renewable energy for the Iluka Cataby Mine Site and the local grid long term, therefore supporting the WA governments target to reduce greenhouse gas emissions by 80% by 2030.

Energy from the project will be fed into the grid providing power to major user (landowner), supporting the resources sector and not oversupplying the overall SWIS network in the short term.

The *Guilderton to Kalbarri Sub-regional Strategy May 2019* was reviewed but relates to the coastal areas and not to the project site. Therefore, the sub strategy has not been addressed within this report.

## 4.4 LOCAL INSTRUMENTS

### 4.4.1 Strategic Community Plan – Envision 2029

The Strategic Community Plan - Envision 2029 itemises the priority areas for the community in the Shire of Dandaragan.

The priorities that relate to the project are:

**Table 16.** Envision 2029 Evaluation

| Attribute | Project Evaluation |
|---|---|
| **Infrastructure**<br>*The Shire will sustain a dynamic infrastructure network responsive to usage demand that attracts and retains residents and businesses (p6).* | The project will contribute to energy infrastructure in the Shire of Dandaragan. |
| **Environment**<br>*The Shire will be a responsible custodian of the environment, working with community groups and other entities to increase renewable energy initiatives, vegetation cover and rehabilitate degraded public land throughout the local region (p6).*<br><br>***(Priority Outcome)***<br>*Our region is recognised as the centre of renewable energy in WA.*<br><br>***(Shire role)** Support renewable energy initiatives and encourage further renewable industry development. Advocate for the improvement to the local electricity distribution network and linkages to the numerous renewable energy sources within the Shire.(p19)* | The project will support the Shire in increasing renewable energy initiatives whilst retaining the environmental values in the area.<br><br>The project will also contribute to the region being recognised as the centre of renewable energy in Western Australia and possibly improve the network locally by alleviating the load by providing energy to a major user in the area. |
| **Prosperity**<br>*The Shire will experience broad economic and population growth with decreasing economic barriers, diversified agriculture and fisheries output and a vibrant visitor economy.* | PWR Hybrid are committed to sourcing regional and Indigenous sub-contractors wherever possible for the project. During the construction period PWR has set a target to source 15% of the construction workforce from the region. |
| **Community**<br>*The Shire's resident population will grow more than the WA regional average supported by increased community recreation and cultural opportunities and access to key liveability factors such as health and wellbeing services and educational opportunities.* | PWR support and the landowner support the community especially by providing local employment opportunities. |

**Compliance Evaluation**

**COMPLIES:** The project is consistent with the community's priorities and will not adversely affect the overall community or the environment. The project will positively contribute to the Shire achieving its renewable energy initiatives.

### 4.4.2 Envision 2029 – Economic and Tourism Development Strategy

The Economic and Tourism Development Strategy supports the Strategic Community Plan - Envision 2029 and itemises the priority areas for supporting and investing with the community in the Shire of Dandaragan. In relation to renewable energy projects, the following relates to the project. Please also refer to section 4.4.1 and **Table 17**.

Economic

*- Support future renewable energy projects*

*- Work with project proponents to maximise local content and job creation*

*- Promote various recreational and tourism activities to major project crews*

*- Investigate community investment in new renewable energy projects*

*- Showcase industry and business with off-grid energy solutions*

*- Support new projects that prioritise a residentially based workforce. (p25).*

**Table 17.** Envision 2029 Economic and Tourism Strategy Evaluation

| Attribute | Project Evaluation |
|---|---|
| Showcase industry and business | The project provides an "off grid" energy solution in the short term with potential to contribute to the SWIS gris in the long term. |
| Support future renewable energy projects | The project provides a renewable energy source. |

**Compliance Evaluation**

**COMPLIES:** The project is consistent with the Shire of Dandaragan's economic priorities and the Shire's support of community of investment in renewable energy projects.

### 4.4.3 Local Planning Strategy

The Local Planning Strategy provides the vision and goals for community development in the Shire of Dandaragan as follows:

**Vision**

*A dynamic, diverse and desirable region delivering sustainable growth and socially connected communities.*

**Goals/aspirations:**

*1. Infrastructure*
*The Shire will sustain a dynamic infrastructure network responsive to usage demand that attracts and retains residents and businesses.*

*2. Prosperity*

*The Shire will experience broad economic and population growth with decreasing economic barriers, diversified agriculture and fisheries output and a vibrant visitor economy.*

*3. Environment*

*The Shire will be a responsible custodian of the environment, working with community groups and other entities to increase renewable energy initiatives, vegetation cover and rehabilitate degraded public land throughout the local region.*

*4. Community*

*The Shire's resident population will grow more than the WA regional average supported by increased community recreation and cultural opportunities and access to key liveability factors such as health and wellbeing services and educational opportunities (p9).*

Relevant elements of the strategy to the project are addressed in **Table 18**.

**Key Issues**

**Issue 3 Economy**

*Renewable energy production in the Central Coast Sub-region (including the Shire of Dandaragan) continues to be an industry with considerable potential based on conducive environmental characteristics (such as consistent sunlight and coastal winds). The proximity of the Shire to the Perth Metropolitan Region means there may be a captive market for additional energy capacity produced in the Shire (p11).*

*Mineral sands are a key resource in the region and there are operating mines extracting and exporting this commodity. Further exploration to identify higher grade deposits of various commodities will be required if this sector is to grow in terms of output and employment opportunities. Access to basic raw materials, which are a key component of building and construction, needs to be protected from incompatible land uses (p11).*

**Issue 4 Land use**

***Rural***

*Agricultural activity remains the principal economic activity in the Shire. There is a desire to introduce greater flexibility into the Rural zone so that a wide range of land uses associated with primary production and intensified rural uses, such as food production and/or manufacturing, can be accommodated. The availability of groundwater in conjunction with high quality agricultural land may provide opportunities to support food production and manufacturing in localities with existing services and good transport connections to the Perth Metropolitan Area. In addition, issues relating to boundary realignments to promote better farming efficiencies and the creation of homestead lots to accommodate retiring farmers need to be addressed.*
(p13)

**Issue 5: Social and physical infrastructure**

***Power***

*Western Power's South West Interconnected System (SWIS) is the primary electricity grid supplying the Shire with the Shire falling within the coastal district area of the Country North Region. Energy production within the SWIS derives predominantly from black coal, natural gas and oil. Significant population growth, such as any scenario where population of Jurien Bay exceeds 20,000 residents, will have implications for the current 33kV distribution network which would need to be updated to 132kV. Opportunities for the renewable energy sector to provide electricity to intensified agricultural activities may also have some capacity for servicing the Shire's settlements.(p14)*

**Issue 6: Physical environment**

***Biodiversity***

*The Shire is located within the Mount Lesueur-Eneabba region and the Lesueur area has been identified as a biodiversity hotspot, reflecting the diversity and uniqueness of the flora, as well as the threats to its continued existence. The challenge for the future will be to manage important biodiversity assets when changes to current land use and development are proposed so that risks to rare and priority species are minimised and locally significant species are protected.*

***Landscape protection***

*The landscape in the western portion of the Shire is significant at a State level for a combination of reasons, including: its open character, with its low dunes carpeted in low-growing heath, providing extensive views across pristine-appearing landscapes; the occasional elevated flat topped hills; the great diversity of plant species which provides an exceptionally colourful display in spring, bringing visitors from around the world; the large, white, mobile dunes near the coast; and ocean vistas that include surf breaking over reefs. The general lack of development visible from major travel routes is unusual, given the Shire's proximity to the Perth Metropolitan area. The key issue in relation to landscapes is to maintain its valued characteristics as the Shire continues to develop*.

***Protection of ground and surface water***

*There are two proclaimed groundwater areas within the Shire - the Jurien Groundwater Area and the Gingin Groundwater Area. The protection and sustainable use of these groundwater areas is critical for supporting the growth of Jurien Bay as a regional centre and for attracting new agricultural industries that require significant water allocations but have been displaced from locations closer to the Perth Metropolitan area. Given the limited and declining rainfall throughout the Shire, use of groundwater needs to be balanced across a range of land uses. The protection of the Hill River resource and associated riverine environment is particularly important so land use impacts must be managed in this area.*

***Bushfire risk***

*Vegetated areas of the Shire are vulnerable to bushfires. There are also risks associated with the drying climate and settlement expansion. Understanding and managing bushfire risk will be a crucial aspect of future land use planning. There is, however, a need to find a balance between managing bush risk and those aspects of the natural environment that are drawcards to visitors, economic drivers and settlement (p15-16).*

***Issue 7: Native title and cultural/historic heritage***

***Aboriginal heritage***

*The Aboriginal Heritage Act 1972 provides for the identification and protection of Aboriginal sites throughout Western Australia. There are approximately 15 registered sites in the Shire. Land use planning has a role in ensuring these sites are protected.*

The AH Act will be repealed and replaced by the *Aboriginal Cultural Heritage Act 2021* on 1 July 2023 and is addressed in section 4.2.12.

***Historic heritage***

*The Shire's municipal inventory identifies 61 sites and there are a further 10 sites identified by the National Trust within the Shire. Historical heritage reflects the Shire's ties to the agriculture sector, and the role of its coastal settlements in the development of the Wheatbelt region. Land use planning has a role in ensuring these sites are protected.*

***Native title***

*The South West Native Title Settlement is the most comprehensive Native Title agreement negotiated in Australian history. Work is currently underway to identify Crown land for possible inclusion into the Noongar Land Estate for a range of purposes, including development. Following finalisation of the South West Native Title Settlement, it will be imperative to include the Yued Noongar people as the custodians of the land in future planning in the Shire (p16-17).*

**Table 18.** Local Planning Strategy Evaluation

| Attribute | Project Evaluation |
|---|---|
| Economy | The project will contribute to the local economy and the captive market for additional energy capacity production in the Shire and reducing GHG emissions. Refer to sections 4.4.1 and 4.4.2. |
| Land use | The project will not adversely effect the surrounding landuse (mining and agriculture) and will return to "rural" on completion. |
| Power | The project will provide a renewable energy resource |
| Physical environment | The project will not have an adverse impact on the environment (biodiversity, flora and fauna). Refer to section 4.2.8. |
| Bushfire risk | The project is not within a Bushfire Prone Area and buffered by roads and firebreak areas to minimise risk to the community and the environment. Refer to section 4.2.4. |
| Aboriginal cultural heritage/ Native title | The project will not adversely impact Aboriginal cultural values of the Yued community in the area. Refer to section 4.2.12. |
| Historic heritage | Not applicable, there are no sites within the project and surrounding area. |

**Compliance Evaluation**

**COMPLIES:** The project is consistent with the Local Planning Strategy by supporting the economy, providing a renewable energy resource; avoiding, minimising any potential impacts to the environment, Aboriginal cultural values and to the community.

### 4.4.4 Shire of Dandaragan Local Planning Scheme No. 7 (LPS No.7)

The Shire of Dandaragan Local Planning Scheme (LPS No.7) provides the local statutory framework for development and land use. An assessment of the project against the provisions of the Scheme is provided as follows:

The aims of the LPS No. 7 scheme are:

- *Protection of the Shire of Dandaragan's viable agricultural base.*
- *Protection and enhancement of the environmental values and natural resources and to promote ecologically sustainable land use and development.*
- *Identification of urban expansion areas and future industrial areas.* Not applicable.
- *Develop a strategy to determine what level of development should occur in the towns of Jurien Bay, Cervantes, Badgingarra and Dandaragan.* Not applicable.
- *Promote and foster the recreation potential of special features within the Shire of Dandaragan.* Not applicable.
- *Protect environmentally sensitive waterways throughout the Shire in recognition of their special management requirements.*
- *Protection of the rural vista adjacent to highways.*
- *Identify opportunities for subdivision, particularly rural residential lots and lots between 10 and 20 hectares.* Not *applicable.*
- *Provide for planning which is responsive to the changing needs of the community and advancements in technology.*
- *Protection of basic raw material deposits through the Shire.*
- *The need for an integrated catchment management based approach to planning issues. (p10)*

The relevant aims of the Scheme are evaluated in **Table 19.**

Rural Zone objective is:

*To provide for a range of rural activities such as broadacre and diversified farming so as to retain the rural character and amenity of the locality, in such a way as to prevent land degradation and further loss of biodiversity.(p13).*

**Table 19.** LPS No. 7 Evaluation

| Attribute | Project Evaluation |
|---|---|
| SCHEME – Aims applicable | |
| *Protection of the Shire of Dandaragan's viable agricultural base.* | The "rural" zoning is not proposed to be changed. At the end of its life the solar facility would be decommissioned and the land would revert to the landuse of "agriculture" long term. |
| *Protection and enhancement of the environmental values and natural resources and to promote ecologically sustainable land use and development.* | The project is avoiding and minimising any potential impacts to the environment. Refer to sections 3.2.3, 3.2.4, 4.2.8 and 4.2.10 for the environmental assessment. |
| *Protect environmentally sensitive waterways throughout the Shire in recognition of their special management requirements.* | The project is avoiding and minimising any potential impacts to the waterways. Refer to sections 3.2.3, 3.2.4, 4.2.8 and 4.2.10 for the environmental assessment. |
| *Protection of the rural vista adjacent to highways.* | The rural vistas are not adversely affected from Brand Highway with no disturbance of the native vegetation verge. Refer to section 4.2.13. |
| *The need for an integrated catchment management based approach to planning issues.* | The surface water management to Minyulo Brook will be managed in conjunction with the surrounding landowner to ensure an integrated approach to catchment management. Refer to section 4.2.8. |
| ZONING – RURAL | |
| *To provide for a range of rural activities such as broadacre and diversified farming so as to retain the rural character and amenity of the locality, in such a way as to prevent land degradation and further loss of biodiversity.(p13).* | The character of the area is not proposed to change with the solar facility. The surface will be vegetated to provide some continuity of paddock vegetation and vistas. Refer to section 4.2.13. |
| LAND USE DEFINTION – Undefined | |
| The land use is not defined in the Local Planning Scheme No. 7 | This assessment is based on addressing the Shire of Dandaragan Local Planning Strategy and LPS No. 7 requirements as well as Envision 2029. |
| ADVERTISING OF APPLICATION | |
| Shire of Dandaragan | To be advertised, preliminary consultation undertaken with the Shire of Dandaragan, landholders in the area and the Yued community. |
| SUPPORTING MATERIAL/ INFORMATION REQUIREMENTS | |
| Location | 11019 Brand Highway Cataby WA 6507.<br>Part of Lot 101 DP66701; Volume 1700 Folio 771) |
| Proposed Land Use | Solar facility |

| Attribute | Project Evaluation |
|---|---|
| Access | Via Marianna's Road (non-gazetted road) off Brand Highway, Cataby. No direct access from Brand Highway. |
| Car Parking | Not required as no occupants on site. Parking/ laydown area for maintenance and servicing of the solar array. |
| Loading/Unloading zones | Not applicable (no ongoing deliveries). |
| Storage | Not applicable. Storage of energy may be considered in the future if feasible. |
| Open Space | Not applicable (no occupants). |
| Plans/Elevations | Provided within this report and the relevant plans/figures as a separate document (A3). |
| Specialist studies | Attached in this report (refer to **Appendices**). |
| Other information | The development envelope and setbacks (at least 10m away from adjoining uses) have been provided for the proposed project area. Refer to **Figure 2**. |

**Compliance Evaluation**

**COMPLIES:** The project is consistent with the aims and objectives of the Shire of Dandaragan Local Planning Scheme No. 7 (scheme aims, zoning objective and as an undefined landuse) in the "Rural" Zoning.

### 4.4.5 Community Consultation

Preliminary consultation has been undertaken for the project with the surrounding landholders, leaseholders and community, the Shire of Dandaragan, Yued Corporation and applicable government agencies (for example, Western Power). The Development Application will be advertised as per the assessment process.

## 4.5 INDUSTRY GUIDELINES/ OTHER INSTRUMENTS

There are no specific guidelines for solar facilities, Good Engineering Practice will be implemented on site. The South West System (SWIS) and the project integrating long term will hopefully contribute to the network to assist in alleviating demand in the future.

**SWIS Demand Assessment 2023 to 2042. A future ready grid. (Government of Western Australia 2023)**

*The SWIS Demand Assessment is an initial assessment of potential future electricity demand required over the next 20 years to meet industry and Government commitments of achieving net zero greenhouse gas emissions by 2050.* (p4).

*Using renewable electricity is one of the most cost effective ways of moving to a net zero future. Through consultation with existing and potential new industry stakeholders, a range of potential demand scenarios were considered. Under all scenarios Western Australia's main transmission network would need to grow significantly to meet industrial demand.*

*The 'Future Ready' scenario shows peak demand would almost triple by 2042. This would require almost 10 times the current amount of generation and storage capacity, and over 4,000 km of new transmission lines to transport that energy from where it is produced to where it is used.*

*Replacing thermal generation with zero emissions electricity requires substantially more renewable generation and energy storage capacity. This is because the amount of electricity wind and solar generators can produce varies significantly with the wind and sun resources available at any time.*

*The modelling shows new renewable generation will need to be installed across the SWIS, as well as in areas with high quality renewable resources outside the existing SWIS footprint.*

The assessment provides three demand growth scenarios, high, extreme and future ready. The preferred, future ready, provides stages for network augmentation to deliver a reduction in emissions, investing in the network and connecting more renewable generation in the future.

**Compliance Evaluation**

**COMPLIES:** The solar facility project provides a renewable source of energy that has the potential to contribute to the SWIS and assist in meeting the demand from users in the future.

# 5 OVERALL IMPACT ASSESSMENT

Overall the project has been assessed against the Commonwealth, State Regional and Local instruments relevant to the project. A brief summary is of the primary factors is provided below:

**Aviation -** Not applicable.

**Heritage** - no built heritage. Minyulo Brook is a registered Aboriginal cultural heritage site (no. 28263) under the *Aboriginal Heritage Act 1972*. No proposed impact to the brook.

**Landscape and Visual Impact Assessment** - minimal impact to Brand Highway to the East; Marianna's Road to the South; Minyulo Brook to North; outlook from paddock tagasaste/ grasses/ *Eucalyptus todtiana* to paddock with panels and vegetative cover, being minimal impact. Fencing proposed to be vegetated along the line to create similar ambience to the brook and its vegetation.

**Noise** no long term impact or monitoring required except at time of construction and will be monitored with the landowner.

**Traffic** no impact except at time of construction (estimate of 10-20 vehicle movements per day), Vehicles entering from Marianna's Road with no direct access from Brand Highway.

**Fauna** no impact. Carnaby's Cockatoos not present in the project area and the site does not have foraging, roosting or breeding habitat. No impact to aquatic fauna with flows maintained to Minyulo Brook.

**Flora and Vegetation** no to minimal impact. The paddock will be cleared for the project area including up to 15 trees (*Eucalyptus todtiana* not threatened species) with tagasaste (tree lucerne) and grasses and be avoided where possible.

**Drainage** – proposed to maintain overland flows minimising any impact to Minyulo Brook and the community.

**Shadow Flicker.** Not applicable

**Electromagnetic Interference** – compliance will be within the limits required by Western Power Technical Rules (1 December 2016, Rev 3) specifically clause 2.2.6:

*2.2.6 Electromagnetic interference*

*Electromagnetic interference caused by equipment forming part of the transmission and distribution system must no exceed the limits set out in Tables 1 and 2 of Australian Standard AS2344 (1997).*

# 6 CONCLUSION

The proposed development of a solar facility at Cataby overall will not have a significant impact on the environment, cultural or social values of the landscape and the community as it avoids in the first instance any direct impacts and proposes to mitigate and manage any potential indirect impacts.

# 7 ACRONYMS

| | |
|---|---|
| AC | Alternating current |
| ACH Act | *Aboriginal Cultural Heritage Act 2021* |
| AEP | Annual exceedance probability |
| AH Act | *Australian Heritage Act 1972* |
| AHD | Australian Height Datum |
| BAM Act | *Biosecurity and Agriculture Management Act 2016* |
| BC Act | *Biodiversity Conservation Act 2016* |
| C'th | Commonwealth |
| DC | Direct current |
| DCCEEW | Department of Climate Change, Energy, the Environment and Water (C'th) |
| DPLH | Department of Planning Lands and Heritage (WA) |
| EPA | Environmental Protection Authority (WA) |
| EPA Act | *Environmental Protection Act 1986* |
| EPBC Act | *Environmental Protection and Biodiversity Conservation Act 1999* |
| Ha | Hectare |
| km | Kilometre |
| KVA | Kilo volt amps |
| KW | Kilowatt |
| KWp | Kilowatt of power |
| LPS | Local Planning Scheme |
| m | Metre |
| MW | Megawatt |
| MWp | Megawatt of power |
| NPR | Noise power ratio |
| RET | Renewable energy target |
| PD Act | *Planning and Development Act 2005* |
| RE(E) Act | *Renewable Energy (Electricity) Act 2000* |

| | |
|---|---|
| SPP | State Planning Policy |
| SPS | State Planning Strategy |
| SWIS | South West Interconnected System |
| WA | Western Australia |
| WAPC | Western Australian Planning Commission |

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# 9 APPENDICES

# APPENDIX A – JINKO SPECIFICATION SHEET

www.jinkosolar.com

Solar JinKO
Building Your Trust in Solar

# Tiger Neo N-type 72HL4-BDV

## 560-580 Watt

BIFACIAL MODULE WITH DUAL GLASS

**N-Type**

Positive power tolerance of 0~+3%

IEC61215(2016), IEC61730(2016)

ISO9001:2015: Quality Management System

ISO14001:2015: Environment Management System

ISO45001:2018
Occupational health and safety management systems



## Key Features

### SMBB Technology

Better light trapping and current collection to improve module power output and reliability.

### Hot 2.0 Technology

The N-type module with Hot 2.0 technology has better reliability and lower LID/LETID.

### PID Resistance

Excellent Anti-PID performance guarantee via optimized mass-production process and materials control.

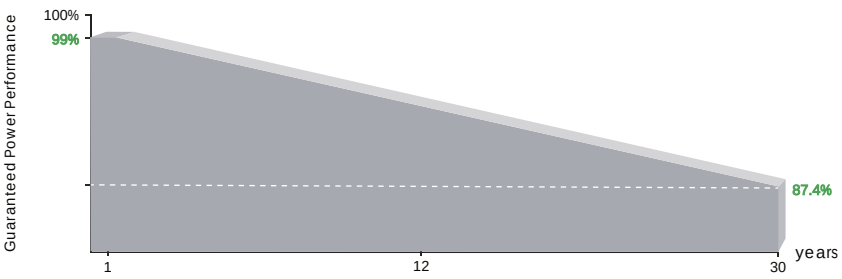
### Enhanced Mechanical Load

Certified to withstand: wind load (2400 Pascal) and snow load (5400 Pascal).

### Higher Power Output

Module power increases 5-25% generally, bringing significantly lower LCOE and higher IRR.

## LINEAR PERFORMANCE WARRANTY

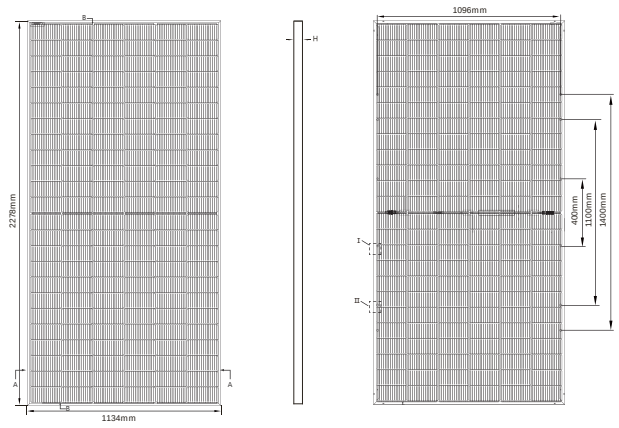



**12** Year Product Warranty

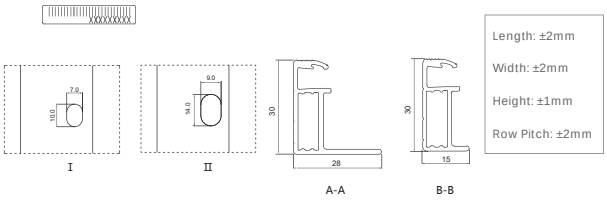
**30** Year Linear Power Warranty

**0.40%** Annual Degradation Over 30 years

## Engineering Drawings




Front Side Back




*This tolerance range applies only to the four-angle distance of the module as indicated above.

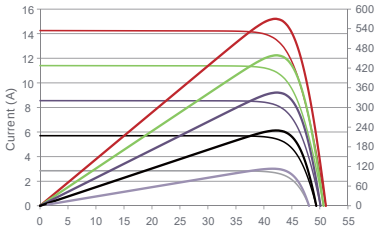
## Packaging Configuration

( Two pallets = One stack )

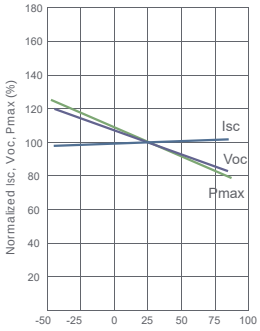
36pcs/pallets, 72pcs/stack, 720pcs/ 40'HQ Container

## Electrical Performance & Temperature Dependence

Current-Voltage & Power-Voltage Curves (570W)




Temperature Dependence of Isc,Voc,Pmax




## Mechanical Characteristics

| | |
|---|---|
| Cell Type | N type Mono-crystalline |
| No. of cells | 144 (2×72) |
| Dimensions | 2278×1134×30mm (89.69×44.65×1.18 inch) |
| Weight | 32 kg (70.55 lbs) |
| Front Glass | 2.0mm, Anti-Reflection Coating |
| Back Glass | 2.0mm, Heat Strengthened Glass |
| Frame | Anodized Aluminium Alloy |
| Junction Box | IP68 Rated |
| Output Cables | TUV 1×4.0mm²<br>(+): 400mm , (-): 200mm or Customized Length |

## SPECIFICATIONS

| Module Type | JKM560N-72HL4-BDV | | JKM565N-72HL4-BDV | | JKM570N-72HL4-BDV | | JKM575N-72HL4-BDV | | JKM580N-72HL4-BDV | |
|---|---|---|---|---|---|---|---|---|---|---|
| | STC | NOCT | STC | NOCT | STC | NOCT | STC | NOCT | STC | NOCT |
| Maximum Power (Pmax) | 560Wp | 421Wp | 565Wp | 425Wp | 570Wp | 429Wp | 575Wp | 432Wp | 580Wp | 436Wp |
| Maximum Power Voltage (Vmp) | 41.95V | 39.39V | 42.14V | 39.52V | 42.29V | 39.65V | 42.44V | 39.78V | 42.59V | 39.87V |
| Maximum Power Current (Imp) | 13.35A | 10.69A | 13.41A | 10.75A | 13.48A | 10.81A | 13.55A | 10.87A | 13.62A | 10.94A |
| Open-circuit Voltage (Voc) | 50.67V | 48.13V | 50.87V | 48.32V | 51.07V | 48.51V | 51.27V | 48.70V | 51.47V | 48.89V |
| Short-circuit Current (Isc) | 14.13A | 11.41A | 14.19A | 11.46A | 14.25A | 11.50A | 14.31A | 11.55A | 14.37A | 11.60A |
| Module Efficiency STC (%) | 21.68% | | 21.87% | | 22.07% | | 22.26% | | 22.45% | |
| Operating Temperature(℃) | -40℃~+85℃ | | | | | | | | | |
| Maximum system voltage | 1500VDC (IEC) | | | | | | | | | |
| Maximum series fuse rating | 30A | | | | | | | | | |
| Power tolerance | 0~+3% | | | | | | | | | |
| Temperature coefficients of Pmax | -0.30%/℃ | | | | | | | | | |
| Temperature coefficients of Voc | -0.25%/℃ | | | | | | | | | |
| Temperature coefficients of Isc | 0.046%/℃ | | | | | | | | | |
| Nominal operating cell temperature (NOCT) | 45±2℃ | | | | | | | | | |
| Refer. Bifacial Factor | 80±5% | | | | | | | | | |

## BIFACIAL OUTPUT-REARSIDE POWER GAIN

| | | | | | | |
|---|---|---|---|---|---|---|
| 5% | Maximum Power (Pmax) | 588Wp | 593Wp | 599Wp | 604Wp | 609Wp |
| | Module Efficiency STC (%) | 22.76% | 22.97% | 23.17% | 23.37% | 23.57% |
| 15% | Maximum Power (Pmax) | 644Wp | 650Wp | 656Wp | 661Wp | 667Wp |
| | Module Efficiency STC (%) | 24.93% | 25.15% | 25.37% | 25.60% | 25.82% |
| 25% | Maximum Power (Pmax) | 700Wp | 706Wp | 713Wp | 719Wp | 725Wp |
| | Module Efficiency STC (%) | 27.10% | 27.34% | 27.58% | 27.82% | 28.07% |

*STC: Irradiance 1000W/m² Cell Temperature 25°C AM=1.5

NOCT: Irradiance 800W/m² Ambient Temperature 20°C AM=1.5 Wind Speed 1m/s

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Specifications included in this datasheet are subject to change without notice.

# APPENDIX B – GOLDER GEOTECHNICAL REPORT 2022

GOLDER
MEMBER OF WSP

**REPORT**

# Geotechnical Investigation

*Cataby Solar Farm*

Submitted to:

**Iluka Resources Limited**
240 St Georges Terrace
PERTH WA 6000

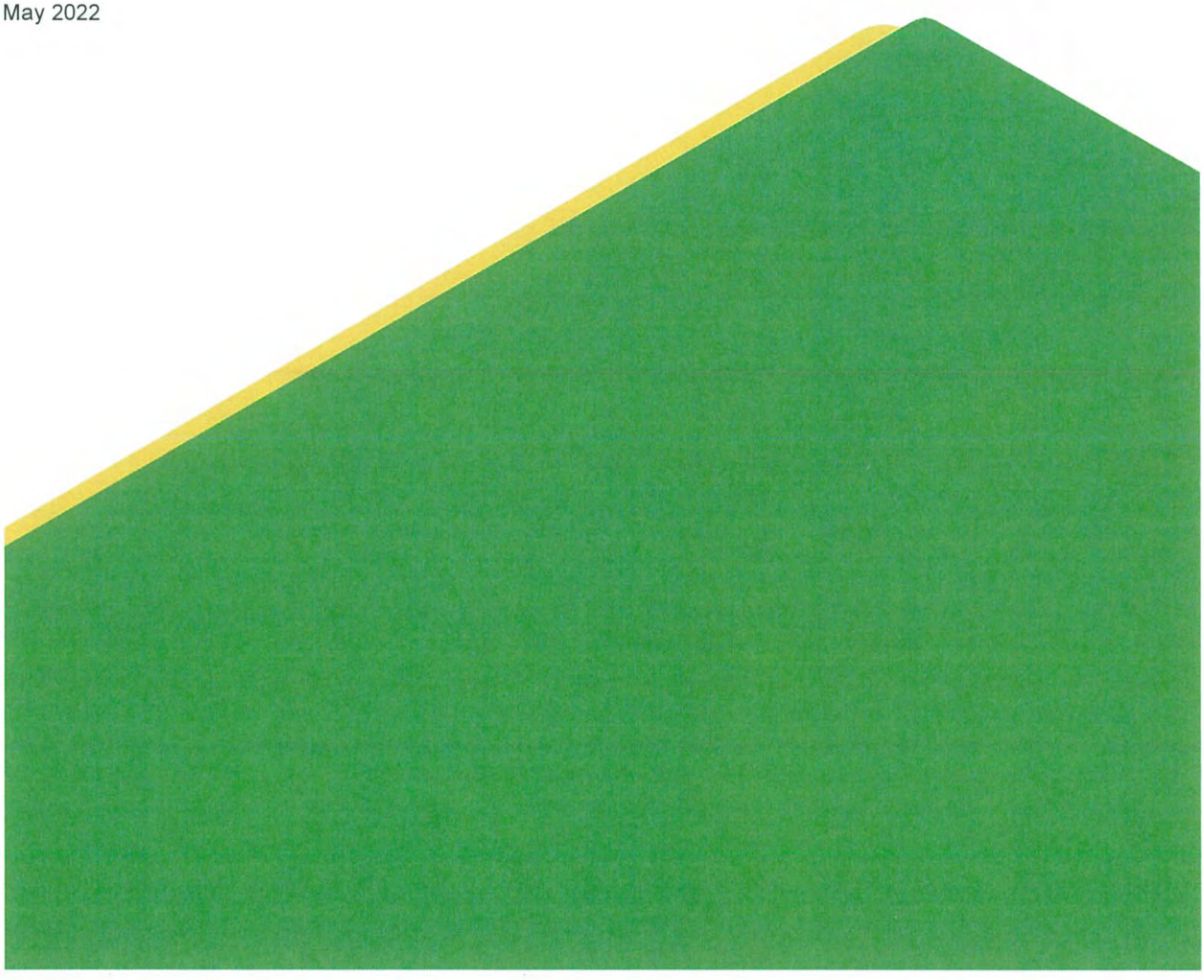
Submitted by:

**Golder Associates Pty Ltd**
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18108366-024-R-Rev0

May 2022



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# 1.0 INTRODUCTION

This report presents the results of the geotechnical investigation for the proposed Cataby Solar Farm located in Cataby, Western Australia. The investigation was requested by Farayi Nyausaru of Iluka Resources Limited via email received on 7 February 2022.

The proposed solar farm site covers an area of about 21.3 hectares and is located off Brandy Highway north of Cataby town. The location is shown on Figure 1.

The proposed solar farm is situated to the west of Brandy Highway within an area of lightly vegetated flat ground.

# 2.0 OBJECTIVES

The objectives of the investigation were to provide:

- Factual information including a site plan showing the test locations and field and laboratory test results.
- A description of surface and subsurface conditions likely to be experienced during construction of roads, foundations, and civil infrastructure.
- A description of the presence/depth of groundwater and recommendations for groundwater management (if encountered). This includes the estimation of groundwater levels from Cone Penetrometer Test (CPT) data if groundwater not encountered during test pitting.
- Recommendations for site preparation and earthworks including stripping, grubbing, compaction criteria, imported fill criteria, and suitability of the onsite soils for use as fill.
- Recommendations for the foundation type to be employed for racking systems and inverter storage structures.
- Recommendations for driven PV post foundations, including skin friction.
- Recommendations for shallow foundations and equipment pads, including bearing capacity, and estimated total and differential settlement.
- Recommendations on earthquake site factor in accordance with AS1170.4 Structure Design Actions-Earthquake action of Australia.
- Recommendations on unsealed pavements and design CBR values.
- Preliminary evaluation of soil corrosivity (pH, sulfate, and chloride) and sulfate attack potential, and recommended measures to be followed to prevent corrosion of steel and concrete piles.
- Recommendations for temporary excavations, including soil parameters.
- Recommendations for additional investigations.

# 3.0 FIELD RESULTS

## 3.1 Overview

The fieldwork for the investigation was conducted between 12 April and 19 April 2022 and comprised:

- Excavation of 6 test pits, TP01 to TP06, extending to depths of between 0.8 m and 2.1 m.
- Dynamic cone penetrometer (DCP) testing at each test pit location.

- Cone Penetrometer Testing with pore water pressure measurement (CPTu) at 10 locations, extending to depths between 2.0 to 10.0 m.
- Electrical resistivity testing at three locations, ER1 to ER3.
- Thermal conductivity testing at three locations given at depths of 0.3 m, 0.8 m and 1.3 m.
- Collection of soil samples for geotechnical and chemical testing.

The test locations are shown on Figure 2. The locations were positioned using a hand-held GPS typically accurate to within about 5 m. A summary table of the test location with coordinates is presented below in Table 1.

**Table 1: Test Location Details**

| Test ID | Test Type | Easting (MGA94) | Northing (MGA94) | Termination Depth (m) | Termination Reason/Comment |
|---|---|---|---|---|---|
| TP01 | Test Pit | 358102 | 6599849 | 2.7 | Collapse |
| TP02 | Test Pit | 357496 | 6600597 | 3.0 | Target Depth Reached |
| TP03 | Test Pit | 357323 | 6600800 | 3.0 | Target Depth Reached |
| TP04 | Test Pit | 357190 | 6600798 | 1.7 | Refusal |
| TP05 | Test Pit | 357267 | 6600683 | 3.0 | Target Depth Reached |
| TP06 | Test Pit | 358582 | 6599421 | 3.0 | Target Depth Reached |
| CPTU01 | CPT | 358102 | 6599849 | 10.2 | Target Depth Reached |
| CPTU02 | CPT | 357496 | 6600597 | 3.0 | Refusal |
| CPTU03 | CPT | 357323 | 6600800 | 4.1 | Refusal |
| CPTU04 | CPT | 357190 | 6600798 | 2.5 | Refusal |
| CPTU04A | CPT | 357190 | 6600798 | 2.1 | Refusal |
| CPTU05 | CPT | 357267 | 6600683 | 5.0 | Refusal |
| CPTU06 | CPT | 358582 | 6599421 | 10.2 | Target Depth Reached |
| CPTU07 | CPT | 357655 | 6600347 | 10.2 | Target Depth Reached |
| CPTU08 | CPT | 357367 | 6600718 | 4.4 | Refusal |
| CPTU09 | CPT | 357508 | 6600444 | 3.9 | Refusal |
| CPTU10 | CPT | 357692 | 6600189 | 10.2 | Target Depth Reached |
| TRT01 | Thermal Resistivity | 357655 | 6600347 | - | Adjacent test CTPU07 |
| TRT02 | Thermal Resistivity | 357367 | 6600718 | - | Adjacent test CTPU08 |
| TRT03 | Thermal Resistivity | 357879 | 6600052 | - | - |
| ERT01 | Electrical Resistivity | 358931 | 6599102 | - | - |
| ERT02 | Electrical Resistivity | 357655 | 6600347 | - | Adjacent test CTPU07 |
| ERT03 | Electrical Resistivity | 357367 | 6600718 | - | Adjacent test CTPU08 |

## 3.2 Test Pit Excavation

The test pits were excavated using a 13-tonne backhoe supplied and operated by ANH Contracting. The test pit reports are provided in Appendix A along with a list of notes and abbreviations and the method of soil description used on the reports. A geotechnical engineer from Golder located the test positions, logged the materials encountered in the test pits, collected samples for laboratory testing, and conducted the testing.

## 3.3 Dynamic Cone Penetrometer Testing

The DCP testing was conducted in accordance with AS 1289.6.3.2 to a termination depth of between 1.0 and 2.0 m on achieving target penetration depth. The results of the DCP testing are provided on the test pit reports in Appendix A.

## 3.4 Cone Penetrometer Testing

The CPT testing was carried out by Probedrill using a 22-tonne truck rig. The CPT output plots are provided in Appendix B.

## 3.5 Electrical Resistivity Testing

The electrical resistivity testing was completed using the 4-electrode Wenner Array method, with a Sonel MRU120 earth tester, at electrode spacings of 1 m, 1.5 m, 2 m, 3 m, 4.5 m, 6 m, 9 m, 13.5 m, 18 m, 22 m, 36 m, 54 m, 81 m (in one of the tests due to site constraints) and 100 m (in two of the tests). The traverses were generally conducted in north-south and east-west orientations and the average reading reported in Table 2.

**Table 2: Earth Electrical Resistivity Test Results**

| Electrode Spacing 'a' (m) | Resistance 'R' (ohms) | | | Apparent Resistivity $\rho = 2\,\pi a R$ (ohm.m) | | |
|---|---|---|---|---|---|---|
| | ER1 | ER2 | ER3 | ER1 | ER2 | ER3 |
| 1.0 | 91.2 | 595.0 | 1359.3 | 575.3 | 3754.8 | 8578.2 |
| 1.5 | 36.4 | 550.7 | 775.2 | 343.7 | 5200.0 | 7320.0 |
| 2.0 | 25.3 | 570.8 | 780.0 | 317.7 | 7181.1 | 9812.5 |
| 3.0 | 13.3 | 375.0 | 476.5 | 250.8 | 7072.0 | 8986.2 |
| 4.5 | 8.6 | 170.6 | 275.3 | 242.7 | 4824.2 | 7786.6 |
| 6.0 | 7.2 | 106.1 | 153.0 | 271.5 | 4000.4 | 5766.8 |
| 9.0 | 5.7 | 41.5 | 47.5 | 320.5 | 2345.0 | 2686.2 |
| 13.5 | 4.2 | 10.4 | 12.9 | 356.3 | 882.2 | 1094.2 |
| 18.0 | 3.5 | 4.4 | 2.5 | 399.6 | 497.6 | 282.8 |
| 22.0 | 1.8 | 2.2 | 1.5 | 248.8 | 304.1 | 207.4 |
| 36.0 | 1.5 | 1.7 | 1.1 | 339.3 | 384.5 | 248.8 |
| 54.0 | 0.7 | 0.8 | 0.5 | 242.0 | 271.4 | 169.7 |
| 81.0 | - | - | 0.5 | - | - | 254.5 |
| 100.0 | 0.3 | 0.9 | - | 188.5 | 565.5 | - |

## 3.6 In Situ Thermal Resistivity Testing

Thermal resistivity testing was carried out in the test pits using a Decagon KD2 Pro Thermal Properties Analyser with RK-1 single needle sensor. The testing was carried out according to the Decagon testing manual, which is generally in accordance with ASTM D5334-141: *Standard test method for determination of thermal conductivity of soil and soft rock by thermal needle probe procedure.* The testing was conducted in the sidewalls of test pits at 0.3 m, 0.8 m and 1.2 m depths.

The results of the field thermal resistivity testing is summarised in Table 3.

**Table 3: Thermal Resistivity Field Testing Summary**

| Test Location | Material Type | Test Depth Below Ground Level (m) | Thermal Resistivity (m°C/W) | Thermal Conductivity (W/m°C) |
|---|---|---|---|---|
| TRT01 | SAND | 0.3 | 0.72 | 1.38 |
| | | 0.8 | 0.82 | 1.23 |
| | | 1.2 | 0.90 | 1.11 |
| TRT02 | SAND | 0.3 | 0.66 | 1.51 |
| | | 0.8 | 0.34 | 2.96 |
| | | 1.2 | 0.38 | 2.60 |

[1] ASTM D5334-14 (2014): Standard Test Method for Determination of Thermal Conductivity of Soil and Soft Rock by Thermal Needle Probe Procedure, ASTM International

| Test Location | Material Type | Test Depth Below Ground Level (m) | Thermal Resistivity (m°C/W) | Thermal Conductivity (W/m°C) |
|---|---|---|---|---|
| TRT03 | SAND | 0.3 | 0.70 | 1.43 |
| | | 0.8 | 0.54 | 1.84 |
| | | 1.2 | 0.53 | 1.89 |

## 4.0 LABORATORY TESTING

Geotechnical laboratory testing was performed in the NATA-accredited laboratories of Golder and ALS and comprised determination of:

- Moisture content – eight tests
- Particle size distribution – six tests
- Atterberg limits and linear shrinkage – six tests
- Maximum dry density using modified compaction (MMDD) – three tests
- Soaked CBR – three tests
- pH, sulfate and chloride – five tests
- Electrical resistivity – five tests.
- Emerson Class Number testing on three samples

Laboratory test certificates are provided in Appendix C and a summary of the test results are presented in Table 4 and Table 5, which includes an assessment of the exposure classification in accordance with Table 6.4.2 and Table 6.5.2 of AS 2159-2009.

**Table 4: Summary of Geotechnical Laboratory Results**

| ID | Depth (m) | MC (%) | Particle Size Distribution (% comprising) | | | LL (%) | PI (%) | LS (%) | OMC (%) | MMDD (t/m³) | CBR (%) | Swell (%) | Emerson Class | Electrical Resistivity (ohm.m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Gravel | Sand | Fines (silt + clay) | | | | | | | | | |
| TP01 | 1.0 - 1.2 | 4.8 | 0.0 | 95.7 | 4.3 | SIB | ND | - | 13.0 | 1.75 | 16 | Nil | | 12 |
| TP02 | 0.3 - 0.5 | 4.3 | 0.0 | 95.4 | 4.6 | SIB | ND | - | - | - | - | - | 5 | 100 |
| TP03 | 0.5 - 0.7 | 2.1 | - | - | - | - | - | - | 10.5 | 1.82 | 18 | Nil | 5 | |
| TP03 | 2.8 - 3.0 | 6.5 | 3.4 | 71.1 | 26.5 | 24 | 14 | 2.5 | - | - | - | - | | 60 |
| TP04 | 1.0 - 1.2 | 3.7 | 15.3 | 68.1 | 16.6 | - | - | - | - | - | - | - | | 120 |
| TP04 | 1.5 - 1.7 | 8.3 | - | - | - | 27 | 15 | 3.0 | - | - | - | - | 5 | |
| TP05 | 0.5 - 0.7 | 3.3 | 0.0 | 94.2 | 5.8 | SIB | ND | - | - | - | - | - | | 85 |
| TP06 | 1.5 - 1.7 | 6.9 | 7.1 | 71.3 | 21.6 | SIB | ND | - | 7.0 | 2.02 | 5 | Nil | | |

Notes: MC = moisture content, LL = liquid limit, PI = plasticity index, LS = linear shrinkage, SIB = slip in bowl, ND = non determined

**Table 5: Summary of Exposure Classification (Aggressivity) Testing Results**

| ID | Depth (m) | pH | Sulfate (ppm) | Chloride (ppm) | Resistivity (ohm.m) | Exposure Classification for Steel | Exposure Classification for Concrete |
|---|---|---|---|---|---|---|---|
| TP01 | 1.0 – 1.2 | 5.3 | <10 | 30 | 2000 | Non-Aggressive | Mild |
| TP02 | 0.3 – 0.5 | 5.5 | <10 | 30 | 1670 | Non-Aggressive | Non-Aggressive |
| TP03 | 2.8 – 3.0 | 5.4 | 20 | 50 | 333 | Non-Aggressive | Mild |
| TP04 | 1.5 – 1.7 | 5.6 | 20 | 40 | 526 | Non-Aggressive | Non-Aggressive |
| TP05 | 0.5 – 0.7 | 5.6 | <10 | 40 | 1110 | Non-Aggressive | Non-Aggressive |

# 5.0 SITE CONDITIONS

The proposed site has previously been used as farmland and is generally flat ground with regularly spaced vegetation which may be remnants of an old orchard/plantation.

# 6.0 SUBSURFACE CONDITIONS

## 6.1 Geology

The 1:250,000 Moora sheet Geological Survey of Western Australia (GSWA) indicates that the area is underlain by:

- Bassendean SAND (Qpb) – leached dunes of quartz sand.
- Alluvium (Qra) – clay, silt, sand.
- Colluvium – quartz sand and soil.

## 6.2 Generalised Profile

Only soil was exposed within the test pits, which reached a maximum depth of 2.1 m. The exception to this was TP04 which refused on ferricrete at 1.7 m depth. Subsurface soil/rock type below the depth of test pitting depth, as encountered within the CPTu's are thus inferred based on our experience in the area.

The inferred ground conditions across the site can be broadly generalised as comprising:

- **SAND / Silty SAND (SP/SM)** – fine to medium grained, loose to dense sand, extending from the surface to depths of between about 1.5 m and 10.2 m; potentially interbedded or underlain by
- **FERRICRETE** – comprised of nodular, moderately to highly cemented Sandy CLAY in TP04, inferred to have been encountered from an upper depth of between 1.5 m and 5.0 m by refusal in TP04 and in 7 of the 11 CPTu's. Due to this refusal, the thickness, condition and strength of the ferricrete is not known.

Variation to the generalised profile does occur and reference should be made to the CPTu's outputs and test pit reports presented in Appendix A and Appendix B, respectively, for subsurface conditions at specific locations.

The depths and locations at which inferred Ferricrete was encountered during the investigation is summarised in Table 6.

**Table 6: Summary of Encountered Ferricrete Depths**

| Ground Unit | Depth to Top of Inferred Ferricrete (m)* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | CPTU02 | CPTU03 | CPTU04 | CPTU04A | CPTU05 | CPTU08 | CPTU09 | TP04 |
| FERRICRETE | 3.0 | 4.1 | 2.5 | 2.1 | 5.0 | 4.4 | 3.9 | 1.5 |

* Inferred ferricrete was not encountered in CPTU01, 06, 07 and 10 or at test pit locations excluding TP04.

## 6.3 Groundwater

Groundwater was encountered during the investigation and is summarised below in Table 7.

**Table 7: Summary of Encountered Groundwater at Test Locations**

| Test ID | Test Termination Depth (m bgl) [Dry to (m bgl)] | Groundwater Level (m bgl) |
|---|---|---|
| TP01 | 2.7 | GWNE |
| TP02 | 3.0 | GWNE |
| TP03 | 3.0 | GWNE |
| TP04 | 1.7 | GWNE |
| TP05 | 3.0 | GWNE |
| TP06 | 3.0 | GWNE |
| CPTU01 | 10.2 | 9.44 on inferred ferricrete |
| CPTU02 | 3.0 [2.1] | GWNE |
| CPTU03 | 4.1 [2.75] | GWNE |
| CPTU04 | 2.5 | GWNE |
| CPTU04A | 2.1 | GWNE |
| CPTU05 | 5.0 [3.19] | GWNE |
| CPTU06 | 10.2 [9.55] | GWNE |
| CPTU07 | 10.2 | 6.12 on inferred cemented sand |
| CPTU08 | 4.4 | GWNE |
| CPTU09 | 3.9 [2.1] | GWNE |
| CPTU10 | 10.2 | 5.47 on inferred cemented sand |

*GWNE: Groundwater Not Encountered

# 7.0 DISCUSSION AND RECOMMENDATIONS

## 7.1 Summary of Geotechnical Considerations

The main geotechnical issues that will affect planning and design of the solar farm infrastructure include:

- The soil present to the likely foundation depth over most of the site is medium dense sand and are generally considered suitable for driven pile construction.
- The presence of inferred Ferricrete at shallow depth in isolated areas which may be unsuitable for driving piles. These areas are present in the northern half of the site.
- Groundwater was not encountered within the likely depth of the footings.

## 7.2 Typical Footing Options for Solar Trackers

Footing design for a typical PV array is typically governed by lateral and uplift loads applied by wind loading during storm events. Common PV array footings are driven galvanised steel post, although screw piles are not uncommon, and occasionally mass concrete or other ballasted footing systems are used. Bored concrete piles would only generally be considered for higher loads associated with dual-axis trackers.

Table 8 presents some advantages and disadvantages for feasible footing types. Note that these are typical issues only for general information rather than specific to the site.

**Table 8: Typical Advantages and Disadvantages of Foundation Types**

| Foundation Type | Advantages | Disadvantages |
|---|---|---|
| Driven galvanised steel piles | Relatively easy to install and load test.<br>Relatively inexpensive.<br>Dense / hard strata at shallow depth may allow relatively short piles (pending confirmation of design loads).<br>Are not as susceptible to loss of capacity associated with collapsible soils. | Potential for refusal on hard strata prior to achieving design uplift loads.<br>Pilot holes may need to be drilled to achieve required pile lengths in hard strata.<br>Softening of strata during wet season may lead to greater pile length than initially anticipated.<br>Noise and vibration. |
| Concrete precast piles | Relatively easy to install and load test.<br>Dense / hard strata at shallow depth may allow relatively short piles (pending confirmation of design loads).<br>Are not as susceptible to loss of capacity associated with collapsible soils. | Short precast concrete piles are not standard and may have to be specifically manufactured.<br>Specialist pile driving equipment required.<br>Potentially difficult to integrate concrete piles to the panel racking systems. |
| Bored piles | Larger capacity if extended into rock.<br>May be able to be installed using backhoe/excavator fitted with an auger.<br>Are not as susceptible to loss of capacity associated with collapsible soils. | Auger drilling only may require large drill rig to overcome early refusal on hard strata.<br>Softening of strata during wet season may lead to greater pile length.<br>Potential hole collapse if drilled lower than the water table.<br>Likely uneconomic unless design loads are particularly high (such as dual-axis trackers). |
| Screw piles | Relatively easy to install and can drill into harder strata.<br>Relatively inexpensive.<br>Are not as susceptible to loss of capacity associated with collapsible soils. | Potential for refusal on hard strata.<br>Softening of strata during wet season may lead to greater pile length than initially anticipated.<br>Higher risk of corrosion impacting load capacity. |
| Cast-in-place mass concrete footings | Relatively easy to construct at shallow depths although reinforcing required.<br>Excavation of footings by excavator would be less impacted by variations in the depth of hard strata. | More expensive and slower than driven or screw pile options.<br>Higher surface movements from seasonal soil shrinkage and swelling, or due to collapsible soils (if present). |

## 7.3 Discussion of Solar Tracker Footing Options

### 7.3.1 Driven Piles

Driven steel C-sections or H-sections are often used to support PV installations, although other driven steel piles could also be considered. Concrete piles are unlikely to be suitable due to the relatively low loads involved and difficulties in integrating concrete piles to the tracking systems. Driven piles can be driven to a suitable set or can be jacked-in place.

Assuming that the piles may extend up to about 3 m depth, it seems likely that installation of driven piles will generally be possible across a majority of the site. However, hard driving conditions due to the presence of shallow ferricrete in the northern half of the site may eliminate the potential use of driven piles in these areas.

Driven steel piles seems likely to be the most feasible option for support of the solar trackers within the deep sand portions of the site area.

### 7.3.2 Bored Piles

It is expected that most boring equipment would achieve the required depth for bored pile installation. In areas where pile driving may be difficult, such as the northern half of the site where shallow ferricrete was encountered, suitably designed bored piled ferricrete of rock strength could be considered.

### 7.3.3 Screw Piles

It is expected that screw piles would generally achieve the required design depth and could be considered.

### 7.3.4 Mass Concrete Footings

Shallow raft footings would also be appropriate but would require significant site preparation works to ensure the underlying soil is well compacted which may require over-excavation and replacement in compacted layers. In areas where pile driving may be difficult, such as the northern half of the site where shallow ferricrete was encountered, shallow footings should be considered.

## 7.4 Preliminary Pile Design

Table 9 presents the preliminary geotechnical design parameters recommended for driven pile foundations. The geotechnical reduction factor $\phi_g$ to be applied to the ultimate capacities will depend on the foundation type, structural redundancy, and level of testing, in accordance with Australian Standard AS2159 (2009). Trial piles and/or pile testing may be necessary to justify the adoption of high $\phi_g$ factors and/or higher design parameters than suggested in Table 9.

**Table 9: Preliminary Pile Design Parameters**

| Design Parameter | Unfactored Value |
|---|---|
| Ultimate End Bearing (kPa) | 2000 |
| Ultimate Shaft Adhesion (kPa) | 50 |

Notes:The geotechnical reduction factor $\phi_g$ to be applied to the ultimate capacities will depend on the foundation type, structural redundancy and level of testing proposed, in accordance with Australian Standard AS2159 (2009). Trial piles and/or pile testing may be necessary to justify adoption of a higher $\phi_g$ factor.

Piles in tension should be designed using 0.7 × Ultimate Shaft Adhesion values

## 7.5 Preliminary Shallow Footing Design

Based on the subsurface conditions encountered, shallow pad and strip footings are considered appropriate to support the structures.

Table 10 and Table 11 present the maximum allowable working bearing pressures for a range of footing sizes for pad footings and strip footings respectively.

**Table 10: Pad Footing Design Parameters**

| Minimum Depth of Embedment (m) | Minimum Plan Dimension (m) | Maximum Allowable Working Bearing Pressure (kPa) | Estimated Settlement at maximum ABP (mm) |
|---|---|---|---|
| 0.3 | 0.5 | 135 | <5 |
| | 1.0 | 150 | <5 |
| | 1.5 | 185 | 5 - 10 |
| | 2.0 | 210 | 5 - 10 |
| | 2.5 | 240 | 10 - 15 |
| | 3.0 | 250 | 15 - 20 |
| 0.5 | 0.5 | 230 | <5 |
| | 1.0 | 240 | 5 - 10 |
| | 1.5 | 250 | 5 - 10 |
| | 2.0 | 250 | 10 - 15 |
| | 2.5 | 250 | 10 - 15 |
| | 3.0 | 250 | 15 - 20 |
| 1.0 | 0.5 | 250 | <5 |
| | 1.0 | 250 | 5 - 10 |
| | 1.5 | 250 | 5 - 10 |
| | 2.0 | 250 | 10 - 15 |
| | 2.5 | 250 | 10 - 15 |
| | 3.0 | 250 | 15 - 20 |

**Table 11: Strip Footing Design Parameters**

| Minimum Depth of Embedment (m) | Minimum Plan Dimension (m) | Maximum Allowable Working Bearing Pressure (kPa) | Estimated Settlement at maximum ABP (mm) |
|---|---|---|---|
| 0.3 | 0.5 | 115 | <5 |
| | 1.0 | 150 | 5 – 10 |
| | 1.5 | 200 | 10 - 15 |
| | 2.0 | 250 | 15 - 20 |
| 0.5 | 0.5 | 180 | <5 |
| | 1.0 | 215 | 5 – 10 |
| | 1.5 | 250 | 10 - 15 |
| | 2.0 | 250 | 15 - 20 |
| 1.0 | 0.5 | 250 | <5 |
| | 1.0 | 250 | 5 – 10 |
| | 1.5 | 250 | 10 - 15 |
| | 2.0 | 250 | 15 - 20 |

The allowable bearing pressure should be limited to 250 kPa. The bearing pressures for larger footings are limited to reduce settlement. Allowable bearing pressures for footings of intermediate plan dimensions to those tabulated can be interpolated. Footings that have a plan dimension either smaller or larger than those covered by the table above will need to be considered individually along with other embedment depths. Footings carrying significant overturning or eccentric loading need to be assessed separately.

Settlement of the structures will depend upon a number of factors including the applied pressures, footing size and base preparation. The preliminary estimates of settlement provided in Table 10 and Table 11 assume that the site preparation measures detailed in Section 7.7 have been completed. The estimated settlements are for the working bearing pressure values shown. Differential settlements of up to about 50% of the total estimated

settlement values may occur. Approximately 70% of the total settlement will occur during construction and initial loading.

## 7.6 Site Classification

A "Class S" site classification is appropriate in accordance with AS2870-2011 "Residential Slabs and Footings". A "Class A" site classification may be appropriate with more onerous site preparation measures to densify the soil and further reduce the potential settlement.

It must be noted that AS2870-2011 is applicable to low-rise residential dwellings up to two storeys in height and applying a bearing pressure of up to 100 kPa. The structural engineers must therefore consider the applicability of this site classification with respect to the proposed development.

## 7.7 Earthworks

### 7.7.1 Site Preparation Procedure

The following site preparation procedure is appropriate below structures and pavements.

- Strip all vegetation, topsoil and other unsuitable or deleterious material. This material should be stockpiled separately and is not considered suitable for use as fill.
- Moisture condition and proof compact the exposed surface by applying at least eight overlapping passes with a minimum 10 tonne vibrating pad foot roller. The rolled surfaces should be observed while being compacted. Any soft, wet, weak or organic materials encountered must be removed and replaced with compacted fill in accordance with Sections 7.7.2 and 7.7.3.
- Place and compact approved fill in accordance with the requirements of Sections 7.7.2 and 7.7.3 up to design level.
- Shape the surface so that water drains away from footings to appropriately designed drains, and is not allowed to pond adjacent to the footings.

Ensure that the level of compaction outlined in Section 7.7.2 is achieved below all footings and slabs.

### 7.7.2 Compaction

Imported fill should be moisture conditioned and compacted using suitable compaction equipment to achieve the minimum compaction requirements outlined below:

- For sandy and gravelly soils, a dry density ratio of at least 95% using Modified compaction is required in accordance with AS 1289 5.2.1-2003.
- For clayey soils (sandy clay, clayey sand) with a fines content of more than about 10%, a dry density ratio of at least 92% using Modified compaction is required in accordance with AS 1289 5.2.1-2003.

Fill materials should be placed in horizontal layers of not greater than 0.3 m loose thickness. Each layer should be compacted by suitable compaction equipment as specified above, and carefully controlled to ensure even compaction over the full area and depth of each layer. The earthworks contractor should demonstrate that the compaction plant is capable of compacting the full thickness of the fill lifts to the required standard.

### 7.7.3 Approved Fill

Imported granular fill must comply with the material requirements as stated in AS 3798-2007, "Guidelines on Earthworks for Commercial and Residential Developments". The fill should comprise gravelly that is free of deleterious materials and organic matter, and has a low plasticity fines content of less than about 25% fines.

### 7.7.4 Fill Batters

From a geotechnical perspective, long-term fill batters of 3H:1V are considered stable. Even at this angle erosion can be expected to occur if water is discharged at the top of the slope. Vegetation of the batters is recommended to reduce erosion potential.

## 7.8 Excavations

Excavations must observe the recommendations provided in the "Code of Practice – Excavation, 2005" produced by WorkSafe on behalf of the Government of Western Australia.

Based on our understanding of the proposed works, most excavations should be relatively shallow, with shallow footings and cable trenches expected to be less than 1.5 m deep. We anticipate that shallow footing excavations will be best achieved using a relatively large excavator (such as 20-tonne minimum mass), equipped with a rock breaker for excavation of less weathered rock or moderately cemented layers, should these be encountered.

Temporary excavations, including trenching, should be battered at an appropriate angle to ensure stability is always maintained. For any battered excavations, stability of batter/bench angles would need to be assessed by a geotechnical engineer. As a guide, for temporary excavations in site soils, we recommend adopting batter slopes no steeper than 1V:2H. Loads should be excluded from the area extending back from the excavation crest for a distance equal to the excavation depth.

Excavation stability is decreased by erosion or accumulation of water in the soil. We recommend that stormwater drainage be provided around any excavations to reduce the risk of instability.

## 7.9 Retaining Structures

Backfill behind retaining structures should be free draining and low in fines content. Retaining structures should be designed in accordance with AS 4678–2002 "Earth-Retaining Structures". For the design of retaining structures, the following parameters are appropriate for sand compacted in accordance with Section 7.7.2.

- Angle of internal friction, $\phi = 35°$.
- Coefficient of active earth pressure $K_a = 0.27$.
- Coefficient of passive earth pressure $K_p = 3.69$.
- At rest coefficient of earth pressure $K_o = 0.50$.
- Bulk density: 18 kN/m$^3$.

Compaction plant can increase the lateral earth pressures acting on retaining walls. Handheld compaction equipment is recommended within 2 m of any such walls to minimise compaction pressures.

Water should not be allowed to build up behind retaining walls as this will increase the lateral loads due to hydrostatic pressure.

## 7.10 Earthquake Risk Classification

The methods of assessing the earthquake risk classification are outlined in the Australian Standard AS1170.4 (2007) *Structural Design Actions, Part 4: Earthquake Actions in Australia*. The standard uses a number of factors in assessing an earthquake design category for a particular structure at a given site.

The governing condition for the site subsoil class is the thickness and consistency of the subsurface materials beneath the building footings. Based on observed ground conditions we recommend that a site Subsoil Class of '$C_e$ – Shallow soil' is appropriate for the site, in accordance with Section 4.2 of AS1170.4 (2007).

## 7.11 Pavements

Laboratory soaked CBR tests were carried out on three soil samples and yielded CBR values of 16% and 18% for the in-situ sand material, and 5% for in-situ silty sand material. Swell during CBR soaking was recorded as nil. Providing previous recommendations regarding drainage, site preparation, compaction and approved fill material are adopted the following design CBR values are recommended:

- Granular fill or in-situ granular soils – Design CBR value of 12%.
- In-situ silty/clayey sand – Design CBR of 5%. This is based on the CBR value for TP03 (1.0 – 1.2 m) which is defined as a silty sand.

Further testing will be required to delineate areas of silty/clayey sand. In instances where the material type is not adequately confirmed/delineated, then a design CBR of 5% should be used.

It is anticipated that a majority of the surficial layer across the site will consist of granular material. The pavement subgrade material should be compacted to achieve a density of at least 96% of Modified maximum dry density (MMDD) in accordance with AS 1289 5.2.1. Suitable drainage should be installed adjacent to pavements so that stormwater does not pond adjacent to the pavement.

## 7.12 Soil Aggressivity

Soil samples were selected to assess the aggressivity to steel and concrete structures. The results of the laboratory testing were compared to the exposure classifications used for concrete and steel piles provided in Australian Standard AS 2159-2009, "Piling – Design and Installation" and are provided in Table 5.

The results indicate an exposure classification of "non-aggressive" for steel and a "non-aggressive" to "mild" exposure classification for concrete.

# 8.0 IMPORTANT INFORMATION

Your attention is drawn to the document titled – "Important Information Relating to this Report", which is included in Appendix D of this report. The statements presented in that document are intended to inform a reader of the report about its proper use. There are important limitations as to who can use the report and how it can be used. It is important that a reader of the report understands and has realistic expectations about those matters. The Important Information document does not alter the obligations Golder has under the contract between it and its client.

# Signature Page

**Golder Associates Pty Ltd**

Joshua Kyle
*Geotechnical Engineer*

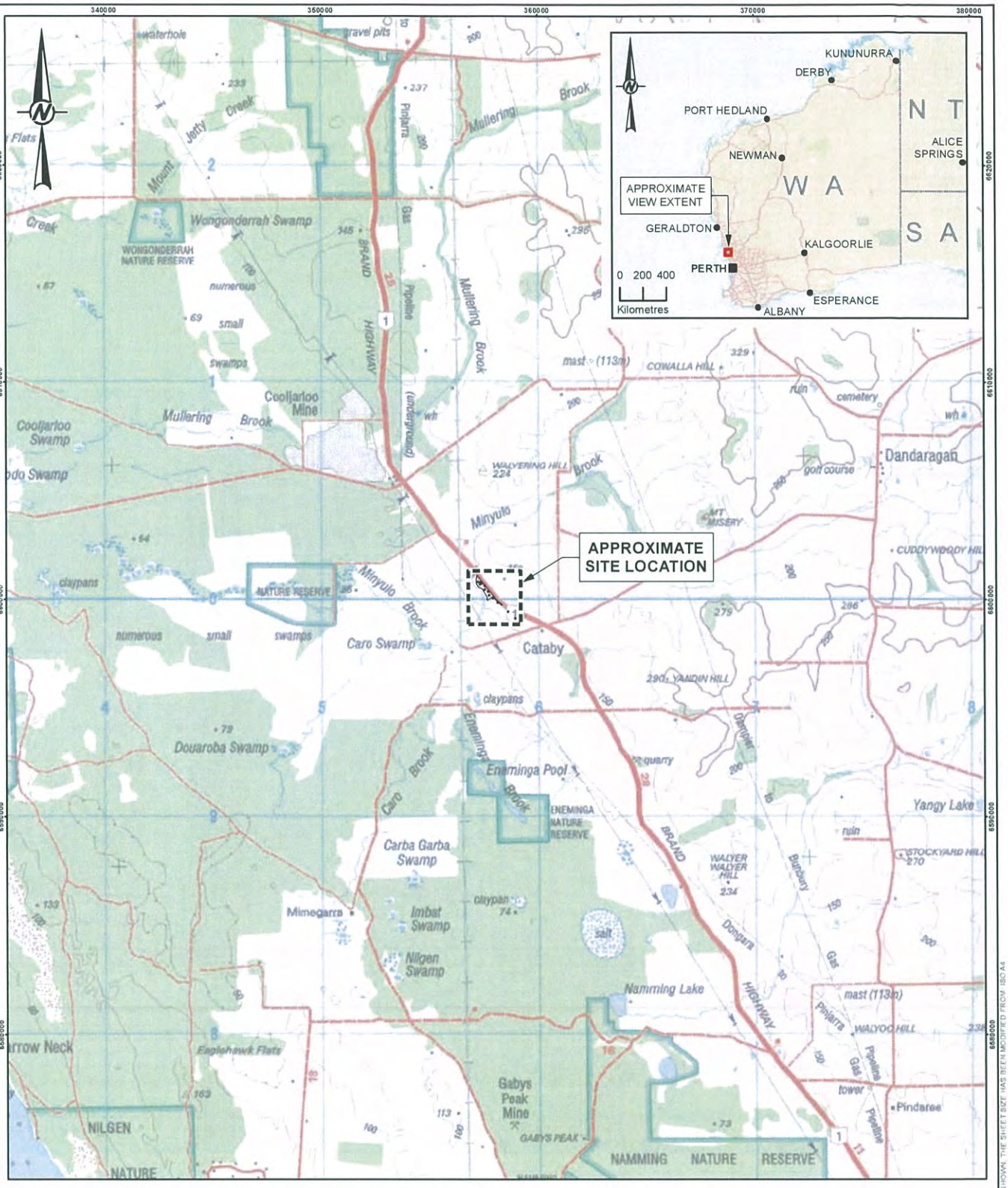
Simon Owens-Collins
*Principal Engineering Geologist*

JAK/SOW/hn

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https://golderassociates.sharepoint.com/sites/32505g/documents/06 deliverables/18108366-024-m-rev0- cataby solar farm investigation.docx




NOTE:
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 50

REFERENCES:
1. IMAGE SOURCED FROM GEOSCIENCE AUSTRALIA 1:250,000 TOPOGRAPHIC MAPPING.

CLIENT
ILUKA RESOURCES

PROJECT
PROPOSED SOLAR FARM

CONSULTANT
WSP GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2022.04.26 |
| DESIGNED | TC |
| PREPARED | JRP |
| REVIEWED | SOC |
| APPROVED | SOC |

TITLE
**LOCATION PLAN**

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 18108366 | 024 R | 0 | 1 |

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A4
25mm
0




LEGEND

- TEST PIT LOCATION
- CONE PENETRATION TEST LOCATION
- ELECTRICAL RESISTIVITY TEST LOCATION
- THERMAL CONDUCTIVITY TEST LOCATION
- APPROXIMATE BOUNDARY OF SOLAR FARM
- CADASTRE




0 250 500
1:8,000 METRES

NOTE:
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 50

REFERENCES:
1. CADASTRE AND AERIAL IMAGERY BASED ON INFORMATION PROVIDED BY AND WITH THE PERMISSION OF THE WESTERN AUSTRALIAN LAND INFORMATION AUTHORITY TRADING AS LANDGATE (2022). AERIAL IMAGERY DATED DECEMBER 2017

CLIENT
ILUKA RESOURCES

PROJECT
PROPOSED SOLAR FARM

TITLE
**SITE PLAN**

CONSULTANT
GOLDER

| | |
|---|---|
| YYYY-MM-DD | 2022-04-26 |
| DESIGNED | TC |
| PREPARED | JRP |
| REVIEWED | SOC |
| APPROVED | SOC |

| PROJECT NO. | CONTROL | REV. | FIGURE |
|---|---|---|---|
| 18108366 | 024 R | 0 | 2 |

**APPENDIX A**

# Test Pit Reports

# METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT REPORTS

## SYMBOLS

FILL

GRAVEL (GW, GP, GM or GC)

SAND (SW, SP, SM or SC)

SILT (ML or MH)

CLAY (CL, CI or CH)

ORGANIC SOILS (OL, OH or Pt)

COBBLES or BOULDERS

Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay.

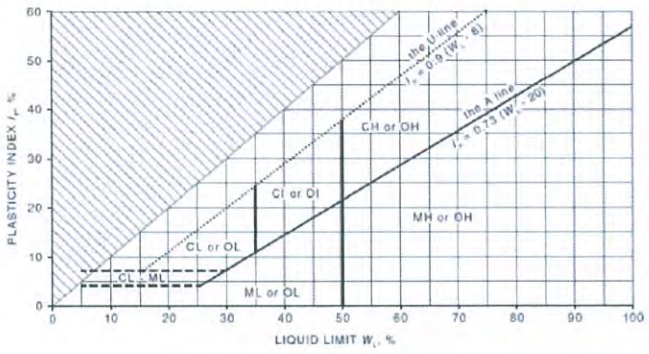
## CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and Rock is classified and described in Reports of Boreholes and Test Pits using the preferred method given in AS1726-2017. The material properties are assessed in the field by visual/tactile methods.

### Particle Size

| Soil Group | Sub Division | Particle Size |
|---|---|---|
| BOULDERS | | > 200 mm |
| COBBLES | | 63 to 200 mm |
| GRAVEL | Coarse | 19 to 63 mm |
| | Medium | 6.7 to 19 mm |
| | Fine | 2.36 to 6.7 mm |
| SAND | Coarse | 0.6 to 2.36 mm |
| | Medium | 0.21 to 0.6 mm |
| | Fine | 0.075 to 0.21 mm |
| SILT | | 0.002 to 0.075 mm |
| CLAY | | < 0.002 mm |

### Plasticity Properties




## MOISTURE CONDITION

| Symbol | Term | Description |
|---|---|---|
| D | Dry | Sands and gravels are free flowing. Clays and silts may be brittle or friable and powdery. |
| M | Moist | Soils are darker than in dry condition and may feel cool. Sands and gravels tend to cohere. |
| W | Wet | Soils exude free water. Sand and gravels tend to cohere. |

Moisture condition for fine grained soils is described relative to the plastic limit or liquid limit as specified in AS1726-2017.

## CONSISTENCY AND DENSITY

### Fine Grained Soils

| Symbol | Term | Undrained Shear Strength |
|---|---|---|
| VS | Very Soft | 0 to 12 kPa |
| S | Soft | 12 to 25 kPa |
| F | Firm | 25 to 50 kPa |
| St | Stiff | 50 to 100 kPa |
| VSt | Very Stiff | 100 to 200 kPa |
| H | Hard | Above 200 kPa |
| Fr | Friable | - |

### Coarse Grained Soils

| Symbol | Term | Density Index (%) | SPN "N" * |
|---|---|---|---|
| VL | Very Loose | Less than 15 | 0 to 4 |
| L | Loose | 15 to 35 | 4 to 10 |
| MD | Medium Dense | 35 to 65 | 10 to 30 |
| D | Dense | 65 to 85 | 30 to 50 |
| VD | Very Dense | Above 85 | Above 50 |

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.

* SPT correlations are not stated in AS1726-2017, and may be subject to corrections for overburden pressure and equipment type.

## CEMENTATION

| | |
|---|---|
| Weakly Cemented | The soil may be easily disaggregated by hand in air or water. |
| Moderately Cemented | Effort is required to disaggregate the soil by hand in air or water. |

# EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT REPORTS

## DRILLING/EXCAVATION METHOD

| | | | | | |
|---|---|---|---|---|---|
| ADH | Hollow auger drilling | EX | Excavator | PQ3 | Diamond core - 83 mm |
| ADT | Auger drilling with tc-bit | HA | Hand auger | PT | Push tube sampling |
| ADV | Auger drilling with v-bit | HAND | Excavated by hand | RAB | Rotary air blast |
| AIRCORE | Aircore | HMLC | methods Diamond core - 63 | RC | Reverse circulation |
| AT | Air track | HQ3 | mm Diamond core - 61 mm | RT | Rock roller |
| BH | Backhoe bucket | JET | Jetting | SONIC | Sonic drilling |
| CT | Cable tool rig | MZ | Mazier tube sampling | SPT | Standard penetration |
| DTC | Diatube coring | NDD | Non-destructive digging | U | testing Undisturbed tube |
| EE | Existing excavation | NMLC | Diamond core - 52 mm | WB | sampling Washbore drilling |
| EPT | Extruded push tube | NQ3 | Diamond core - 45 mm | | |

## PENETRATION/EXCAVATION RESISTANCE

| | |
|---|---|
| L | **Low resistance.** Rapid penetration possible with little effort from the equipment used. |
| M | **Medium resistance.** Excavation/possible at an acceptable rate with moderate effort from the equipment used. |
| H | **High resistance** to penetration/excavation. Further penetration is possible at a slow rate and requires significant effort from the equipment. |
| R | **Refusal or Practical Refusal.** No further progress possible without the risk of damage or unacceptable wear to the digging implement or machine. |

These assessments are subjective and are dependent on many factors including the equipment power, weight, condition of excavation or drilling tools, and the experience of the operator.

## WATER

| | | | |
|---|---|---|---|
| ▽ | Water level at date shown | ◁ | Partial water loss |
| ▷ | Water inflow | ◀ | Complete water loss |

| | |
|---|---|
| GROUNDWATER NOT OBSERVED | The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit. |
| GROUNDWATER NOT ENCOUNTERED | The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period. |

## SAMPLING AND TESTING

| | |
|---|---|
| SPT | Standard Penetration Test to AS1289.6.3.1-2004 |
| 4,7,11 N=18 | 4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following 150mm seating |
| 30/80 mm | Where practical refusal occurs, the blows and penetration for that interval are reported |
| RW | Penetration occurred under the rod weight only |
| HW | Penetration occurred under the hammer and rod weight only |
| HB | Hammer double bouncing on anvil |
| DS | Disturbed sample |
| BDS | Bulk disturbed sample |
| G | Gas Sample |
| W | Water Sample |
| FP | Field permeability test over section noted |
| FV | Field vane shear test expressed as uncorrected shear strength (sv = peak value, sr = residual |
| PID | value) Photoionisation Detector reading in ppm |
| PM | Pressuremeter test over section noted |
| PP | Pocket penetrometer test expressed as instrument reading in kPa |
| U63 | Thin walled tube sample - number indicates nominal sample diameter in millimetres |
| WPT | Water pressure test |
| DCP | Dynamic cone penetration test |
| CPT | Cone penetration test |
| CPTu | Cone penetration test with pore pressure (u) measurement |

## RANKING OF VISUALLY OBSERVABLE CONTAMINATION AND ODOUR (for specific soil contamination assessment projects)

| | | | |
|---|---|---|---|
| R = 0 | No visible evidence of contamination | R = A | No non-natural odours identified |
| R = 1 | Slight evidence of visible | R = B | Slight non-natural odours identified |
| R = 2 | contamination Visible contamination | R = C | Moderate non-natural odours identified |
| R = 3 | Significant visible contamination | R = D | Strong non-natural odours identified |

## ROCK CORE RECOVERY

| TCR = Total Core Recovery (%) | RQD = Rock Quality Designation (%) | SCR = Solid Core Recovery (%) | F = Fracture Frequency |
|---|---|---|---|
| $= \frac{\text{Length of core recovered}}{\text{Length of core run}} \times 100$ | $= \frac{\sum \text{Axial lengths of core} > 100\text{ mm}}{\text{Length of core run}} \times 100$ | $= \frac{\sum \text{Length of cyclindrical core recovered}}{\text{Length of core run}} \times 100$ | $= \frac{\text{No. of defects}}{\text{Length of zone (m)}}$ |

# TERMS FOR ROCK MATERIAL STRENGTH & WEATHERING AND ABBREVIATIONS FOR DEFECT DESCRIPTIONS

GOLDER

## STRENGTH

| Symbol | Term | UCS (MPa) | Field Guide |
|---|---|---|---|
| VL | Very Low | 0.6 to 2 | Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30 mm can be broken by finger pressure. |
| L | Low | 2 to 6 | Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling. |
| M | Medium | 6 to 20 | Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty. |
| H | High | 20 to 60 | A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow; rock rings under hammer. |
| VH | Very High | 60 to 200 | Hand specimen breaks with pick after more than one blow; rock rings under hammer. |
| EH | Extremely High | >200 | Specimen requires many blows with geological pick to break through intact material; rock rings under hammer. |

Material with strength less than 'Very Low' shall be described using soil characteristics. The presence of an original rock structure, fabric or texture should be noted, if relevant.

## ROCK MATERIAL WEATHERING

| Symbol | | Term | Field Guide |
|---|---|---|---|
| RS | | Residual Soil | Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported. |
| XW | | Extremely Weathered | Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible. |
| DW | HW | Highly Weathered | The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores. |
| | MW | Moderately Weathered | The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable, but shows little or no change of strength from fresh rock. |
| SW | | Slightly Weathered | Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock. |
| FR | | Fresh | Rock shows no sign of decomposition of individual minerals or colour changes. |

## ABBREVIATIONS FOR DEFECT TYPES AND DESCRIPTIONS

| Defect Type | | Coating or Infilling | | Roughness | |
|---|---|---|---|---|---|
| P | Parting | Cn | Clean | VRo | Very Rough |
| X | Foliation | Sn | Stain | Ro | Rough |
| L | Cleavage | Ve | Veneer | Sm | Smooth |
| C | Contact | Ct | Coating | Po | Polished |
| J | Joint | In | Infill | Sl | Slickensided |
| SSu | Sheared Surface | | | **Vertical Boreholes –** The dip (inclination from horizontal) of the defect is given. **Inclined Boreholes –** The inclination is measured as the acute angle between the core axis and the vertical direction. | |
| SS | Sheared Seam | **Planarity** | | | |
| SZ | Sheared Zone | Pl | Planar | | |
| CS | Crushed Seam | Cv | Curved | | |
| IS | Infilled Seam | Un | Undulating | | |
| EWS | Extremely Weathered Seam | St | Stepped | | |
| V | Vein | Ir | Irregular | | |

GOLDER
MEMBER OF WSP

# REPORT OF TEST PIT: TP1

CLIENT: Iluka Resources
PROJECT: Solar Farm
LOCATION: Cataby
JOB NO: 18108366

COORDS: 358102.0 m E 6599849.0 m N MGA94 50
SURFACE RL: DATUM: AHD
PIT DEPTH: 2.70 m
BUCKET TYPE:

SHEET: 1 OF 1
MACHINE: JCB 3CX Backhoe
CONTRACTOR: ANH Contracting
LOGGED: TC DATE: 14/4/22
CHECKED: JK DATE: 18/5/22

| Excavation | | | | | Sampling | | Field Material Description | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METHOD | EXCAVATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST | RECOVERED | GRAPHIC LOG | GROUP SYMBOL | SOIL/ROCK MATERIAL DESCRIPTION | MOISTURE CONDITION | CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS | DCP TEST (AS1289.6.3.2) Blows per 100 mm |
| BH | L | | 0.0 | | | | | SP | SAND<br>fine to medium grained, pale yellow becoming yellow | M | L | about 200 mm of topsoil | SEAT<br>0 5 10 15 20 25 |
| | | | 0.5 | | | | | | | | | | |
| | | | 1.0 | | DS 1.00-1.20 m<br>Rec = /200 mm | | | | | | | | |
| | | | 1.5 | | | | | | | | MD | | |
| | | | 2.0 | | | | | | | | | | |
| | | | 2.5 | | | | | | TEST PIT DISCONTINUED @ 2.70 m<br>COLLAPSE<br>GROUNDWATER NOT ENCOUNTERED<br>BACKFILLED | | | | |
| | | | 3.0 | | | | | | | | | | |
| | | | 3.5 | | | | | | | | | | |
| | | | 4.0 | | | | | | | | | | |

This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.



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GOLDER
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# REPORT OF TEST PIT PHOTOGRAPHS: TP1

| | | | |
|---|---|---|---|
| | COORDS: 358102.0 m E 6599849.0 m N MGA94 50 | SHEET: 1 OF 1 | |
| CLIENT: Iluka Resources | SURFACE RL: DATUM: AHD | MACHINE: JCB 3CX Backhoe | |
| PROJECT: Solar Farm | | CONTRACTOR: ANH Contracting | |
| LOCATION: Cataby | PIT DEPTH: 2.70 m | LOGGED: TC | DATE: 14/4/22 |
| JOB NO: 18108366 | BUCKET TYPE: | CHECKED: JK | DATE: 18/5/22 |



TP1 - 1



TP1 - 2

This report of test pit photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.



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# REPORT OF TEST PIT: TP2

CLIENT: Iluka Resources
PROJECT: Solar Farm
LOCATION: Cataby
JOB NO: 18108366

COORDS: 357496.0 m E 6600597.0 m N MGA94 50
SURFACE RL: DATUM: AHD
PIT DEPTH: 3.00 m
BUCKET TYPE:

SHEET: 1 OF 1
MACHINE: JCB 3CX Backhoe
CONTRACTOR: ANH Contracting
LOGGED: TC DATE: 14/4/22
CHECKED: JK DATE: 18/5/22

| Excavation | | | | | Sampling | | Field Material Description | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METHOD | EXCAVATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST | RECOVERED | GRAPHIC LOG | GROUP SYMBOL | SOIL/ROCK MATERIAL DESCRIPTION | MOISTURE CONDITION | CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS | DCP TEST (AS1289.6.3.2) Blows per 100 mm |
| BH | L | | 0.0 | | | | | SP | SAND<br>fine to medium grained, pale grey | | | approximately 200 mm of topsoil | SEAT |
| | | | | | DS 0.30-0.50 m<br>Rec = /200 mm | | | | | | MD | | |
| | | | 1.0 | 1.20 | | | | | pale yellow | M | | | |
| | | | 2.0 | | | | | | | | | | |
| | M | | 2.5 | 2.80 | | | | GP | Sandy GRAVEL<br>fine to coarse grained, sub-rounded to sub-angular, brown orange, expected to become more competent cemented material | | | | |
| | | | 3.0 | | | | | | TEST PIT DISCONTINUED @ 3.00 m<br>TARGET DEPTH<br>GROUNDWATER NOT ENCOUNTERED<br>BACKFILLED | | | | |
| | | | 3.5 | | | | | | | | | | |
| | | | 4.0 | | | | | | | | | | |

DCP TEST (AS1289.6.3.2) Blows per 100 mm: 0 5 10 15 20 25

This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.



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# REPORT OF TEST PIT PHOTOGRAPHS: TP2

| | | | |
|---|---|---|---|
| | COORDS: 357496.0 m E 6600597.0 m N MGA94 50 | SHEET: 1 OF 1 | |
| CLIENT: Iluka Resources | SURFACE RL: DATUM: AHD | MACHINE: JCB 3CX Backhoe | |
| PROJECT: Solar Farm | | CONTRACTOR: ANH Contracting | |
| LOCATION: Cataby | PIT DEPTH: 3.00 m | LOGGED: TC | DATE: 14/4/22 |
| JOB NO: 18108366 | BUCKET TYPE: | CHECKED: JK | DATE: 18/5/22 |



TP2 - 1



TP2 - 2

This report of test pit photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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# REPORT OF TEST PIT: TP3

CLIENT: Iluka Resources
PROJECT: Solar Farm
LOCATION: Cataby
JOB NO: 18108366

COORDS: 357323.0 m E 6600800.0 m N MGA94 50
SURFACE RL: DATUM: AHD
PIT DEPTH: 3.00 m
BUCKET TYPE:

SHEET: 1 OF 1
MACHINE: JCB 3CX Backhoe
CONTRACTOR: ANH Contracting
LOGGED: TC DATE: 14/4/22
CHECKED: JK DATE: 18/5/22

| Excavation | | | | | Sampling | | Field Material Description | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METHOD | EXCAVATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST | RECOVERED | GRAPHIC LOG | GROUP SYMBOL | SOIL/ROCK MATERIAL DESCRIPTION | MOISTURE CONDITION | CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS | DCP TEST (AS1289.6.3.2) Blows per 100 mm |
| BH | L | | 0.0 | | | | | SP | SAND<br>fine to medium grained, yellow and orange | M | MD | | Seat |
| | | | 0.5 | | DS 0.50-0.70 m<br>Rec = /200 mm | | | | | | | | |
| | | | 1.0 | | | | | | | | | | |
| | | | 1.5 | | | | | | | | | | |
| | | | 2.0 | 2.10 | | | | | with weakly cemented Sandy CLAY/Clayey SAND zones | | | | |
| | M | | 2.5 | | | | | | | | | | |
| | | | | 2.70 | | | | CL / SC | Sandy CLAY /Clayey SAND<br>low plasticity, yellow, orange and brown, fine to coarse sand, generally weaky to moderately cemented | | | | |
| | | | 3.0 | | DS 2.80-3.00 m<br>Rec = /200 mm | | | | TEST PIT DISCONTINUED @ 3.00 m<br>TARGET DEPTH<br>GROUNDWATER NOT ENCOUNTERED<br>BACKFILLED | | | | |
| | | | 3.5 | | | | | | | | | | |
| | | | 4.0 | | | | | | | | | | |

This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.



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# REPORT OF TEST PIT PHOTOGRAPHS: TP3

| | | | |
|---|---|---|---|
| | COORDS: 357323.0 m E 6600800.0 m N MGA94 50 | SHEET: 1 OF 1 | |
| CLIENT: Iluka Resources | SURFACE RL: DATUM: AHD | MACHINE: JCB 3CX Backhoe | |
| PROJECT: Solar Farm | | CONTRACTOR: ANH Contracting | |
| LOCATION: Cataby | PIT DEPTH: 3.00 m | LOGGED: TC | DATE: 14/4/22 |
| JOB NO: 18108366 | BUCKET TYPE: | CHECKED: JK | DATE: 18/5/22 |



TP3 - 1



TP3 - 2

This report of test pit photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.



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# REPORT OF TEST PIT: TP4

CLIENT: Iluka Resources
PROJECT: Solar Farm
LOCATION: Cataby
JOB NO: 18108366

COORDS: 357190.0 m E 6600798.0 m N MGA94 50
SURFACE RL: DATUM: AHD
PIT DEPTH: 1.70 m
BUCKET TYPE:

SHEET: 1 OF 1
MACHINE: JCB 3CX Backhoe
CONTRACTOR: ANH Contracting
LOGGED: TC DATE: 14/4/22
CHECKED: JK DATE: 18/5/22

| Excavation | | | | | Sampling | | Field Material Description | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METHOD | EXCAVATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST | RECOVERED | GRAPHIC LOG | GROUP SYMBOL | SOIL/ROCK MATERIAL DESCRIPTION | MOISTURE CONDITION | CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS | DCP TEST (AS1289.6.3.2) Blows per 100 mm |
| BH | L | | 0.0 | | | | | SP | SAND<br>fine to medium grained, pale grey | M | MD | | Seat |
| | | | 0.5 | | | | | | | | | | |
| | | | | 0.90 | | | | | with fine to coarse ferricrete gravel, becoming Gravelly SAND/Sandy GRAVEL | | | | |
| | M | | 1.0 | | DS 1.00-1.20 m<br>Rec = /200 mm | | | | | | D | | |
| | | | 1.5 | 1.50 | DS 1.50-1.70 m<br>Rec = /200 mm | | | | FERRICRETE<br>orange, red and yellow brown, generally moderately cemented Sandy CLAY matrix, medium strength in parts | | | | |
| | H | | | | | | | | TEST PIT DISCONTINUED @ 1.70 m<br>REFUSAL<br>GROUNDWATER NOT ENCOUNTERED<br>BACKFILLED | | | | |
| | | | 2.0 | | | | | | | | | | |
| | | | 2.5 | | | | | | | | | | |
| | | | 3.0 | | | | | | | | | | |
| | | | 3.5 | | | | | | | | | | |
| | | | 4.0 | | | | | | | | | | |

This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

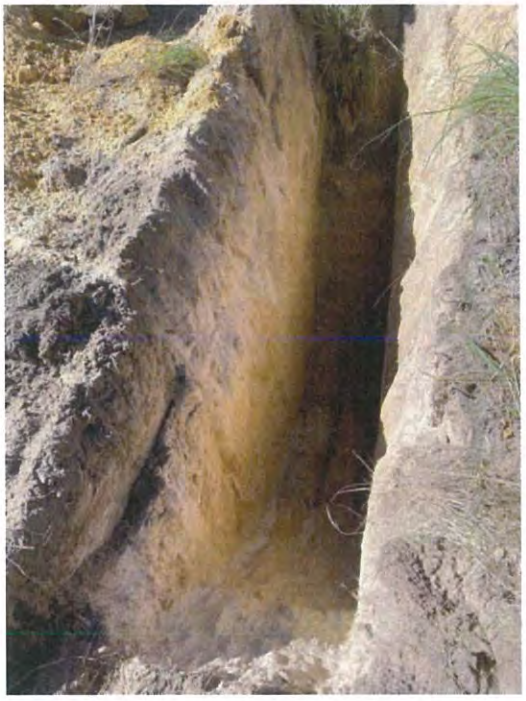


GAP 10.0.6 LIB.GLB Log GAP NON-CORED FULL PAGE CATABY SOLAR FARM.GPJ <<DrawingFile>> 19/05/2022 12:45 10.02.00.04 Datgel Tools

GOLDER
MEMBER OF WSP

# REPORT OF TEST PIT PHOTOGRAPHS: TP4

| | | | |
|---|---|---|---|
| | COORDS: 357190.0 m E 6600798.0 m N MGA94 50 | SHEET: 1 OF 1 | |
| CLIENT: Iluka Resources | SURFACE RL: DATUM: AHD | MACHINE: JCB 3CX Backhoe | |
| PROJECT: Solar Farm | | CONTRACTOR: ANH Contracting | |
| LOCATION: Cataby | PIT DEPTH: 1.70 m | LOGGED: TC | DATE: 14/4/22 |
| JOB NO: 18108366 | BUCKET TYPE: | CHECKED: JK | DATE: 18/5/22 |



TP4 - 1



TP4 - 2

This report of test pit photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.



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# REPORT OF TEST PIT: TP5

CLIENT: Iluka Resources
PROJECT: Solar Farm
LOCATION: Cataby
JOB NO: 18108366

COORDS: 357267.0 m E 6600683.0 m N MGA94 50
SURFACE RL: DATUM: AHD
PIT DEPTH: 3.00 m
BUCKET TYPE:

SHEET: 1 OF 1
MACHINE: JCB 3CX Backhoe
CONTRACTOR: ANH Contracting
LOGGED: TC DATE: 14/4/22
CHECKED: JK DATE: 18/5/22

| Excavation | | | | | Sampling | | Field Material Description | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METHOD | EXCAVATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST | RECOVERED | GRAPHIC LOG | GROUP SYMBOL | SOIL/ROCK MATERIAL DESCRIPTION | MOISTURE CONDITION | CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS | DCP TEST (AS1289.6.3.2) Blows per 100 mm |
| BH | L | | 0.0 | | | | | SP | SAND<br>fine to medium grained, yellow and orange | M | MD | | 0 5 10 15 20 25<br>Seat |
| | | | 0.5 | | DS 0.50-0.70 m<br>Rec = /200 mm | | | | | | | | |
| | | | 1.0 | | | | | | | | | | |
| | | | 1.5 | | | | | | | | D | | |
| | | | 2.0 | | | | | | | | | | |
| | | | 2.5 | | | | | | | | | | |
| | | | 3.0 | | | | | | TEST PIT DISCONTINUED @ 3.00 m<br>TARGET DEPTH<br>GROUNDWATER NOT ENCOUNTERED<br>BACKFILLED | | | | |
| | | | 3.5 | | | | | | | | | | |
| | | | 4.0 | | | | | | | | | | |

This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

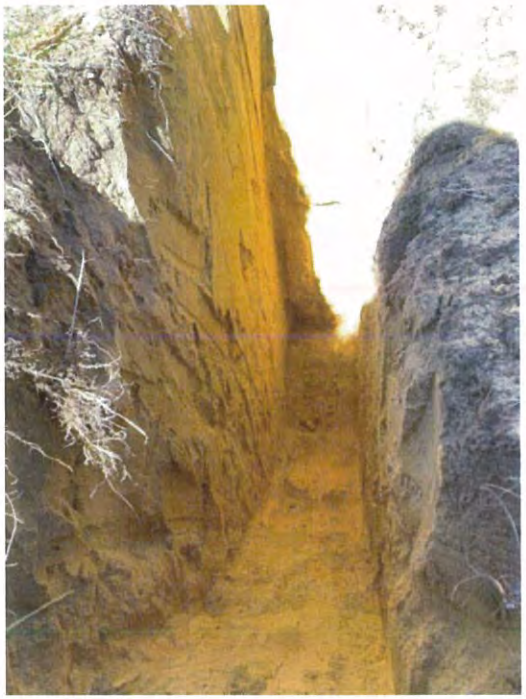


GAP 10.0.6 LIB.GLB Log GAP NON-CORED FULL PAGE CATABY SOLAR FARM.GPJ <<DrawingFile>> 19/05/2022 12:45 10.02.00.04 Datgel Tools

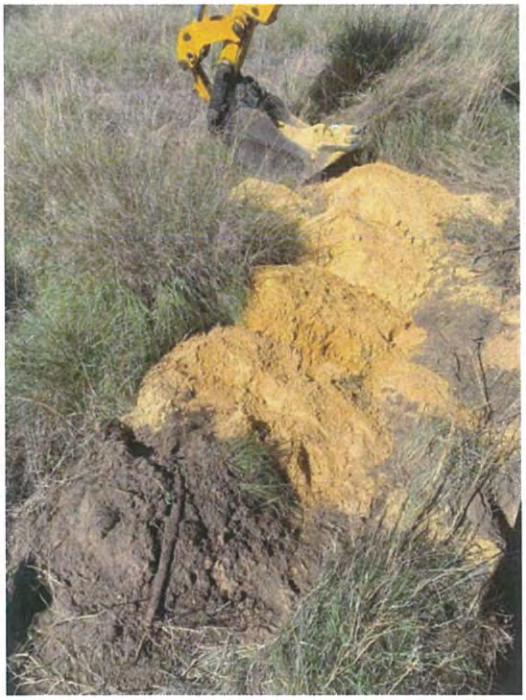
GOLDER
MEMBER OF WSP

# REPORT OF TEST PIT PHOTOGRAPHS: TP5

| | | | |
|---|---|---|---|
| | COORDS: 357267.0 m E 6600683.0 m N MGA94 50 | SHEET: 1 OF 1 | |
| CLIENT: Iluka Resources | SURFACE RL: DATUM: AHD | MACHINE: JCB 3CX Backhoe | |
| PROJECT: Solar Farm | | CONTRACTOR: ANH Contracting | |
| LOCATION: Cataby | PIT DEPTH: 3.00 m | LOGGED: TC | DATE: 14/4/22 |
| JOB NO: 18108366 | BUCKET TYPE: | CHECKED: JK | DATE: 18/5/22 |



TP5 - 1



TP5 - 2

This report of test pit photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP gINT FN. F27 RL1

GAP 10.0.6 LIB:GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE CATABY SOLAR FARM.GPJ <<DrawingFile>> 19/05/2022 12:43 10.02.00.04 Datgel Tools

GOLDER
MEMBER OF WSP

# REPORT OF TEST PIT: TP6

CLIENT: Iluka Resources
PROJECT: Solar Farm
LOCATION: Cataby
JOB NO: 18108366

COORDS: 358582.0 m E 6599421.0 m N MGA94 50
SURFACE RL: DATUM: AHD
PIT DEPTH: 3.00 m
BUCKET TYPE:

SHEET: 1 OF 1
MACHINE: JCB 3CX Backhoe
CONTRACTOR: ANH Contracting
LOGGED: TC DATE: 14/4/22
CHECKED: JK DATE: 18/5/22

| Excavation | | | | | Sampling | | Field Material Description | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| METHOD | EXCAVATION RESISTANCE | WATER | DEPTH (metres) | DEPTH RL | SAMPLE OR FIELD TEST | RECOVERED | GRAPHIC LOG | GROUP SYMBOL | SOIL/ROCK MATERIAL DESCRIPTION | MOISTURE CONDITION | CONSISTENCY DENSITY | STRUCTURE AND ADDITIONAL OBSERVATIONS | DCP TEST (AS1289.6.3.2) Blows per 100 mm |
| BH | L | | 0.0 | | | | | SP | SAND<br>fine to medium grained, pale grey | | L | | Seat |
| | | | 0.5 | 0.60 | | | | GP | Sandy GRAVEL<br>fine to coarse grained, pale grey and brown orange | | | | |
| | H | | | 0.80 | | | | CL / SC | Sandy CLAY /Clayey SAND<br>low plasticity, orange, brown, yellow, fine to coarse sand, generally moderately cemented | | VD | | 20+ |
| | | | 1.0 | | | | | | | | | | |
| | | | 1.5 | 1.50 | DS 1.50-1.70 m<br>Rec = /200 mm | | | | becoming less cemented | M | | | |
| | M | | 2.0 | | | | | | | | | | |
| | | | 2.5 | | | | | | | | | | |
| | | | 3.0 | | | | | | TEST PIT DISCONTINUED @ 3.00 m<br>TARGET DEPTH<br>GROUNDWATER NOT ENCOUNTERED<br>BACKFILLED | | | | |
| | | | 3.5 | | | | | | | | | | |
| | | | 4.0 | | | | | | | | | | |

This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP gINT FN. F01i RL3

GAP 10.0.6 LIB.GLB Log GAP NON-CORED FULL PAGE CATABY SOLAR FARM.GPJ <<DrawingFile>> 19/05/2022 12:45 10.02.00.04 Datgel Tools

GOLDER
MEMBER OF WSP

# REPORT OF TEST PIT PHOTOGRAPHS: TP6

| | | | |
|---|---|---|---|
| | COORDS: 358582.0 m E 6599421.0 m N MGA94 50 | SHEET: 1 OF 1 | |
| CLIENT: Iluka Resources | SURFACE RL: DATUM: AHD | MACHINE: JCB 3CX Backhoe | |
| PROJECT: Solar Farm | | CONTRACTOR: ANH Contracting | |
| LOCATION: Cataby | PIT DEPTH: 3.00 m | LOGGED: TC | DATE: 14/4/22 |
| JOB NO: 18108366 | BUCKET TYPE: | CHECKED: JK | DATE: 18/5/22 |



TP6 - 1



TP6 - 2

This report of test pit photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP gINT FN. F27 RL1

GAP 10.0.6 LIB:GLB GrkTbl GAP TEST PIT PHOTO 2 PER PAGE CATABY SOLAR FARM.GPJ <<DrawingFile>> 19/05/2022 12:43 10.02.00.04 Datgel Tools

# APPENDIX C – UMWELT FLORA AND VEGETATION REPORT 2023

umwelt
Environmental & Social Consultants



ILUKA

# PROPOSED SOLAR FACILITY

Reconnaissance Flora and Vegetation Survey

**FINAL**

**May 2023**

# PROPOSED SOLAR FACILITY

Reconnaissance Flora and Vegetation Survey

## FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Iluka Resources Limited

Project Director: Cathy Godden
Project Manager: Cathy Godden
Report No. 22084/R02
Date: May 2023

Environmental & Social Consultants

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

***Acknowledgement of Country***

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

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Appendix B Results of Search of the Department of the Agriculture, Water and the Environment Species Profile and Threats (SPRAT) Database (DAWE 2022)
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# 1.0 Introduction

## 1.1 Project Overview

Iluka Resources Limited (Iluka) operates the Cataby Mineral Sands Project at Cataby, Western Australia, located approximately 150 kilometres (km) north of Perth. The operations including dry-mining of several open pit areas over a distance of approximately 25 km on a north-west to south-east direction, lying immediately west of Brand Highway.

Iluka commissioned Umwelt to undertake a desktop assessment and reconnaissance flora and vegetation survey for an area proposed for an independent entity to operate a solar facility to supply renewable energy.

## 1.2 Study Area Definitions

The Proposed Solar Facility Study Area (Study Area) is located within the Shire of Dandaragan, approximately 150 km north of Perth (**Figure 1.1**) and covers a total area of approximately 40.1 ha.

The closest conservation estate to the Study Area is Namming Nature Reserve, which is located 25 km to the south.

A Desktop Study Area has been defined encompassing the Study Area with an approximate 10 km buffer, also shown on **Figure 1.1**, for the purposes of conducting database and relevant literature searches.




Legend

- Study Area
- Roads
- Drainage Line

FIGURE 1.1

Study Area Location

Image Source: ESRI Basemap (2021) Data source: Iluka (2022), Landgate (2022)

## 1.3 Aims and Objectives

The aim of the assessment is to provide information regarding the flora and vegetation values within the Study Area to support future approvals.

The overall objectives of the assessment were to:

- Complete a desktop review of all publicly available information for the Study Area to identify the significant flora and vegetation likely to be present, including interrogation of the Department of Biodiversity Conservation and Attractions (DBCA) databases and data from previous surveys.
- Undertake a Reconnaissance vegetation survey to confirm the vegetation type and significance of the vegetation that occurs within the Study Area (see **Section 2.6** for definition of significant vegetation).
- Undertake a Targeted flora survey to determine the presence of significant flora taxa within the Study area (see **Section 2.5** for definition of significant flora).

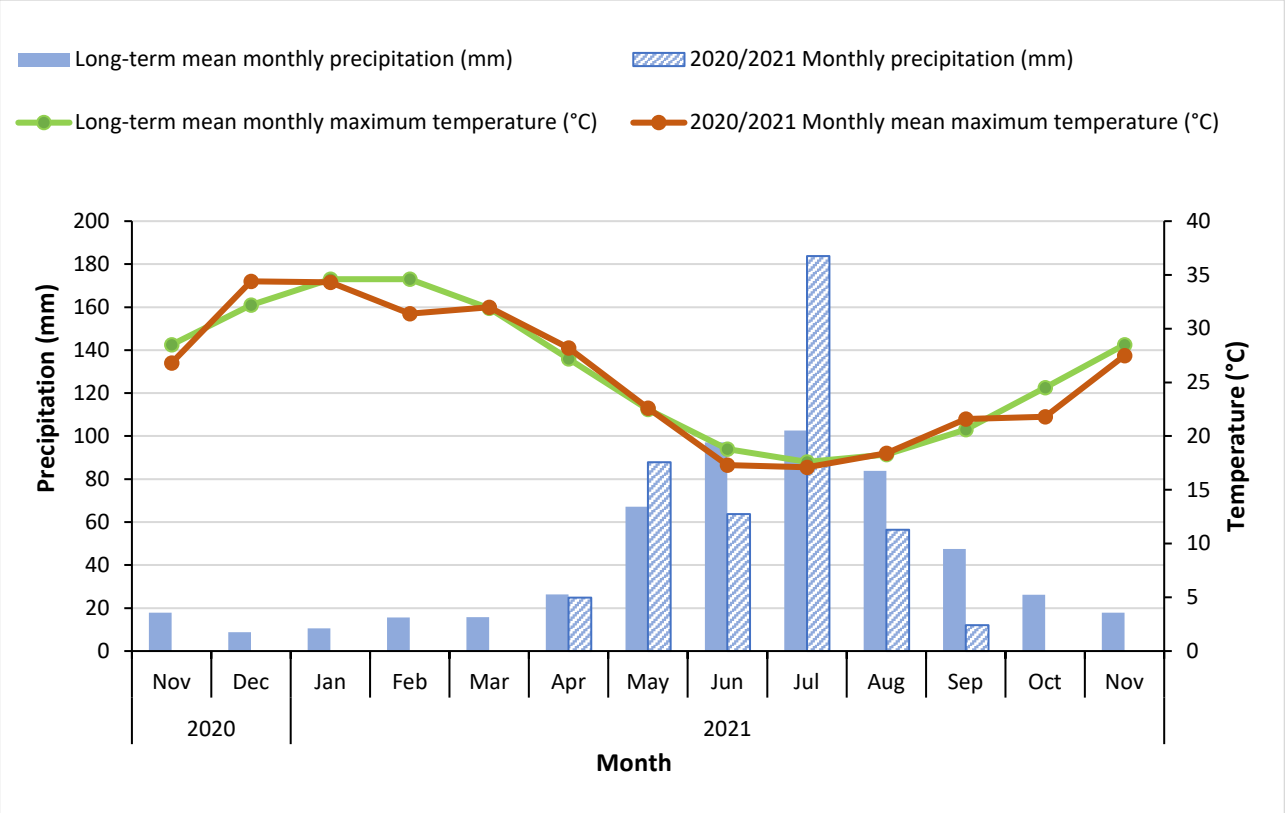
## 1.4 Level of Assessment

The flora and vegetation survey of the Study Area involved a reconnaissance survey and targeted survey as defined in Sections 4.1 and 4.2 of the '*Technical Guidance for Flora and Vegetation Surveys for Environmental Impact Assessment* (Environmental Protection Authority (EPA) 2016a). A Reconnaissance Survey is sufficient where flora and vegetation values are well defined, the area is not likely to support significant flora or vegetation and the scale and nature of potential impacts are not likely to be significant (EPA 2016b). Given the area proposed to be impacted is small, in a highly modified landscape and is located in a region where the flora and vegetation values are well defined, a Reconnaissance Survey with Targeted flora survey is considered to be the appropriate survey level.

## 1.5 Climate

The Study Area is located in the Swan Coastal Plain Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion within the Southwest Botanical Province as classified by Beard (1990). The climate of this bioregion is classified as dry, warm Mediterranean, with predominantly winter precipitation (600–1000 mm) and five to eight months per year (Beard 1990). **Graph 1.1** displays monthly precipitation and monthly maximum temperature statistics for the months preceding each survey, as well as long-term average monthly maximum temperature and average monthly precipitation data (1962–2021) for Badgingarra Research Station (temperature) and Lake Namman Station (precipitation), the most relevant meteorological stations recording such data to the Study Area (Bureau of Meteorology (BoM) 2022).

Long-term average monthly maximum temperatures at Badgingarra peak in January and February (35°C), while long-term average monthly precipitation at Lake Namman peaks from late autumn to late winter (May–August), with the highest rainfall on average received in July (117 mm). This period is considered to be the most relevant in terms of promoting plant growth and flowering in the Southwest Province.




**Graph 1.1 Long-term Mean Monthly and 2020/2021 Monthly Climate Statistics (BoM 2022)**

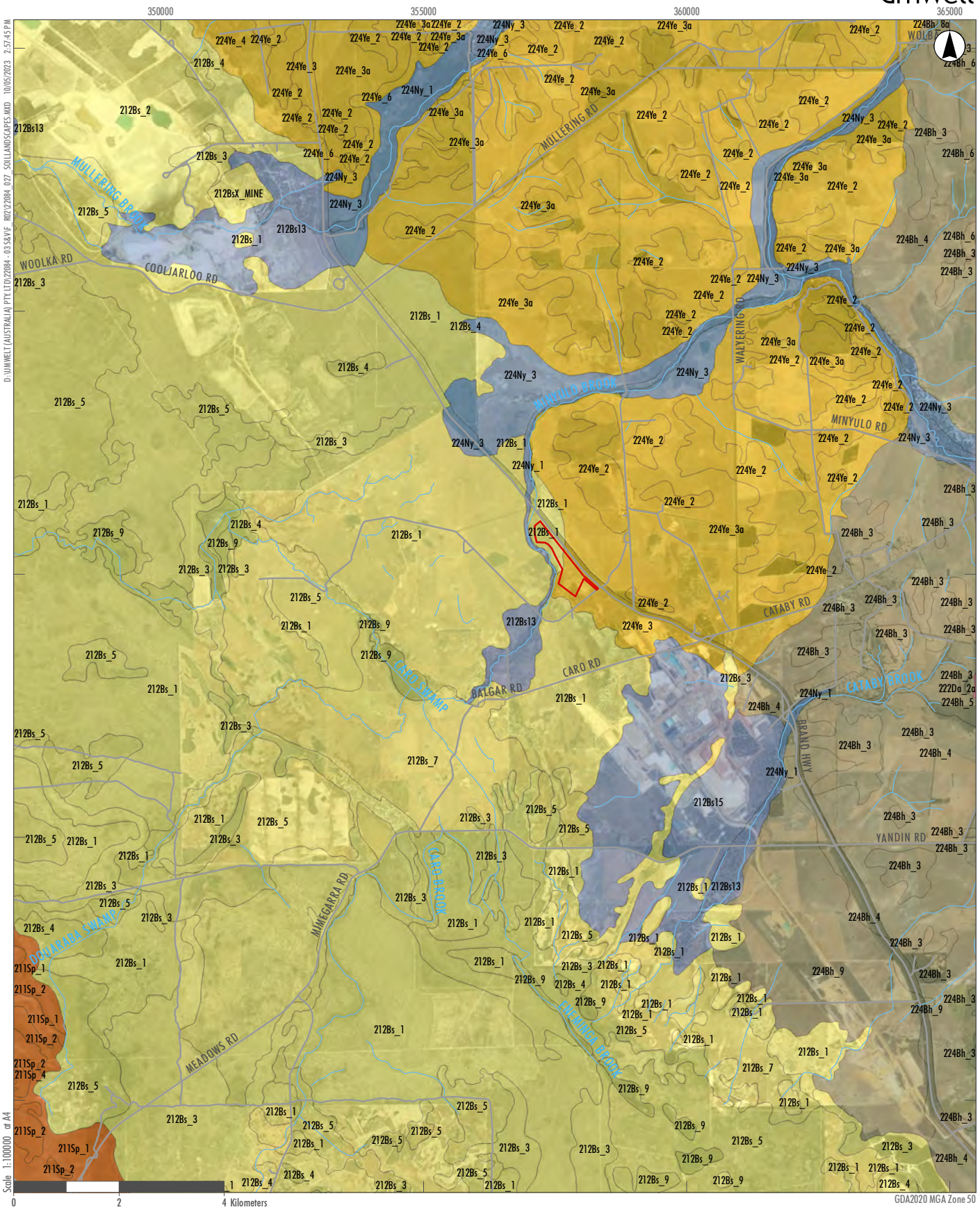
## 1.6 Geology, Landforms and Soils

The Study Area is located in the Swan Coastal Plain Subregion (which is broadly equivalent to the Swan Coastal Plain IBRA Bioregion) as defined by Beard (1990). The Swan Coastal Plain Subregion consists of Mesozoic to recent sediments of the Perth Basin. It is a coastal plain that is low-lying, often swampy, and contains sandhills. The soils are mainly recent sands or swamp deposits. The region also consists of dissects country rising to the duricrusted Dandaragan plateau on Mesozoics, mainly yellow sandy soils (Beard 1990).

The Study Area occurs within the Bassendean and Yeermullah Soil-Landscape Zones of the Swan Province. The Bassendean Zone is described as consisting of 'mid-Pleistocene Bassendean sand and fixed dunes inland from the coastal dune zone, with non-calcareous sands and podsolised soils with low-lying wet areas'; the Yeermullah Zone is described as 'colluvial slopes and some plateau remnants, very gently to gently inclined hillslopes and sand filled minor valleys; pale and yellow deep sands, pale sandy gravels, shallow gravel over duricrust, some sandy duplexes and sandy earths' (Purdie *et al.,* 2004) (**Figure 1.2**). Two sub-systems occur within the Study Area, as described in **Table 1.1**.

**Table 1.1 Soil Landscape Subsystems of the Study Area**

| Subsystem and Name | | Description | Area in Study Area (ha) |
|---|---|---|---|
| 212Bs_1 | Bassendean 1 subsystem | Undulating to flat sandplain and minor swamps; pale to yellow deep sands | 70.5 |
| 224Ye_3 | Yeermullah3 subsystem | colluvial slopes and some plateau remnants, very gently to gently inclined hillslopes and sand filled minor valleys; pale and yellow deep sands, pale sandy gravels, shallow gravel over duricrust, some sandy duplexes and sandy earths | 13.6 |




## Legend

- Study Area
- Roads
- Drainage Line

**Soil Landscape Unit**

211Sp_1, 211Sp_2, 211Sp_4, 212Bs_1, 212Bs_2, 212Bs_3, 212Bs_4, 212Bs_5, 212Bs_7, 212Bs_9, 212Bs13, 212Bs15, 212BsX_MINE, 222Da_2a, 224Bh_3, 224Bh_4, 224Bh_5, 224Bh_6, 224Bh_8a, 224Bh_9, 224Ny_1, 224Ny_3, 224Ye_2, 224Ye_3, 224Ye_3a, 224Ye_4, 224Ye_6

FIGURE 1.2

# Soil Landscape Units of the Study Area

Note: Soil landscape units within the study area are underlined

Image Source:ESRI Basemap (2021) Data source: Iluka (2022), Landgate (2022), DPIRD (2019)

# 2.0 Methods

## 2.1 Desktop Review

A review of all publicly available flora and vegetation relevant to the Study Area was undertaken. This included review of the regional and local context of the flora and vegetation, through review of previous biological surveys undertaken in the vicinity of the Study Area and interrogation of relevant databases and other sources as listed in **Table 2.1**.

**Table 2.1 Flora and Vegetation Searches Undertaken for the Desktop Study Area**

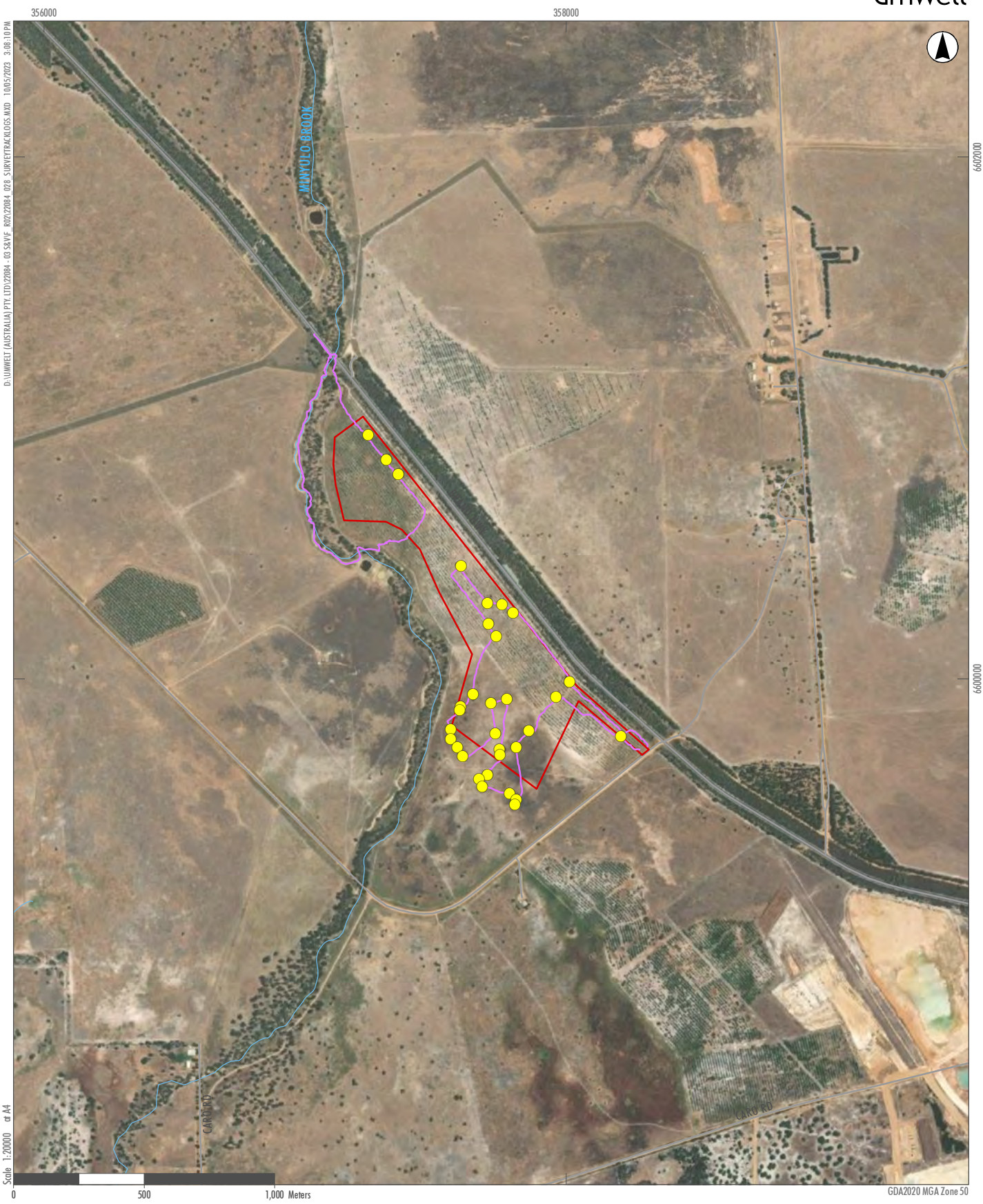
| Source | Search Attributes | Search Purpose |
|---|---|---|
| DBCA Threatened and Priority Ecological Communities Database (DBCA 2022a) | Database interrogated using Study Area boundary and 10 km buffer | Obtain records of DBCA-classified TECs and/or DBCA-classified PECs within the Study Area |
| DBCA TEC and PEC lists (DBCA 2018; DBCA 2021) | Review of current DBCA TEC and PEC lists | Identify whether there are any DBCA listed TECs or PECs that could occur within the Study Area |
| DBCA Significant Flora Databases (WA Herbarium specimen database and Threatened and Priority (TPFL) database) (DBCA 2022b) | Database interrogated using Study Area boundary and 10 km buffer | Obtain records of listed significant flora within the Study Area |
| Department of Agriculture, Water and the Environment (DAWE) (now Department of Climate Change, Energy, the Environment and Water (DCCEEW)) Species Profile and Threats (SPRAT) Database (interrogated using the Protected Matters Search Tool) (DAWE 2022) | Database interrogated using approximate Study Area boundary | Identify Matters of National Environmental Significance (MNES), including Threatened flora and TECs, listed under the EPBC Act, that occur or have the potential to occur within the Study Area |
| 2018 State-wide Vegetation Statistics incorporating the CAR Reserve Analysis (Government of Western Australia 2019) | Database interrogated using Study Area boundary | Identify extent of Vegetation System Associations within the Study Area |

## 2.2 Field Survey Methods

The vegetation Reconnaissance survey was undertaken during one field visit on 22–23 November 2021. This survey period meets the guidance as per survey timing presented in EPA (2016a), being within the Spring season. The Study Area was accessed by vehicle using existing access and via foot transects.
The survey involved on-ground inspection of vegetated areas (as defined through initial aerial photography interpretation) within the Study Area with data being collected from 32 observation points using traverses throughout, as shown in **Figure 2.1**. These observation points targeted isolated trees present in the Study Area.

Data recorded at observation points included GPS location, a description of species present, vegetation condition and a photograph.

Traverses (tracklogs) and observation points in the Study Area are mapped on **Figure 2.1**.




Legend

- Study Area
- Observation Point
- Releve
- Survey Track Logs - November 2021
- Roads
- Drainage Line

FIGURE 2.1

Track Logs and Observation Points

Image Source: ESRI Basemap (2021) Data source: Iluka (2022), Landgate (2022)

## 2.3 Personnel and Licensing

**Table 2.2** lists the personnel involved in both fieldwork and plant identifications for the survey conducted in 2021. The field manager has had over three years of experience in conducting flora surveys, including those in the Swan Coastal Plain. All plant material was collected under the relevant *Flora Taking (Biological Assessment) Licence* (under Regulation 62 of the *Biodiversity Conservation Regulations 2018* (BC Regs)) and *Authorisation to Take or Disturb Threatened Species* (pursuant to Section 40 of the *Biodiversity Conservation Act 2016* (BC Act)), as listed in **Table 2.2**. David Coultas has over 15 years' experience in undertaking plant identifications, including identification of taxa from the Swan Coastal Plain.

**Table 2.2 Personnel and Licensing Information**

| Personnel | Role | Trip Dates | Qualifications | Flora Collecting Permit (BC Act (WA)) |
|---|---|---|---|---|
| Leah Firth | Field Manager | 22–23 Nov 2021 | BSc (Conservation Biology) | FB62000055<br>TFL145-1920 |
| Monika Hrubanova | Field Member | 22–23 Nov 2021 | Mgr (Botany) (equivalent to Masters) | FB62000375 |
| David Coultas | Plant identification | NA | BSc (Environmental Biology) | NA |

## 2.4 Plant Collection and Identification

Specimens of any unknown taxa that were collected were pressed for later identification at the WA Herbarium. External experts of particular families or genera were consulted for any specimens considered to be difficult to identify or of taxonomic interest.

Taxon nomenclature generally follows *FloraBase* (WA Herbarium 1998–present) with all names checked against the current DBCA Max database to ensure their validity. However, in cases where names of plant taxa have been published recently in scientific literature but have not yet been adopted on *FloraBase* due to time constraints (WA Herbarium 1998-present), nomenclature in the published literature is followed. The conservation status of each taxon was checked against *FloraBase*, which provides the most up-to-date information regarding the conservation status of flora taxa in Western Australia.

Specimens of interest, including significant flora taxa, range extensions of taxa and potential new taxa, are sent to the WA Herbarium for consideration for vouchering as soon as practicable. However, this process is via donation, and the WA Herbarium may not voucher all specimens, in accordance with its own requirements. The specimen vouchering will be supported by completed Threated and Priority Flora Report Forms submitted to DBCA (Species and Communities Branch) in the case of listed significant flora (e.g., Threatened and Priority flora taxa).

## 2.5 Significant Flora

As per EPA (2016b), flora taxa may be significant for a range of reasons, including but not limited to the following:

- Being identified as a Threatened or Priority species (formally listed significant taxa – includes taxa listed under both State and Commonwealth legislation, and classified as Priority by DBCA).
- Locally endemic or associated with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems).
- New species or species with anomalous features that indicate a potential new species.
- Representative of the range of a species (particularly at the extremes of range, recently discovered range extensions, or isolated outliers of the main range).
- Unusual species, including restricted subspecies, varieties or naturally occurring hybrids.
- Relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

Any significant flora taxa recorded within the Study Area are discussed in **Section 4.2.1**.

## 2.6 Significant Vegetation

As per EPA (2016b), vegetation may be significant for a range of reasons, including, but not limited to the following:

- Being identified as a Threatened Ecological Community (TEC) or Priority Ecological Community (PEC) (formally listed significant vegetation – includes vegetation listed under Commonwealth legislation, endorsed as a TEC by the Western Australian Government, or classified as a PEC by DBCA).
- Having restricted distribution.
- Degree of historical impact from threatened processes.
- A role as a refuge.
- Providing an important function required to maintain ecological integrity of a significant ecosystem.

Significant vegetation known from the desktop study area is presented in **Section 4.1.4**, with significant vegetation recorded by this survey presented in **Section 4.2.2.2**.

# 3.0 Limitations

**Table 3.1** presents the limitations of the flora and vegetation survey of the Study Area in accordance with EPA (2016a), as applicable to Reconnaissance Survey.

**Table 3.1 Flora and Vegetation Survey Table of Limitations**

| Limitation | Limitation of Survey | Comment |
|---|---|---|
| Effort and Extent | No | A reconnaissance and targeted survey was undertaken in November 2021, within the peak flowering season in Swan Coastal Plain bioregion. It is considered that the survey being conducted in the peak flowering season only is appropriate, as it is likely that most taxa that flower outside the peak flowering season could be identified during the surveys. Twenty-two vegetation mapping note locations were recorded with mapping of vegetation boundaries undertaken using a combination of aerial photography and information collected in the field. Targeted survey for significant flora taxa and significant vegetation identified from the desktop study was conducted over the entire Study Area. No constraints prevented appropriate sampling techniques being employed. |
| Competency/experience of the team carrying out the survey | No | The field team leader has over three years of experience conducting similar assessments including, on the Swan Coastal Plain bioregion and was guided by personnel with over 15 years of experience within the region. Personnel conducting plant identifications have had over 15 years' experience in plant identification in this bioregion. |
| Proportion of flora identified, recorded and/or collected | No | All vascular groups that were present in the Study Area were sampled. A high proportion of perennial and annual vascular taxa were recorded based on the timing, intensity and method of survey, and all could be positively identified. Unknown vascular taxa were collected, with specimens identified at the WA Herbarium. |
| Sources of information e.g. previously available information (whether historic or recent) as distinct from new data | No | Good contextual information for the Study Area was available prior to the survey, including several broad historical surveys. Sources of information used included government databases (DBCA), as well as numerous general sources pertaining to the climate, geomorphology, flora and vegetation of the Swan Coastal Plain, and previous vegetation surveys conducted in the local area, including the Study Area. |
| Timing/ weather/ season/ cycle | No | The field survey was conducted in spring, corresponding with the optimum flowering period for the Swan Coastal Plain bioregion. The 2021 flowering period appeared to be good, with above-average rainfall received from May–August (438 mm compared to the long-term average of 386 mm) (BoM 2022b). |
| Disturbances (e.g. fire, flood, accidental human intervention, etc.), which affected results of survey | No | There was evidence of significant impact to vegetation composition and structure throughout the Study Area as a result of human activities, including extensive clearing and high levels of introduced (weed) taxa. The vegetation condition mapping and type descriptions reflect this disturbance. |
| Remoteness and/or access problems | No | The entire Study Area was accessible via tracks or foot transects. There was no impediment to access of the entire Study Area. |

# 4.0 Results

## 4.1 Desktop Review

### 4.1.1 Regional Vegetation

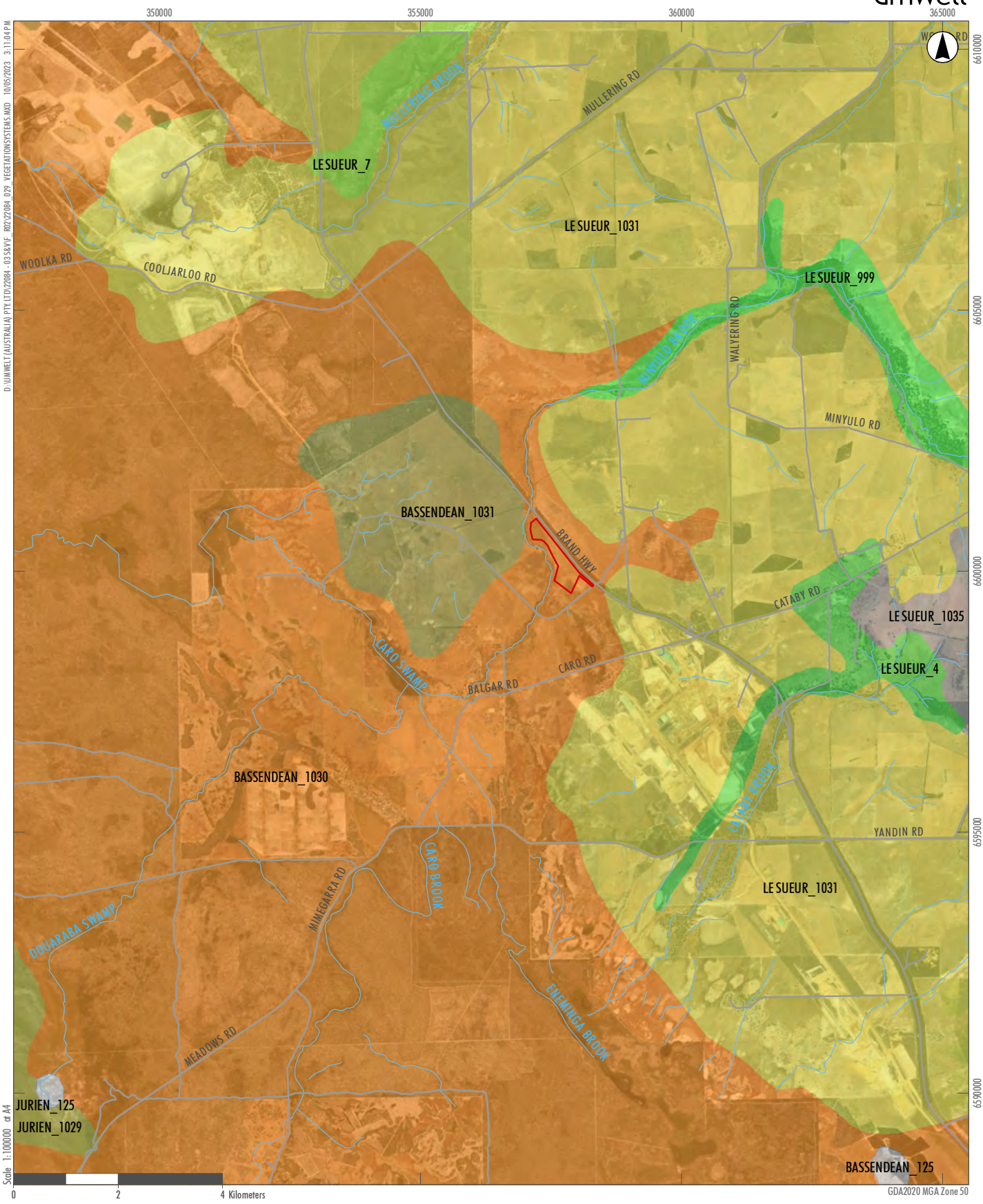
The Study Area is located in the Swan Coastal Plain IBRA region, specifically within the SWA02 Perth subregion (Commonwealth of Australia 2012). The Perth subregion comprises mainly of a low lying coastal plain, mainly covered with woodlands dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas (Mitchell *et al.,* 2002).

The vegetation of Western Australia as it was presumed to have existed prior to European settlement has been mapped at a scale of 1:250,000 as vegetation system associations, with the Pre-European Vegetation spatial database subsequently created (Beard *et al.,* 2013).

The Study Area lies entirely in the Bassendean 1030 vegetation system association (**Table 4.1, Figure 4.1**) of which 70% remains of its pre-European extent within the SWA02 IBRA sub-region. Of this remaining extent, 14% is protected in conservation estate.

**Table 4.1 Vegetation System Associations Occurring in the Study Area**

| Vegetation System Association | Description | Current Extent (ha) | Percentage of Pre-European Extent Remaining | Percentage of Current Extent Protected for Conservation |
|---|---|---|---|---|
| Bassendean_1030 | Low woodland; *Banksia attenuata* & *B. menziesii* | 79, 560.88 | 69.66 | 13.86 |




Legend

- Study Area
- Roads
- Drainage Line

**Vegetation System Association (DPIRD, 2019)**

- Le Sueur - 4
- Le Sueur - 999
- Le Sueur - 7
- Bassendean - 1030
- Bassendean - 1031
- Jurien - 1029
- Le Sueur - 1031
- Le Sueur - 1035
- Bassendean - 125
- Jurien - 125

FIGURE 4.1

## Vegetation System Associations of the Study Area

Note: Vegetation systems within the study area are underlined

Image Source: ESRI Basemap (2021) Data source: Iluka (2022), Landgate (2022), DPIRD (2019)

### 4.1.2 Significant Flora

The search of the DBCA WA Herbarium specimen Database and TPFL Database (DBCA 2022a) returned a total of 66 taxa significant vascular flora taxa that have records within the Desktop Study Area.

The search of the DAWE SPRAT Database (DAWE 2022) with regard to MNES listed under the EPBC Act identified 16 flora taxa listed as Threatened species, or habitat for such species, that are likely to or may occur in the Desktop Study Area. Appendix B presents the results of this search.

There have been numerous significant flora surveys within the vicinity of the Study Area conducted by Umwelt (previously Woodman Environmental Consulting Pty Ltd), primarily for the Cooljarloo Mine site operated by Tronox Management Ltd (to the north of the Study Area), however also within areas such as Brand Hwy, as listed in the Iluka-Tronox significant flora database. A total of 82 significant flora taxa were returned from a search of this database.

A summary of significant flora taxa known from within the Desktop Study Area is presented in **Appendix C**, with a total of 83 flora taxa known from the Desktop Area including 10 Threatened flora taxa and 73 Priority flora taxa. An additional seven taxa were returned from the DAWE PMST search, being taxa which may be, or may have habitat located in the search area (no known records in the search area). This list has been compiled from the results of searches of DBCA's Threatened Flora Database and WA Herbarium Database, DAWE's SPRAT Database (only those with actual records within the Desktop Study Area included in this tally) and the Iluka-Tronox significant flora database. **Figure 4.2** presents locations of significant flora taxa within the Desktop Study Area.

From the database searches, no known listed significant flora are known to occur within the Study Area.

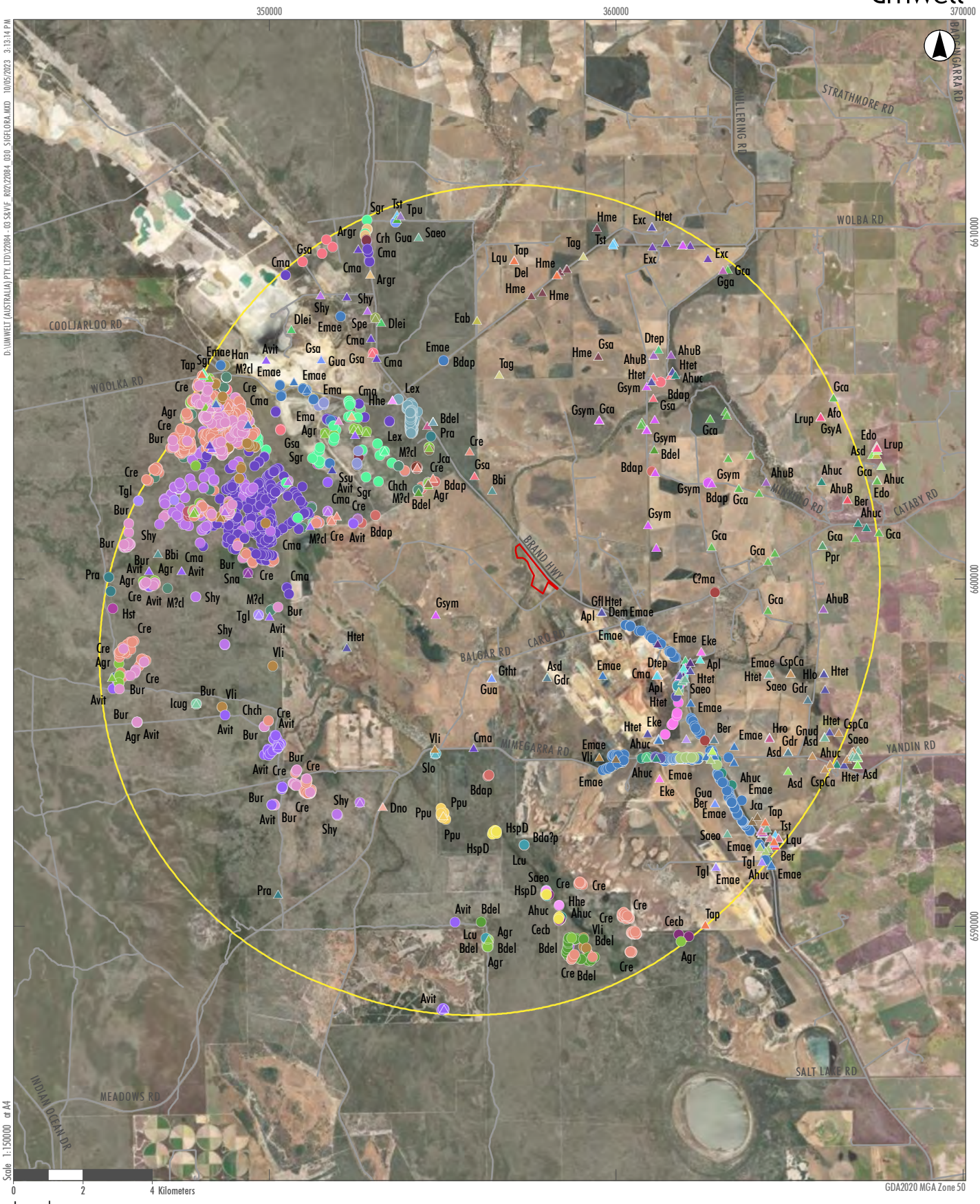



FIGURE 4.2

Significant Flora of the Desktop Study Area

D:\UMWELT (AUSTRALIA) PTY LTD\22084 - 03 S&V\F 8022\22084_030_SIGFLORA_LEGEND.MXD 10/05/2023 3:14:11 PM

Legend

**Significant Flora (DBCA, 2022)**

- Afo, *Acacia forrestiana* (T)
- Apl, *Acacia plicata* (P3)
- Agr, *Andersonia gracilis* (T)
- AhuB, *Anigozanthos humilis* subsp. Badgingarra (S.D. Hopper 7114) (P2)
- Ahuc, *Anigozanthos humilis* subsp. *chrysanthus* (P4)
- Avit, *Anigozanthos viridis* subsp. *terraspectans* (T)
- Argr, *Arnocrinum gracillimum* (P3)
- Asd, *Asterolasia drummondii* (P4)
- Bdel, *Babingtonia delicata* (P1)
- Bur, *Babingtonia urbana* (P3)
- Bkip, *Banksia kippistiana* var. *paenepeccata* (P3)
- Bpr, *Banksia prionophylla* (P1)
- Bbi, *Beaufortia bicolor* (P3)
- Ber, *Beaufortia eriocephala* (P3)
- CspCa, *Chamelaucium* sp. Cataby (G.J. Keighery 11009) (T)
- Cre, *Chordifex reseminans* (P2)
- Cma, *Conostephium magnum* (P4)
- Dtep, *Dampiera tephrea* (P2)
- Del, *Desmocladus elongatus* (P4)
- Dem, *Desmocladus microcarpus* (P2)
- Dno, *Desmocladus nodatus* (P3)
- Dlei, *Drosera leioblastus* (P1)
- Dpr, *Drosera prophylla* (P3)
- Eab, *Eucalyptus abdita* (P2)
- Edo, *Eucalyptus dolorosa* (T)
- Eke, *Eleocharis keigheryi* (T)
- Emae, *Eucalyptus macrocarpa* subsp. *elachantha* (P4)
- Exc, *Eucalyptus x carnabyi* (P4)
- Gnud, *Gastrolobium nudum* (P2)
- Gca, *Grevillea calliantha* (T)
- Gdr, *Grevillea drummondii* (P4)
- Gfl, *Grevillea florida* (P3)
- Gsa, *Grevillea saccata* (P4)
- GsyA, *Grevillea synapheae* subsp. A Flora of Australia (S.D. Hopper 6333) (P1)
- Gsym, *Grevillea synapheae* subsp. *minyulo* (P1)
- Gtht, *Grevillea thyrsoides* subsp. *thyrsoides* (P3)
- Gga, *Gompholobium gairdnerianum* (P3)
- Gua, *Guichenotia alba* (P3)
- Hlo, *Hakea longiflora* (P3)
- Hme, *Hakea megalosperma* (T)
- Hhe, *Hibbertia helianthemoides* (P4)
- HspC, *Hypocalymma* sp. Cataby (G.J. Keighery 5151) (P2)
- Htet, *Hypocalymma tetrapterum* (P3)
- Hro, *Hypolaena robusta* (P4)
- Icug, *Isotropis cuneifolia* subsp. *glabra* (P3)
- Jca, *Jacksonia carduacea* (P3)
- Lrup, *Lasiopetalum rupicola* (P1)
- Lqu, *Lepidobolus quadratus* (P3)
- Lfo, *Leucopogon foliosus* (P3)
- Lex, *Lyginia excelsa* (P2)
- Pdix, *Paracaleana dixonii* (T)
- Pfi, *Persoonia filiformis* (P3)
- Ppr, *Podotheca pritzelii* (P3)
- Pra, *Platysace ramosissima* (P3)
- Ppu, *Ptychosema pusillum* (T)
- Sgr, *Schoenus griffinianus* (P4)
- Sna, *Schoenus natans* (P4)
- Spe, *Schoenus pennisetis* (P3)
- Ssu, *Stenanthemum sublineare* (P2)
- Saeo, *Stylidium aeonioides* (P4)
- Shy, *Stylidium hymenocraspedum* (P3)
- Slo, *Stylidium longitubum* (P4)
- Sper, *Stylidium periscelianthum* (P3)
- Tag, *Tetratheca angulata* (P3)
- Tap, *Thelymitra apiculata* (P4)
- Tpu, *Thelymitra pulcherrima* (P2)
- Tst, *Thelymitra stellata* (T)
- Tgl, *Thysanotus glaucus* (P4)
- Vli, *Verticordia lindleyi* subsp. *lindleyi* (P4)

**Significant Flora (WEC, 2022)**

- Apl, *Acacia plicata* (P3)
- Agr, *Andersonia gracilis* (T)
- Ahuc, *Anigozanthos humilis* subsp. *chrysanthus* (P4)
- Avit, *Anigozanthos viridis* subsp. *terraspectans* (T)
- Argr, *Arnocrinum gracillimum* (P3)
- Bdel, *Babingtonia delicata* (P1)
- Bur, *Babingtonia urbana* (P3)
- Bda?p, *Banksia dallanneyi* subsp. *?pollosta* (P3)
- Bdap, *Banksia dallanneyi* subsp. *pollosta* (P3)
- Cbre, *Calothamnus brevifolius* (P4)
- Cecb, *Calytrix ecalycata* subsp. *brevis* (P3)
- C?gi, *Chamaescilla ?gibsonii* (P3)
- Chch, *Chordifex chaunocoleus* (P4)
- C?re, *Chordifex ?reseminans* (P2)
- Cre, *Chordifex reseminans* (P2)
- Crh, *Comesperma rhadinocarpum* (P3)
- C?ma, *Conostephium ?magnum* (P4)
- Cma, *Conostephium magnum* (P4)
- Csc, *Conospermum scaposum* (P3)
- Dtep, *Dampiera tephrea* (P2)
- Eke, *Eleocharis keigheryi* (T)
- Ema, *Eucalyptus macrocarpa*
- Emae, *Eucalyptus macrocarpa* subsp. *elachantha* (P4)
- Gpe, *Goodenia perryi* (P3)
- Gsa, *Grevillea saccata* (P4)
- Gsym, *Grevillea synapheae* subsp. *minyulo* (P1)
- Gtht, *Grevillea thyrsoides* subsp. *thyrsoides* (P3)
- Gua, *Guichenotia alba* (P3)
- Hlo, *Hakea longiflora* (P3)
- Hst, *Hensmania stoniella* (P3)
- HahN, *Hibbertia* aff.*helianthemoides (Northern variant)* (P4)
- Hhe, *Hibbertia helianthemoides* (P4)
- Han, *Hopkinsia anoectocolea* (P3)
- HspD, *Hypocalymma* sp. Dandaragan (C.A. Gardner 9014) (P1)
- Htet, *Hypocalymma tetrapterum* (P3)
- Icug, *Isotropis cuneifolia* subsp. *glabra* (P3)
- Jca, *Jacksonia carduacea* (P3)
- Lcu, *Lepyrodia curvescens* (P2)
- Lex, *Lyginia excelsa* (P2)
- M?cl, *Melaleuca ?clavifolia* (P3)
- Pdix, *Paracaleana dixonii* (T)
- Pra, *Platysace ramosissima* (P3)
- Ppu, *Ptychosema pusillum* (T)
- Sgr, *Schoenus griffinianus* (P4)
- Sna, *Schoenus natans* (P4)
- Spe, *Schoenus pennisetis* (P3)
- Saeo, *Stylidium aeonioides* (P4)
- Sca?N, *Stylidium carnosum* subsp. *?Narrow leaves (J.A. Wege 490)* (P1)
- Shy, *Stylidium hymenocraspedum* (P3)
- Slo, *Stylidium longitubum* (P4)
- Tgl, *Thysanotus glaucus* (P4)
- Vli, *Verticordia lindleyi* subsp. *lindleyi* (P4)

FIGURE 4.2

## LEGEND - Significant Flora of the Desktop Study Area

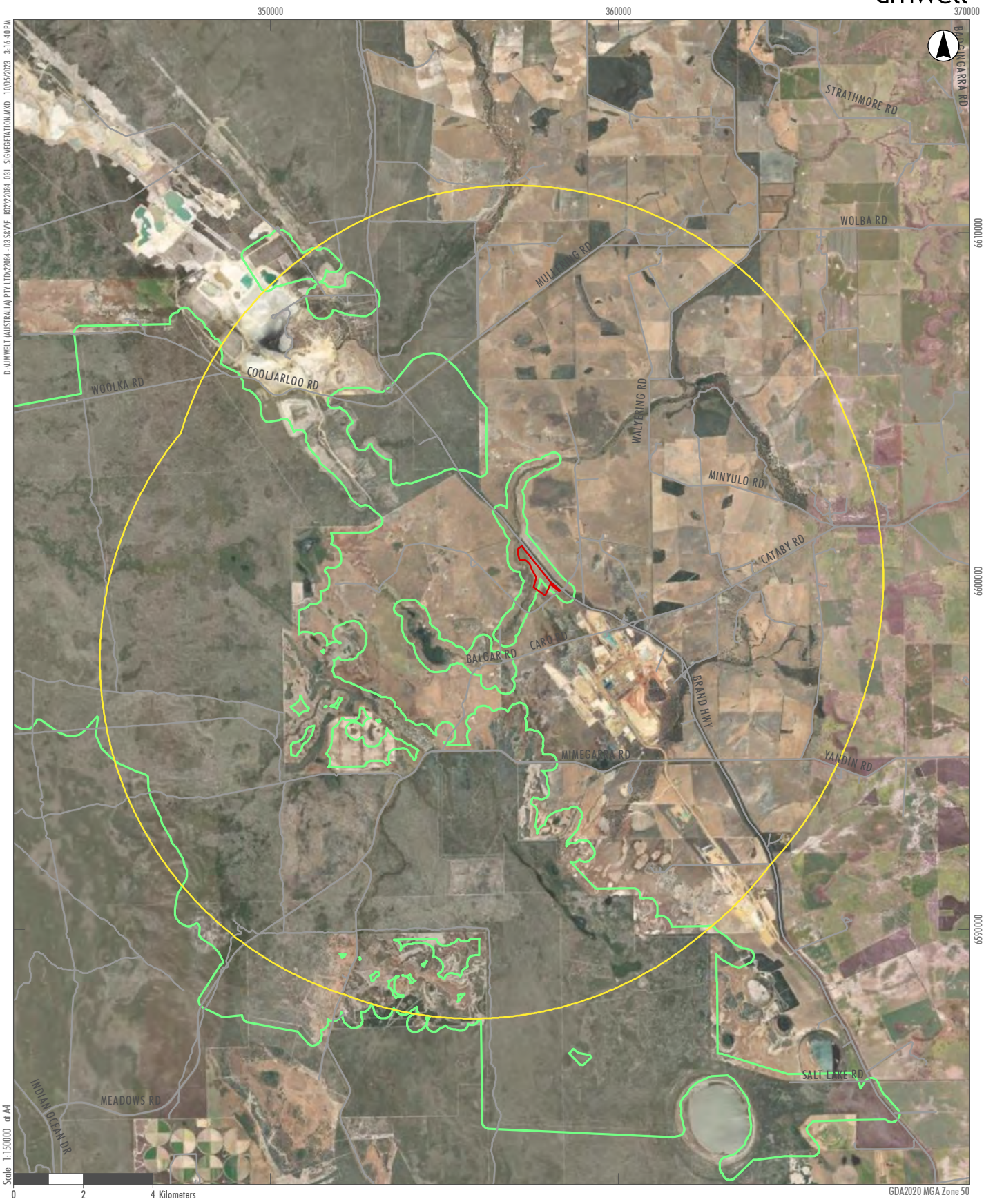
### 4.1.3 Significant Vegetation

A list of significant vegetation known from within the Desktop Study Area is presented in **Table 4.2** and presented in **Figure 4.3**. This list has been compiled from the Desktop Study and includes the results of searches of DBCA's TEC and PEC Database and DAWE's SPRAT Database (DBCA 2022b).

One significant vegetation type was returned from the DBCA database search (Banksia Woodlands of the Swan Coastal Plain TEC/PEC). One TEC (as listed under the EPBC Act; equivalent to PEC as listed under the BC Act) were returned from the DAWE SPRAT database search, with these communities either likely to or may occur within the Desktop Study Area. These communities constitute two PECS listed under the BC Act or otherwise by the DBCA and are equivalent to two TECs listed by the Commonwealth under the EPBC Act (**Table 4.2**).

**Table 4.2 Significant Vegetation Known from Within the Desktop Study Area**

| Community | Conservation Status (WA) | EPBC Act Ranking | Source |
|---|---|---|---|
| Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain | Priority 3 (PEC) | Critically Endangered (TEC) | DAWE (TEC may occur in the desktop study area) |
| Banksia Woodlands of the Swan Coastal Plain | Priority 3 (PEC) | Endangered (TEC) | DBCA, DAWE (TEC is likely to occur in the desktop study area) |




Legend

- Desktop Study Area
- Study Area
- Roads

**Significant Vegetation (DBCA, 2021)**

- Banksia WL SCP

FIGURE 4.3

## Significant Vegetation of the Desktop Study Area

Image Source: ESRI Basemap (2021) Data source: Iluka (2022), DBCA (2021), Landgate (2022)

## 4.2 Field Survey Results

### 4.2.1 Flora

The only native taxon recorded in the Study Area was *Eucalyptus todtiana*, with all other taxa consisting of introduced taxa including the planted Tagasaste (*Chamaecytisus palmensis*). A full list of taxa is presented in **Appendix D**.

No significant flora taxa were recorded within the Study Area during the Reconnaissance survey in 2021. Suitable habitat does not occur within the Study Area for the significant taxa identified within the Desktop Study (**Appendix C**).

No Weeds of National Significance (WoNS) were recorded in the Study Area. One Declared Weed as per the *Biosecurity and Agriculture Management Act 2016* (BAM Act) was recorded:

- *Echium plantagineum* (Paterson's Curse): Declared Pest S22(2), no control category for the Whole of State.

Of note is the record of **Brassica fruticulosa*, a weed currently known in Western Australia only from records in the Perth Metropolitan Region (WA Herb 1998-).

### 4.2.2 Vegetation

#### 4.2.2.1 Vegetation Types and Vegetation Condition

The Study Area contains Cleared Lands, including C1 (remnant *Eucalyptus todtiana* over mixed introduced understorey) and C2 (**Chamaecytisus palmensis* (Tagasaste) plantation or other agricultural crops).
The vegetation condition of these areas is Completely Degraded (EPA 2016a) (**Figure 4.4**). Photographs and other relevant information regarding this vegetation and cleared land types are presented in **Table 4.3**, with vegetation condition mapping presented in **Figure 4.5**.

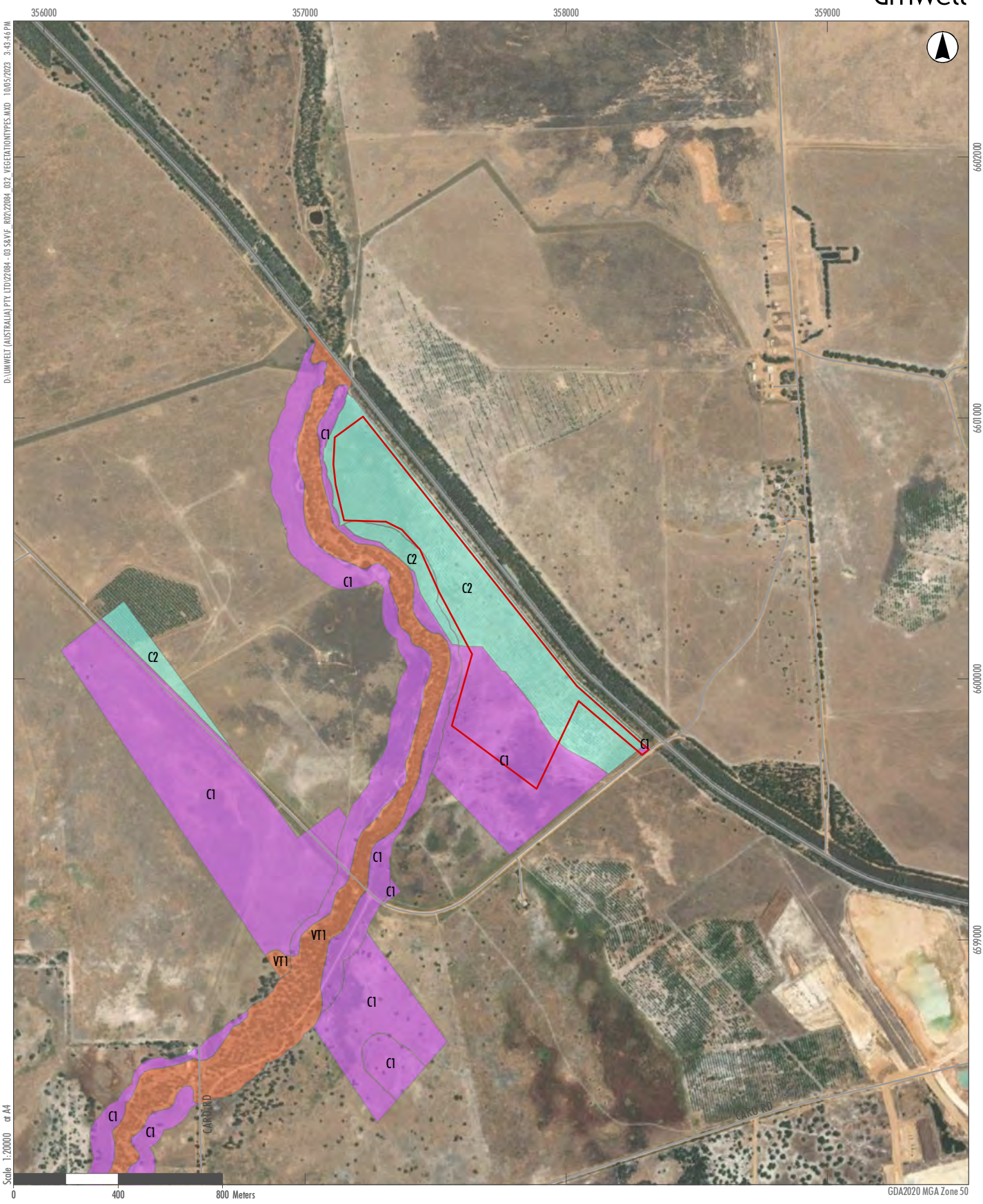
#### 4.2.2.2 Significant Vegetation

No significant vegetation was recorded within the Study Area during the Reconnaissance survey of 2021. The vegetation of the Study Area represents neither the 'Banksia Woodlands of the Swan Coastal Plain' TEC (EPBC Act) or PEC (BC Act), or the 'Tuart (*Eucalyptus gomphocephala*) Woodlands and Forests of the Swan Coastal Plain' TEC (EPBC Act) or PEC (BC Act).

**Table 4.3 Vegetation Types Within the Study Area**

| Vegetation Type (VT) | Summary | Photo |
|---|---|---|
| C1 | Cleared paddocks consisting of Low Isolated trees of *Eucalyptus todtiana* over low grassland of introduced taxa<br><br>Total Area mapped: 11.2 (28.0 % of Study Area)<br><br>Vegetation Condition: Completely Degraded<br><br>C1 consists of remnant trees of *Eucalyptus todtiana* over introduced taxa. |  <br>  |

| Vegetation Type (VT) | Summary | Photo |
|---|---|---|
| C2 | Plantation of **Chamaecytisus palmensis* or other agricultural crops, over low grassland of introduced taxa, with isolated trees of *Eucalyptus todtiana*<br><br>Total Area mapped: 28.9 ha (72.0 % of Study Area)<br><br>Vegetation Condition: Completely Degraded<br><br>C2 consists of rows of planted Tagasaste or monoculture agricultural crops, with occasional remnant isolated *Eucalyptus todtiana*, over introduced taxa. |  <br>  |




Legend

Study Area

Roads

**Vegetation Type**

Low Open Woodland of *Eucalyptus rudis* and *Melaleuca rhaphiophylla* with occasional *E. wandoo* over low grassland of introduced taxa

Cleared paddocks consisting of Low Isolated trees of *Eucalyptus todtiana* over low grassland of introduced taxa

Plantation of **Chamaecytisus palmensis* or other agricultural crops, over low grassland of introduced taxa, with isolated trees of *Eucalyptus todtiana*

FIGURE 4.4

## Vegetation Types of the Study Area

Image Source: ESRI Basemap (2021) Data source: Umwelt (Australia) Pty Ltd (2022), Landgate (2022)

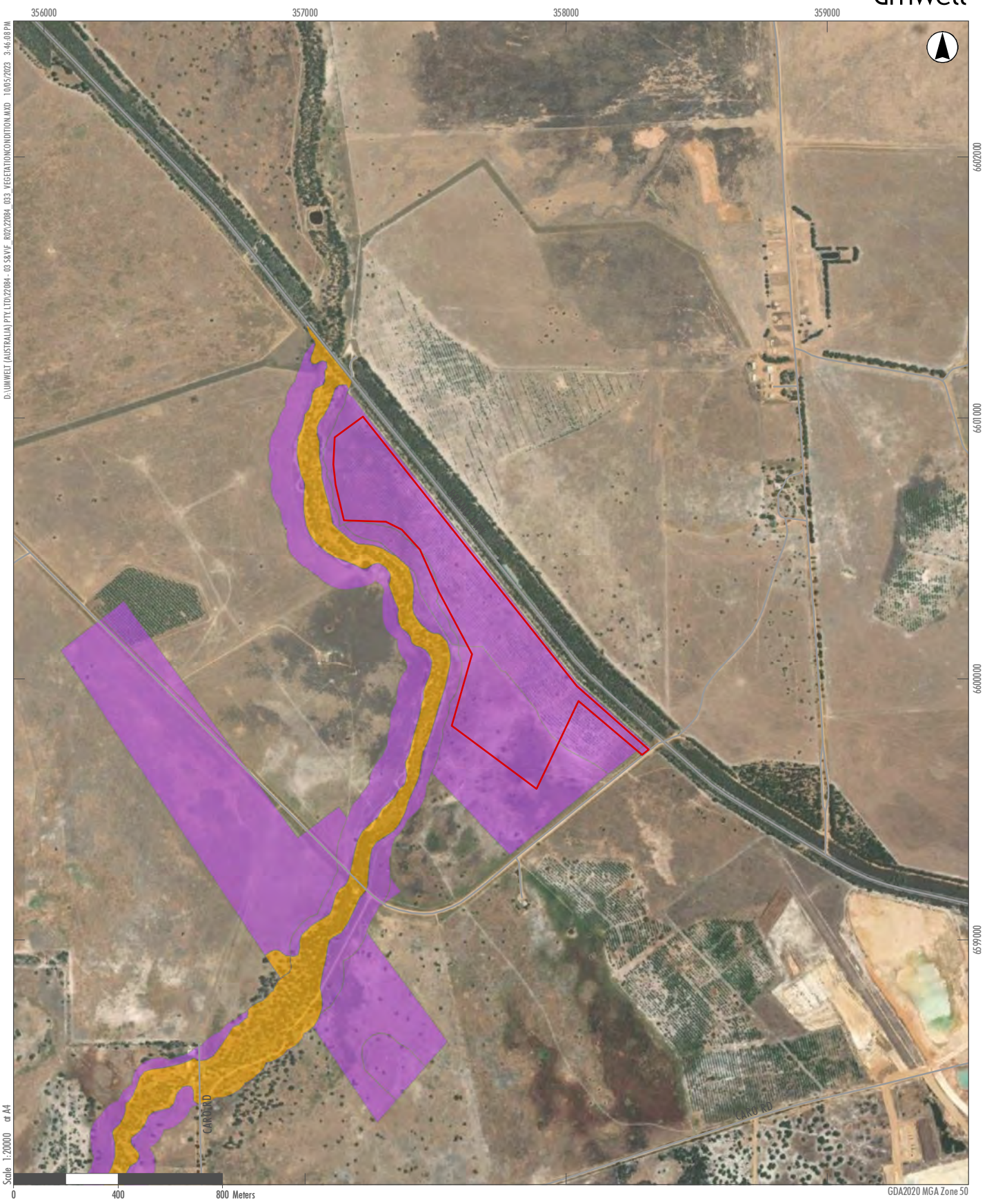



FIGURE 4.5

Vegetation Condition of the Study Area

Image Source: ESRI Basemap (2021) Data source: Umwelt (Australia) Pty Ltd (2022), Landgate (2022)

# 5.0 Discussion and Conclusions

The vegetation within the Study Area is Completely Degraded (EPA 2016a), being either Tagasaste (**Chamaecytisus palmensis*) plantation or pasture with isolated trees of *Eucalyptus todtiana*, thus two types of Cleared vegetation have been mapped (C1 and C2) respectively. The vegetation has no structural resemblance to native vegetation and retains no native taxa other than *E. todtiana*. Historical clearing for agricultural purposes has had heavy impacts on the vegetation of the Study Area.

No TECs, PECs, significant flora taxa or vegetation were recorded in the Study Area, and it is highly unlikely any significant flora taxa occur in the Study Area due to the extent of historical disturbance and extent of survey undertaken in the Study Area.

# 6.0 References


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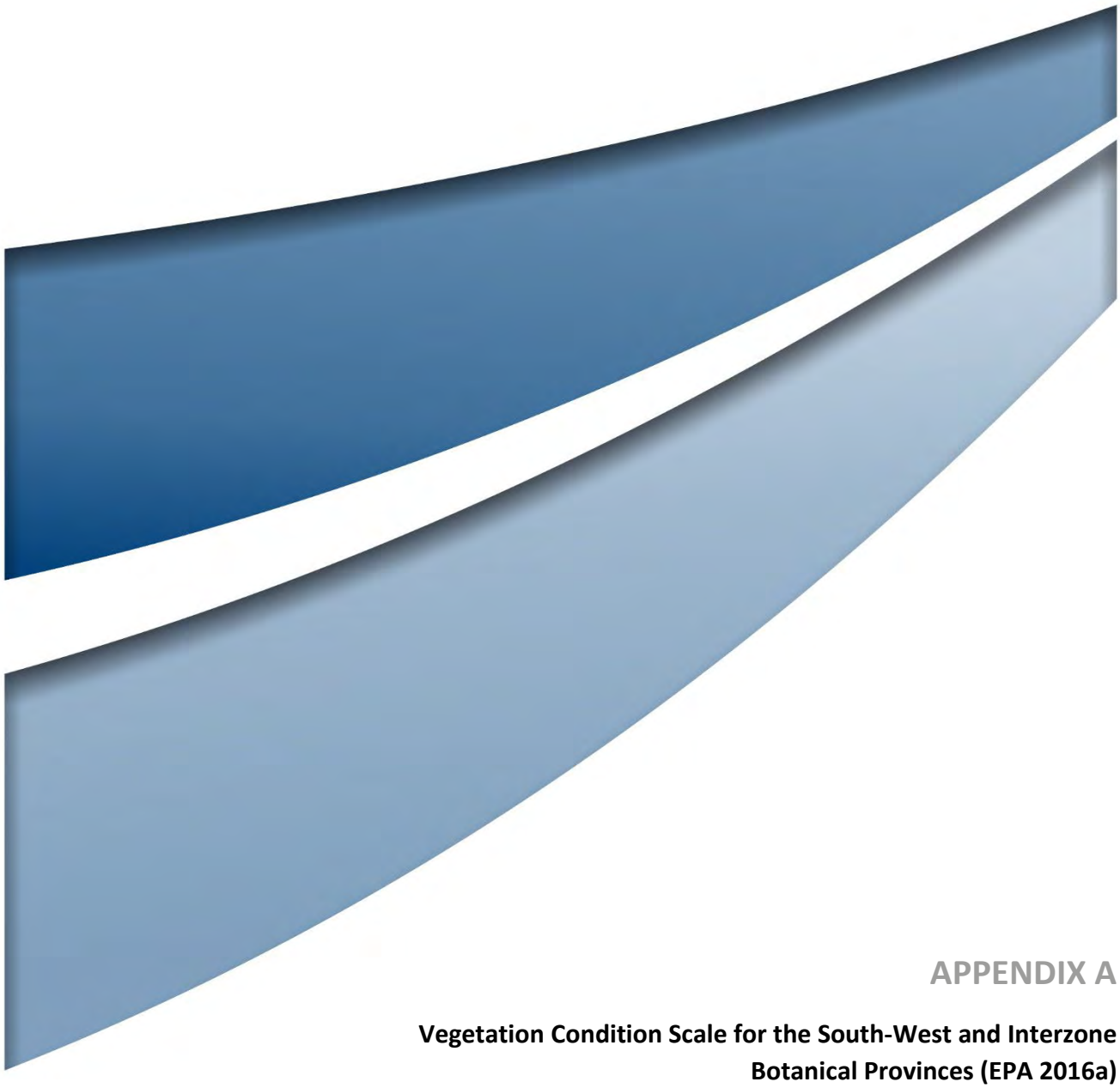
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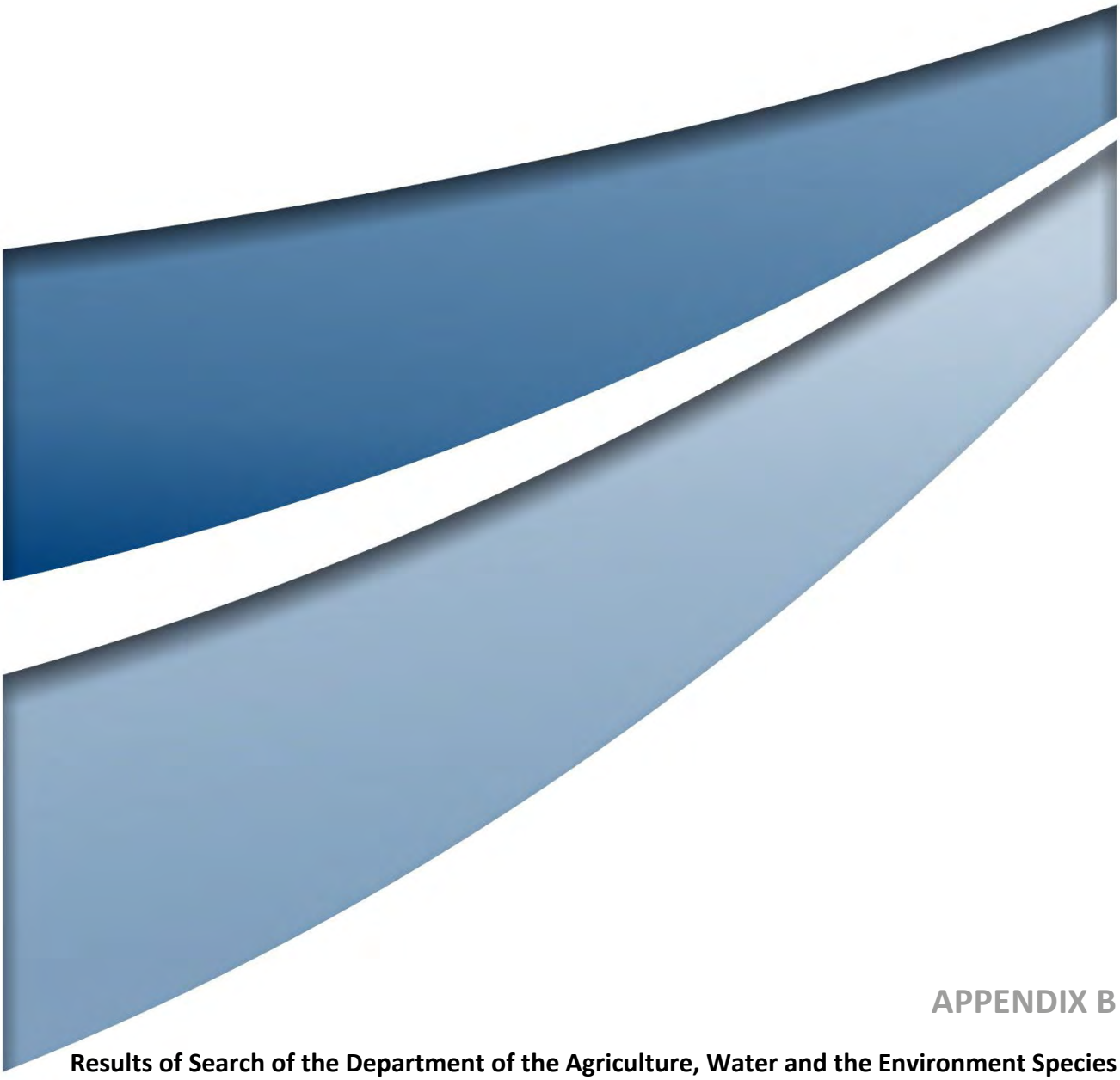
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# APPENDIX A

**Vegetation Condition Scale for the South-West and Interzone Botanical Provinces (EPA 2016a)**

| Condition Ranking | Description |
|---|---|
| Pristine | Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement. |
| Excellent | Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks. |
| Very Good | Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing. |
| Good | Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing. |
| Degraded | Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing. |
| Completely Degraded | The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs. |



# APPENDIX B

**Results of Search of the Department of the Agriculture, Water and the Environment Species Profile and Threats (SPRAT) Database (DAWE 2022)**

Australian Government
Department of Agriculture, Water and the Environment

# EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 25-Mar-2022


Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

# Summary

## Matters of National Environment Significance

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

| | |
|---|---|
| World Heritage Properties: | None |
| National Heritage Places: | None |
| Wetlands of International Importance (Ramsar | None |
| Great Barrier Reef Marine Park: | None |
| Commonwealth Marine Area: | None |
| Listed Threatened Ecological Communities: | 2 |
| Listed Threatened Species: | 24 |
| Listed Migratory Species: | 8 |

## Other Matters Protected by the EPBC Act

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

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

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

| | |
|---|---|
| Commonwealth Lands: | None |
| Commonwealth Heritage Places: | None |
| Listed Marine Species: | 13 |
| Whales and Other Cetaceans: | None |
| Critical Habitats: | None |
| Commonwealth Reserves Terrestrial: | None |
| Australian Marine Parks: | None |
| Habitat Critical to the Survival of Marine Turtles: | None |

## Extra Information

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

| | |
|---|---|
| State and Territory Reserves: | None |
| Regional Forest Agreements: | None |
| Nationally Important Wetlands: | None |
| EPBC Act Referrals: | 6 |
| Key Ecological Features (Marine): | None |
| Biologically Important Areas: | None |
| Bioregional Assessments: | None |
| Geological and Bioregional Assessments: | None |

# Details

## Matters of National Environmental Significance

### Listed Threatened Ecological Communities [ Resource Information ]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

| Community Name | Threatened Category | Presence Text | Buffer Status |
|---|---|---|---|
| Banksia Woodlands of the Swan Coastal Plain ecological community | Endangered | Community likely to occur within area | In feature area |
| Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community | Critically Endangered | Community may occur within area | In feature area |

### Listed Threatened Species [ Resource Information ]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

| Scientific Name | Threatened Category | Presence Text | Buffer Status |
|---|---|---|---|
| BIRD | | | |
| Calidris ferruginea | | | |
| Curlew Sandpiper [856] | Critically Endangered | Species or species habitat may occur within area | In feature area |
| Leipoa ocellata | | | |
| Malleefowl [934] | Vulnerable | Species or species habitat likely to occur within area | In feature area |
| Numenius madagascariensis | | | |
| Eastern Curlew, Far Eastern Curlew [847] | Critically Endangered | Species or species habitat may occur within area | In feature area |
| Rostratula australis | | | |
| Australian Painted Snipe [77037] | Endangered | Species or species habitat likely to occur within area | In feature area |
| Zanda latirostris listed as Calyptorhynchus latirostris | | | |
| Carnaby's Black Cockatoo, Short-billed Black-cockatoo [87737] | Endangered | Species or species habitat known to occur within area | In feature area |
| MAMMAL | | | |

| Scientific Name | Threatened Category | Presence Text | Buffer Status |
|---|---|---|---|
| Dasyurus geoffroii<br>Chuditch, Western Quoll [330] | Vulnerable | Species or species habitat likely to occur within area | In feature area |
| Macroderma gigas<br>Ghost Bat [174] | Vulnerable | Species or species habitat may occur within area | In feature area |
| Parantechinus apicalis<br>Dibbler [313] | Endangered | Species or species habitat may occur within area | In feature area |
| PLANT | | | |
| Andersonia gracilis<br>Slender Andersonia [14470] | Endangered | Species or species habitat likely to occur within area | In feature area |
| Anigozanthos viridis subsp. terraspectans<br>Dwarf Green Kangaroo Paw [3435] | Vulnerable | Species or species habitat likely to occur within area | In feature area |
| Chamelaucium sp. Gingin (N.G.Marchant 6)<br>Gingin Wax [88881] | Endangered | Species or species habitat may occur within area | In feature area |
| Drakaea elastica<br>Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753] | Endangered | Species or species habitat may occur within area | In feature area |
| Eleocharis keigheryi<br>Keighery's Eleocharis [64893] | Vulnerable | Species or species habitat likely to occur within area | In buffer area only |
| Eucalyptus dolorosa<br>Dandaragan Mallee, Mount Misery Mallee [56709] | Endangered | Species or species habitat may occur within area | In feature area |
| Eucalyptus impensa<br>Eneabba Mallee [56711] | Endangered | Species or species habitat may occur within area | In feature area |
| Eucalyptus leprophloia<br>Scaly Butt Mallee, Scaly-butt Mallee [56712] | Endangered | Species or species habitat may occur within area | In feature area |

| Scientific Name | Threatened Category | Presence Text | Buffer Status |
|---|---|---|---|
| Grevillea calliantha<br>Foote's Grevillea, Cataby Grevillea, Black Magic Grevillea [56339] | Endangered | Species or species habitat may occur within area | In feature area |
| Hakea megalosperma<br>Lesueur Hakea [10505] | Vulnerable | Species or species habitat may occur within area | In feature area |
| Hemiandra gardneri<br>Red Snakebush [7945] | Endangered | Species or species habitat may occur within area | In feature area |
| Leucopogon obtectus<br>Hidden Beard-heath [19614] | Endangered | Species or species habitat may occur within area | In feature area |
| Macarthuria keigheryi<br>Keighery's Macarthuria [64930] | Endangered | Species or species habitat may occur within area | In feature area |
| Paracaleana dixonii<br>Sandplain Duck Orchid [86882] | Endangered | Species or species habitat may occur within area | In feature area |
| Ptychosema pusillum<br>Dwarf Pea [11268] | Vulnerable | Species or species habitat may occur within area | In feature area |
| Thelymitra stellata<br>Star Sun-orchid [7060] | Endangered | Species or species habitat may occur within area | In feature area |

| Listed Migratory Species | | | [ Resource Information ] |
|---|---|---|---|
| Scientific Name | Threatened Category | Presence Text | Buffer Status |
| Migratory Marine Birds | | | |
| Apus pacificus<br>Fork-tailed Swift [678] | | Species or species habitat likely to occur within area | In feature area |
| Migratory Terrestrial Species | | | |
| Motacilla cinerea<br>Grey Wagtail [642] | | Species or species habitat may occur within area | In feature area |
| Migratory Wetlands Species | | | |

| Scientific Name | Threatened Category | Presence Text | Buffer Status |
|---|---|---|---|
| Actitis hypoleucos<br>Common Sandpiper [59309] | | Species or species habitat may occur within area | In feature area |
| Calidris acuminata<br>Sharp-tailed Sandpiper [874] | | Species or species habitat may occur within area | In feature area |
| Calidris ferruginea<br>Curlew Sandpiper [856] | Critically Endangered | Species or species habitat may occur within area | In feature area |
| Calidris melanotos<br>Pectoral Sandpiper [858] | | Species or species habitat may occur within area | In feature area |
| Numenius madagascariensis<br>Eastern Curlew, Far Eastern Curlew [847] | Critically Endangered | Species or species habitat may occur within area | In feature area |
| Tringa nebularia<br>Common Greenshank, Greenshank [832] | | Species or species habitat likely to occur within area | In buffer area only |

## Other Matters Protected by the EPBC Act

| Listed Marine Species | | | [ Resource Information ] |
|---|---|---|---|
| Scientific Name | Threatened Category | Presence Text | Buffer Status |
| Bird | | | |
| Actitis hypoleucos<br>Common Sandpiper [59309] | | Species or species habitat may occur within area | In feature area |
| Apus pacificus<br>Fork-tailed Swift [678] | | Species or species habitat likely to occur within area overfly marine area | In feature area |
| Bubulcus ibis as Ardea ibis<br>Cattle Egret [66521] | | Species or species habitat may occur within area overfly marine area | In feature area |

| Scientific Name | Threatened Category | Presence Text | Buffer Status |
|---|---|---|---|
| Calidris acuminata<br>Sharp-tailed Sandpiper [874] | | Species or species habitat may occur within area | In feature area |
| Calidris ferruginea<br>Curlew Sandpiper [856] | Critically Endangered | Species or species habitat may occur within area overfly marine area | In feature area |
| Calidris melanotos<br>Pectoral Sandpiper [858] | | Species or species habitat may occur within area overfly marine area | In feature area |
| Chalcites osculans as Chrysococcyx osculans<br>Black-eared Cuckoo [83425] | | Species or species habitat likely to occur within area overfly marine area | In feature area |
| Haliaeetus leucogaster<br>White-bellied Sea-Eagle [943] | | Species or species habitat likely to occur within area | In feature area |
| Merops ornatus<br>Rainbow Bee-eater [670] | | Species or species habitat may occur within area overfly marine area | In feature area |
| Motacilla cinerea<br>Grey Wagtail [642] | | Species or species habitat may occur within area overfly marine area | In feature area |
| Numenius madagascariensis<br>Eastern Curlew, Far Eastern Curlew [847] | Critically Endangered | Species or species habitat may occur within area | In feature area |
| Rostratula australis as Rostratula benghalensis (sensu lato)<br>Australian Painted Snipe [77037] | Endangered | Species or species habitat likely to occur within area overfly marine area | In feature area |
| Tringa nebularia<br>Common Greenshank, Greenshank [832] | | Species or species habitat likely to occur within area overfly marine area | In buffer area only |

## Extra Information

| EPBC Act Referrals | | | | [ Resource Information ] |
|---|---|---|---|---|
| Title of referral | Reference | Referral Outcome | Assessment Status | Buffer Status |
| Controlled action | | | | |
| Brand Highway Widening and Passing Lanes Project 34.83-164.3 SLK | 2017/7864 | Controlled Action | Post-Approval | In feature area |
| Not controlled action | | | | |
| Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia | 2015/7522 | Not Controlled Action | Completed | In feature area |
| Walyering 3D Seismic Survey, Cataby, WA | 2017/7982 | Not Controlled Action | Completed | In buffer area only |
| Not controlled action (particular manner) | | | | |
| Mineral Sands Mine | 2005/2001 | Not Controlled Action (Particular Manner) | Post-Approval | In feature area |
| Transmission Line Rebuild and Extension | 2009/5105 | Not Controlled Action (Particular Manner) | Post-Approval | In feature area |
| Referral decision | | | | |
| Transmission Line Rebuild and Extension | 2009/4972 | Referral Decision | Completed | In feature area |

# Caveat

## 1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

## 2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

## 3 DATA SOURCES

Threatened ecological communities

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

Threatened, migratory and marine species

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

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

## 4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

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

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

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

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

# Acknowledgements

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

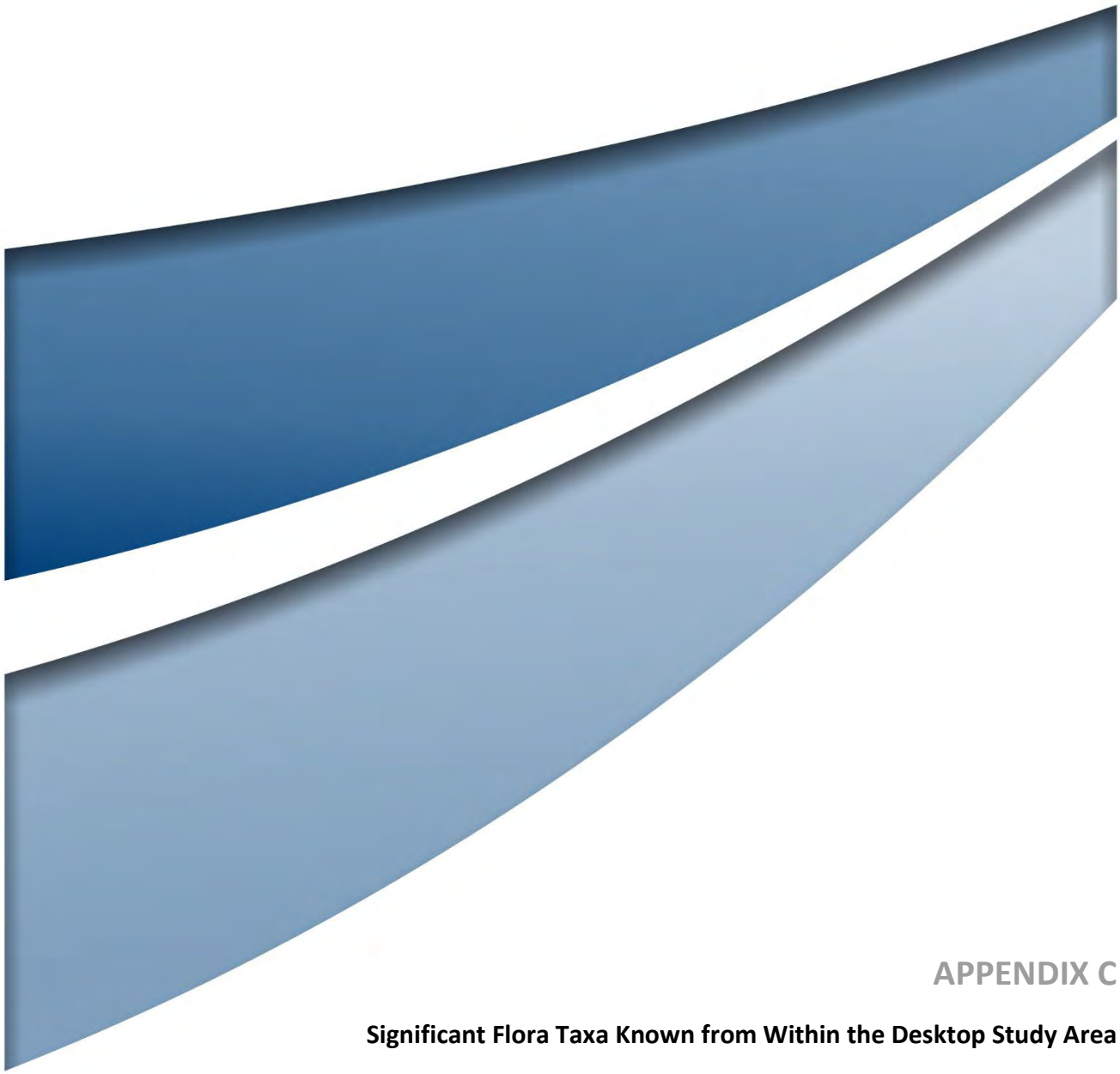
-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management,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

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

Please feel free to provide feedback via the Contact Us page.

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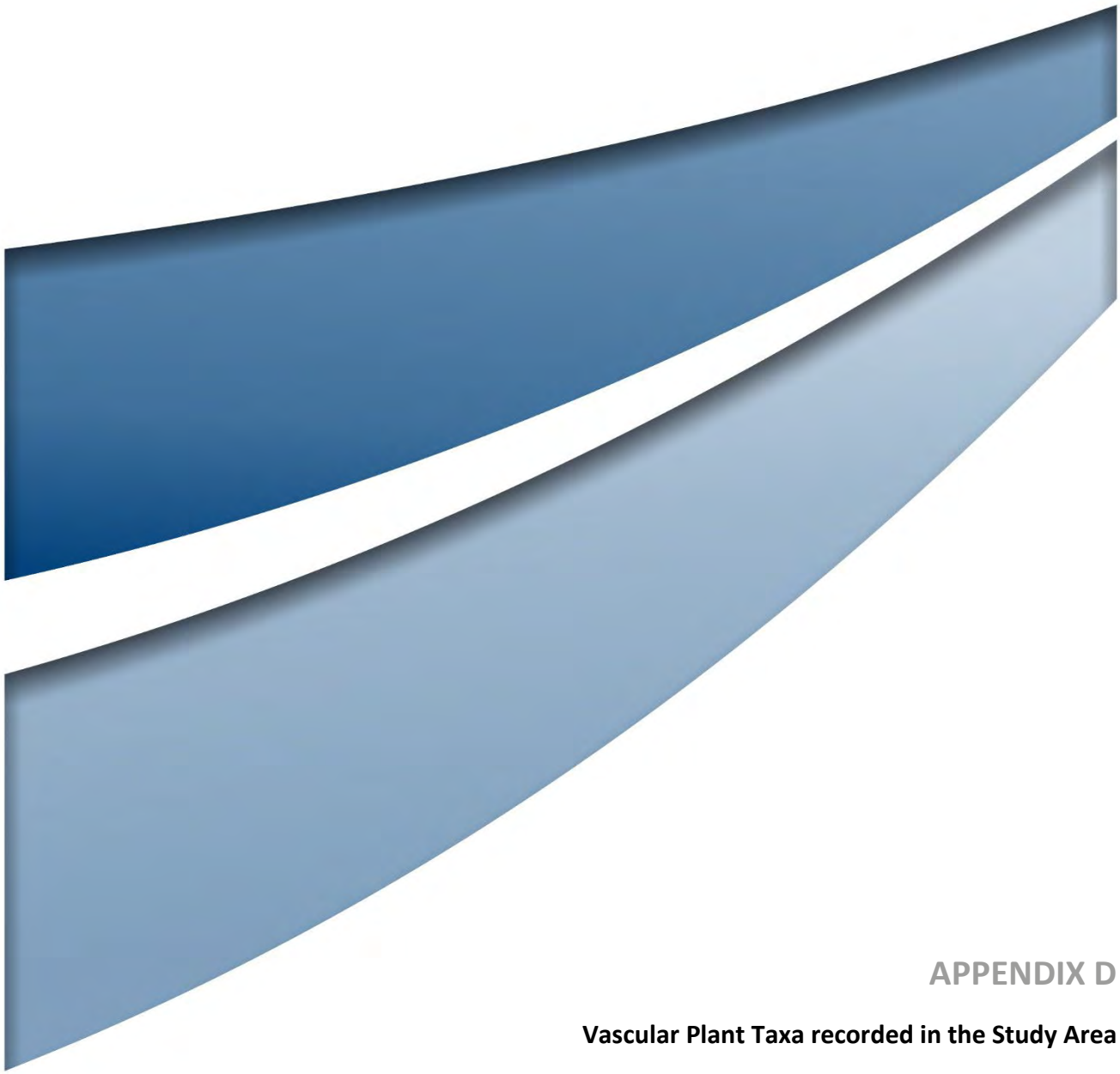
# APPENDIX C

**Significant Flora Taxa Known from Within the Desktop Study Area**

| Taxon | Status | WEC | DBCA | DAWE |
|---|---|---|---|---|
| *Acacia forrestiana* | T | * | * | |
| *Acacia plicata* | P3 | * | * | |
| *Andersonia gracilis* | T | * | * | Species or species habitat likely to occur in area |
| *Anigozanthos humilis* subsp. Badgingarra (S.D. Hopper 7114) | P2 | * | * | |
| *Anigozanthos humilis* subsp. *chrysanthus* | P4 | * | * | |
| *Anigozanthos viridis* subsp. *terraspectans* | T | * | * | Species or species habitat likely to occur in area |
| *Arnocrinum gracillimum* | P3 | * | * | |
| *Asterolasia drummondii* | P4 | * | * | |
| *Babingtonia delicata* | P1 | * | * | |
| *Babingtonia urbana* | P3 | * | * | |
| *Banksia dallanneyi subsp. pollosta* | P3 | * | | |
| *Banksia kippistiana* var. *paenepeccata* | P3 | * | * | |
| *Banksia prionophylla* | P1 | * | | |
| *Beaufortia bicolor* | P3 | * | | |
| *Beaufortia eriocephala* | P3 | * | * | |
| *Calothamnus brevifolius* | P4 | * | | |
| *Calytrix ecalycata* subsp. *brevis* | P3 | * | | |
| *Chamaescilla ?gibsonii* | P3 | * | | |
| *Chamelaucium lullfitzii* | T | | | Species or species habitat may occur in area |
| *Chamelaucium* sp. Cataby (G.J. Keighery 11009) | T | * | * | |
| *Chordifex chaunocoleus* | P4 | * | | |
| *Chordifex reseminans* | P2 | * | * | |
| *Comesperma rhadinocarpum* | P3 | * | | |
| *Conospermum scaposum* | P3 | * | | |
| *Conostephium magnum* | P4 | * | * | |
| *Dampiera tephrea* | P2 | * | * | |
| *Desmocladus elongatus* | P4 | * | * | |
| *Desmocladus microcarpus* | P2 | * | * | |
| *Desmocladus nodatus* | P3 | * | * | |
| *Diuris recurva* | P4 | * | | |
| *Drakaea elastica* | T | | | Species or species habitat may occur in area |
| *Drosera leioblastus* | P1 | * | * | |
| *Drosera pedicellaris* | P1 | * | | |
| *Drosera prophylla* | P3 | * | * | |

| Taxon | Status | WEC | DBCA | DAWE |
|---|---|---|---|---|
| *Eleocharis keigheryi* | T | * | * | Species or species habitat likely to occur in area |
| *Eucalyptus abdita* | P2 | * | * | |
| *Eucalyptus dolorosa* | T | | * | Species or species habitat may occur in area |
| *Eucalyptus impensa* | T | | | Species or species habitat may occur in area |
| *Eucalyptus leprophloia* | T | | | Species or species habitat may occur in area |
| *Eucalyptus macrocarpa subsp. elachantha* | P4 | * | * | |
| *Eucalyptus* x *carnabyi* | P4 | * | * | |
| *Gastrolobium nudum* | P2 | * | * | |
| *Gompholobium gairdnerianum* | P3 | * | * | |
| *Goodenia perryi* | P3 | * | | |
| *Grevillea calliantha* | T | * | * | Species or species habitat may occur in area |
| *Grevillea drummondii* | P4 | * | * | |
| *Grevillea florida* | P3 | * | * | |
| *Grevillea saccata* | P4 | * | * | |
| *Grevillea synapheae* subsp. A Flora of Australia (S.D. Hopper 6333) | P1 | * | * | |
| *Grevillea synapheae* subsp. *minyulo* | P1 | * | * | |
| *Grevillea thyrsoides* subsp. *thyrsoides* | P3 | * | * | |
| *Guichenotia alba* | P3 | * | * | |
| *Hakea longiflora* | P3 | * | * | |
| *Hakea megalosperma* | T | * | * | Species or species habitat may occur in area |
| *Hemiandra gardneri* | T | | | Species or species habitat may occur in area |
| *Hensmania stoniella* | P3 | * | | |
| *Hibbertia* aff. *helianthemoides* (Northern variant) **; Hibbertia helianthemoides | P4 | * | * | |
| *Hopkinsia anoectocolea* | P3 | * | | |
| *Hypocalymma* sp. Cataby (G.J. Keighery 5151) | P2 | * | * | |
| *Hypocalymma* sp. Dandaragan (C.A. Gardner 9014) | P1 | * | | |
| *Hypocalymma tetrapterum* | P3 | * | * | |

| Taxon | Status | WEC | DBCA | DAWE |
|---|---|---|---|---|
| *Hypolaena robusta* | P4 | * | * | |
| *Isotropis cuneifolia* subsp. *glabra* | P3 | * | * | |
| *Jacksonia carduacea* | P3 | * | * | |
| *Lasiopetalum rupicola* | P1 | * | * | |
| *Lepidobolus quadratus* | P3 | * | * | |
| *Lepyrodia curvescens* | P2 | * | | |
| *Leucopogon foliosus* | P3 | * | * | |
| *Lyginia excelsa* | P2 | * | * | |
| *Macarthuria keigheryii* | T | | | Species or species habitat may occur in area |
| *Paracaleana dixonii* | T | * | * | Species or species habitat may occur in area |
| *Persoonia filiformis* | P3 | * | * | |
| *Platysace ramosissima* | P3 | * | * | |
| *Podotheca pritzelii* | P3 | * | * | |
| *Ptychosema pusillum* | T | * | * | Species or species habitat may occur in area |
| *Schoenus griffinianus* | P4 | * | * | |
| *Schoenus natans* | P4 | * | * | |
| *Schoenus pennisetis* | P3 | * | * | |
| *Stenanthemum sublineare* | P2 | * | * | |
| *Stylidium aeonioides* | P4 | * | * | |
| *Stylidium carnosum* subsp. ?Narrow leaves (J.A. Wege 490) | P1 | * | | |
| *Stylidium hymenocraspedum* | P3 | * | * | |
| *Stylidium longitubum* | P4 | * | * | |
| *Stylidium periscelianthum* | P3 | * | * | |
| *Styphelia obtecta* | T | | | Species or species habitat may occur in area |
| *Tetratheca angulata* | P3 | * | * | |
| *Thelymitra apiculata* | P4 | * | * | |
| *Thelymitra pulcherrima* | P2 | * | * | |
| *Thelymitra stellata* | T | * | * | Species or species habitat may occur in area |
| *Thysanotus glaucus* | P4 | * | * | |
| *Verticordia lindleyi* subsp. *lindleyi* | P4 | * | * | |



# APPENDIX D

**Vascular Plant Taxa recorded in the Study Area**

| Family | Taxon |
|---|---|
| Asteraceae | **Arctotheca calendula* |
| | **Cotula coronopifolia* |
| | **Hypochaeris glabra* |
| | **Ursinia anthemoides* |
| Boraginaceae | **Echium plantagineum* |
| | **Brassica fruticulosa* |
| | **Brassica tournefortii* |
| Campanulaceae | **Monopsis debilis* |
| Fabaceae | **Chamaecytisus palmensis* |
| | **Lotus subbiflorus* |
| | **Trifolium campestre* |
| Myrtaceae | *Eucalyptus todtiana* |
| Poaceae | **Bromus diandrus* |
| | **Cynodon dactylon* |
| | **Ehrharta calycina* |
| | **Ehrharta longiflora* |
| | **Eragrostis curvula* |
| | **Hordeum leporinum* |
| | **Hordeum marinum* |
| | **Lolium perenne* |
| | **Polypogon monspeliensis* |

**No taxa listed in this table are recognised as significant.**



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# APPENDIX D – JOHNSTONE AND KIRKBY CARNABY'S COCKATOO REPORT 2022

# Carnaby's Cockatoo Minyulo Brook Habitat Survey 2021.

**R.E. JOHNSTONE AND T. KIRKBY**

## Scope

The scope of this work was to undertake a targeted survey to identify any breeding, feeding and roosting sites use by Carnaby's Cockatoo *Calyptorhynchus latirostris* at Cataby along the Minyulo Brook riparian area north of Caro Road.

## Tree and hollow information.

To be large enough to provide a breeding hollow for black cockatoos most trees need to have reached a Diameter at Breast Height (DBH) of 500mm. The exceptions are Salmon Gum *Eucalyptus salmonophloia* and Wandoo *E. wandoo* which require 300mm DBH (*Department of the Environment and Energy,* 2017). The hollows need to have an entrance size of at least 120mm diameter and lead to a suitably sized and sheltered nest chamber of approximately 300mm diameter or larger.

## Survey Methodology and Techniques

Key objectives of the survey are to:

1. Carry out field visit to inspect potential breeding trees and assess the suitability of the hollows for use by Carnaby's Cockatoo.
2. Visually inspect and pick up with handheld GPS (GDA 94) all trees with a suitable DBH and check all suitable hollows with binoculars for signs of cockatoo use, including wear around the hollow, chewing, scarring and scratch marks on trunks and branches.
3. Log hollows deemed to be possible cockatoo nest hollows.
4. Log all observations of cockatoos in the area.
5. Log all old and recent evidence of foraging.
6. Log all feral European Honeybee hives.

## Carnaby's Cockatoo Species Background Information

Carnaby's Cockatoo (*Calyptorhynchus latirostris*)
Carnaby's Cockatoo is listed as 'fauna that is rare or likely to become extinct' (generally referred to as threatened fauna) under the Western Australian Wildlife Conservation Act 1950, Wildlife Conservation (Specially Protected Fauna) Notice 2010(2). It has been given a ranking of Endangered by the Western Australian Threatened Species Scientific Committee. It is also listed as Endangered under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

## Distribution

Carnaby's Cockatoo is endemic to the south-west of Western Australia, north to the lower Murchison River and east to Nabawa, Wilroy, Waddi Forest, Nugadong, Manmanning, Durokoppin, Noogar (Moorine Rock), Lake Cronin, Ravensthorpe Range, head of Oldfield River, 20 km ESE of Coondingup and Cape Arid; also casual on Rottnest Island (Johnstone and Storr 1998).




Distribution map of Carnaby's Cockatoo.

### Status and Habitat Preferences

This species is a postnuptial nomad, and birds originating in the central and northern Wheatbelt tending to move west after breeding. For example; most birds breeding in Badgingarra, Dandaragan, Moora and Bindoon regions tend to move west after breeding into higher rainfall areas especially the near-coastal Banksia scrubs e.g. at Wanagarren Nature Reserve, Nilgen Nature Reserve, Yanchep area and Wanneroo area then many of these move further south onto the southern Swan Coastal Plain including the southern Perth metropolitan area .

It is uncommon to common in the subhumid zone and wetter parts of the semiarid zone, scarce and patchily distributed in the drier parts of its range (north of Arrowsmith Lake and east of Marchagee, New Norcia, Toodyay, Tarin Rock and Lake Magenta) and scarce to moderately common in deep south-west (south of Margaret River, Nannup and Bridgetown and east of Albany).

The migration and movement of birds from the south-east portion of their breeding range (e.g. areas such as Broomehill, Lake Cronin, Hatter Hill and Lake King) tends to be from the inland breeding sites to the south coast then east or west along it.

## Breeding

Breeding occurs mainly from early July to mid-December in the semiarid and subhumid interior from the Three Springs district south to the Stirling Range, west to Cockleshell Gully, Cataby, Regans Ford, Gingin, near mouth of Moore River, Yanchep, Serpentine, Mandurah, Lake Clifton, Bunbury, Nannup and Tone River and east to Manmanning, Kellerberrin, Woolundra, Lake Cronin, Hatter Hill and near Ravensthorpe (Storr-Johnstone Bird Data Bank).

## Breeding Requirements

Carnaby's Cockatoo display strong pair bonds and mate for life. They nest in hollows of smooth-barked eucalypts especially Salmon Gum (*Eucalyptus salmonophloia*) and Wandoo (*Eucalyptus wandoo*) but nests have also been found in other eucalypts including York Gum (*Eucalyptus loxophleba*), Flooded Gum (*Eucalyptus rudis*), Tuart (*Eucalyptus gomphocephala*) and the rough-barked Marri (*Corymbia calophylla*). Eggs are laid on a mat of wood chips at the bottom of a large hollow (mostly top entry hollows) ranging from a few centimetres to 5 m deep; clutch 1–2 (mostly 2 but only one young reared). Incubation lasts 29 days and only the female incubates and broods. The nestling is brooded by the female during which time both rely on the male for food. The female then leaves the nest each day at dawn, sometimes returning mid-morning (with the male) to feed the chick. After about 2–3 weeks she ceases to brood and the chick is fed by one or both parents in the morning and at late evening.

## Food

Carnaby's Cockatoo has been observed feeding on a wide range of foods including the seeds of *Banksia attenuata, B. baxteri, B. coccinea, B. menziesii, B. grandis, B. prionotes, B. speciosa, B. ilicifolia, B. longifolia, B. ericifolia, B. quercifolia, B. hookeriana, Dryandra fraseri, D. praemorsa, D. carlinoides, D. squarrosa, D. sessilis, Corymbia calophylla, C. citriodora, Eucalyptus patens, E. todtiana, E. marginata, E. caesia, E. salmonophloia, Hakea erinacea, H. laurina, H. incrassata, H. lasiantha, H. lissocarpha, H. stenocarpa, H. trifurcata, Hakea undulata, H. prostrata, H. lasianthoides, H. cucullata, Grevillea* spp*., Pinus* spp. (including *P. radiata, P. caribaea* and *P. canariensis*), *Callitris, Jacaranda, Helianthus, Macadamia, Prunus, Carya, Liquidambar styraciflua, Mesomelaena* spp., *Citrullus lanatus* and *Erodium* spp.; flower buds, flowers and nectar of *Banksia attenuata, B. ericifolia, B. grandis, B. ilicifolia, B. menziesii, Callistemon* spp., *Corymbia calophylla, Dryandra lindleyana, D. squarrosa, D. sessilis, D. purdieana, D. erythocephala, Eucalyptus erythrocorys, E. gomphocephala, E. patens, E. robusta, Grevillea robusta, Stenocarpus sinuatus, Protea* spp., insect larvae and insects (including weevils) from under bark, from wood of live and dead trees and shrubs, from galls and from flowers and flower stems, of Acacia spp. (including *A. saligna* and *A. pentedenia*)

*Banksia* spp., *Eucalyptus* spp., *Jacksonia, Agonis* and *Xanthorrhoea*; also the flesh and juice of apples and persimmons.

## Results of 2021 surveys.

The surveys were carried out on 6 and 28 August, 11 October, 8 and 29 November and 20 December2021.Most of the area contained riparian vegetation of Flooded Gums (River gums) scattered Wandoo. Also some large trees of *Eucalyptus todtiana* (mostly in parkland cleared / grazed farmland) and some small patches of Banksia woodland in the road verge on each side of the Minyulo Brook Bridge on Brand Highway. Most of the trees along Minyulo Brook appear to be typical Flooded Gums *Eucalyptus rudis* however some appear to be more like River Gum *Eucalyptus camaldulensis* and hybrids between the two. Apparently the two taxa intergrade between Perth and Geraldton but for the purpose of this report we have referred to them as *E. rudis*

## Conclusions

We located one pair of Carnaby's Cockatoos breeding in a Wandoo near Minyulo Bridge, several possible nest hollows and a small number ( 7) large well chewed hollows suitable for cockatoos ( but these were most probably used by Western Long-billed Corellas and Galahs that are common in this area). See attached spreadsheet.

We found very little evidence of Carnaby's Cockatoos foraging in the survey area except in the Banksia woodland and heath near Minyulo Bridge. In 2008 we recorded a flock of 60 birds in road verge near Minyulo Bridge and in 2010 recorded a pair in verge near Minyulo Brook, so the Banksia verge vegetation appears to be important foraging habitat for the Cataby breeding population.

Most of the southern area (D. Chaffy farm) was farmland with scattered large trees of *Eucalyptus todtiana.* Although listed as a food for Carnaby's Cockatoos there is little evidence that Carnaby's Cockatoos forage on *E. todtiana* and historical records may relate to birds bill cleaning on stems and branches.

No roost sites were located in the project area.

# APPENDIX E – WRM REPORT 2021

# Cataby Mine Development Expansion Program

## Aquatic Fauna Field Survey 2021

December 2021



# Cataby Mine Development Expansion Program

## Aquatic Fauna Survey 2021

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Draft Report
December 2021

Frontispiece: Inundated paperbark woodland at Caro Swamp site CS1 in September 2021 (photo M. Tucker, WRM).

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Internal review: Susan Davies

## Recommended Reference Format

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## Disclaimer

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# EXECUTIVE SUMMARY

Iluka Resources Limited (Iluka) is a major international producer of mineral sands and operates a mine (the Mine) at Cataby, Western Australia. The Mine is located approximately 150 km north of Perth, adjacent to the Brand Highway, and is approximately 18 km in length. To undertake mine expansion activities, additional aquatic fauna baseline surveys were required. Field methods used for the 2021 survey were consistent with methods used for previous surveys, and align with those routinely used by government departments, *i.e.* DBCA, Department of Water Environmental Regulation (DWER) and the National Monitoring River Health Initiative (NMRHI).

Water quality sampling found surface waters to be highly coloured (visually tannin-stained), neutral to basic (pH 7.24 – 8.31), and conductivity (388 - 3330 µS/cm). Conductivity in the Minyulo Brook complex was considerably higher than that of Eneminga Swamp and Dog Swamp.

The 2021 field survey yielded 102 macroinvertebrate taxa. No listed conservation significant species were recorded. One isopod species considered a candidate for DBCA Priority listing, *Paramphisopus palustris* (Pennifold 2018), was recorded at M6, CS2, EM1 and EM2. Gouws and Stewart (2007) recorded this species from 23 locations on the Swan Coastal Plain, with three phylogenetically different clades between Lake Bambun (80 km south-east of Cataby) in the north to Buchanan Drain in Pinjarra in the south, covering approximately 150 km. It is possible that the populations of *Paramphisopus palustris* recorded during this survey are distinct and unique to other known populations. This would need to be confirmed through DNA sequencing. This species is not currently listed under any State or Commonwealth legislation.

A total of 818 fish were recorded, representing four species, including native western minnow and Swan River goby, and introduced mosquitofish and goldfish. Western minnows were by far the most common and abundant fish species recorded. Despite the sampling effort in 2021, conservation listed species *G. munda* was not recorded. *G. munda* are typically found in undisturbed waterbodies that are well vegetated and have permanent or semi-permanent flow, with low electrical conductivity. The species is considered unlikely to occur in the area.

Overall, the study area is considered to support a high diversity of aquatic invertebrates, based on the DBCA reference ranges for wetland evaluation (Jones *et al*. 2009) and relatively undisturbed seasonal wetlands sampled for the *Wetlands of the Swan Coastal Plain* study (Davis *et al.* 1993). While most species are common and widespread, the ecological value of the remnant aquatic habitat in the study area is considered to be moderate to high, based on extensive local and regional-scale loss of seasonal wetland habitat to agriculture.

# 1 INTRODUCTION

## 1.1 Background

Iluka Resources Limited (Iluka) is a major international producer of mineral sands and operates a mine (the Mine) at Cataby, Western Australia (WA). The Mine is located approximately 150 km north of Perth, adjacent to the Brand Highway, and is approximately 18 km in length. The area is on the margins of the SWA1 (Dandaragan Plateau) and SWA2 (Perth) subregions of the Swan Coastal Plan Interim Biogeographic Regionalisation for Australia (IBRA) region. Land use on the mining tenements is predominantly pastoral with some areas of remnant vegetation of varying condition. The local topography slopes from east to west, with wetlands being present to the west. Mining tenements intersect two surface water systems in the local region, Minyulo Brook and Cataby Brook. Construction of the Mine commenced in 2017 with mineral extraction starting in 2018. Mining activity to date has been predominantly to the south of Caro Road.

Stream flows in both Minyulo and Cataby Brooks are highly ephemeral with Cataby Brook recording no annual flows in some years. Cataby Brook has a catchment area of approximately 7 $km^2$, with a maximum recorded flow of approximately 85,000 $m^3$/day. Minyulo Brook has a catchment area of approximately 1.09 $km^2$, with maximum recorded flows of approximately 250,000 $m^3$/day and 502,000 $m^3$/day.

To undertake mine expansion activities, additional aquatic fauna baseline surveys are required. Surveys conducted to date on Minyulo and Cataby Brooks indicate “neither Cataby nor Minyulo Brook appear to support aquatic communities of high ecological value” (WRM 2012).

The scope of future mining activity however may include increased ground disturbance within the development envelope in the Minyulo Brook catchment, and the potential for surface water discharge of excess mine wastewaters to surface waters upstream of Caro Swamp (Figure 1 and 2). Caro Swamp itself is degraded (Froend and Loomes 2004), and subject to elevated salinities in summer, however this wetland system flows to the north west and interacts with other wetland systems such as Emu Lakes and Dog Hole (Figure 1 and 2). There has been historical reference to the possibility of habitat suited to the conservation-listed species *Galaxiella munda* (mud minnow) (Beatty and Morgan 2012). Although it is believed that no suitable habitat exists in the Cataby/Minyulo brooks systems, this has yet to be determined through targeted habitat surveys.

## 1.2 Study Objectives

The objective of this scope of works is to assess the current status/health of the Minyulo Brook and Caro Swamp systems by investigating the aquatic macrofauna (invertebrate and fish diversity) and determine if suitable aquatic habitat exists for *G. munda* in either Caro Swamp, Eneminga Swamp, Emu Lake or Dog Hole. The area of interest for these works are indicated in Figures 1, 2 and 3 and has three targeted outcomes:

1. Aquatic ecosystem status/health;
    a. Historic sampling locations (re-survey for aquatic fauna using similar methods – Minyulo Brook only).
    b. Caro Swamp – investigate/establish sampling site and baseline sampling using the same methodologies as for Minyulo Brook.
2. Identify downstream wetlands dependent on outflow from Caro Swamp;
    a. Primary downstream wetland – initial baseline sampling as for 1(b).
3. Conservation significant species;
    a. Assess Caro Swamp, Emu Lakes, Eneminga Lake and Dog Hole for suitable habitat for *G. munda*.

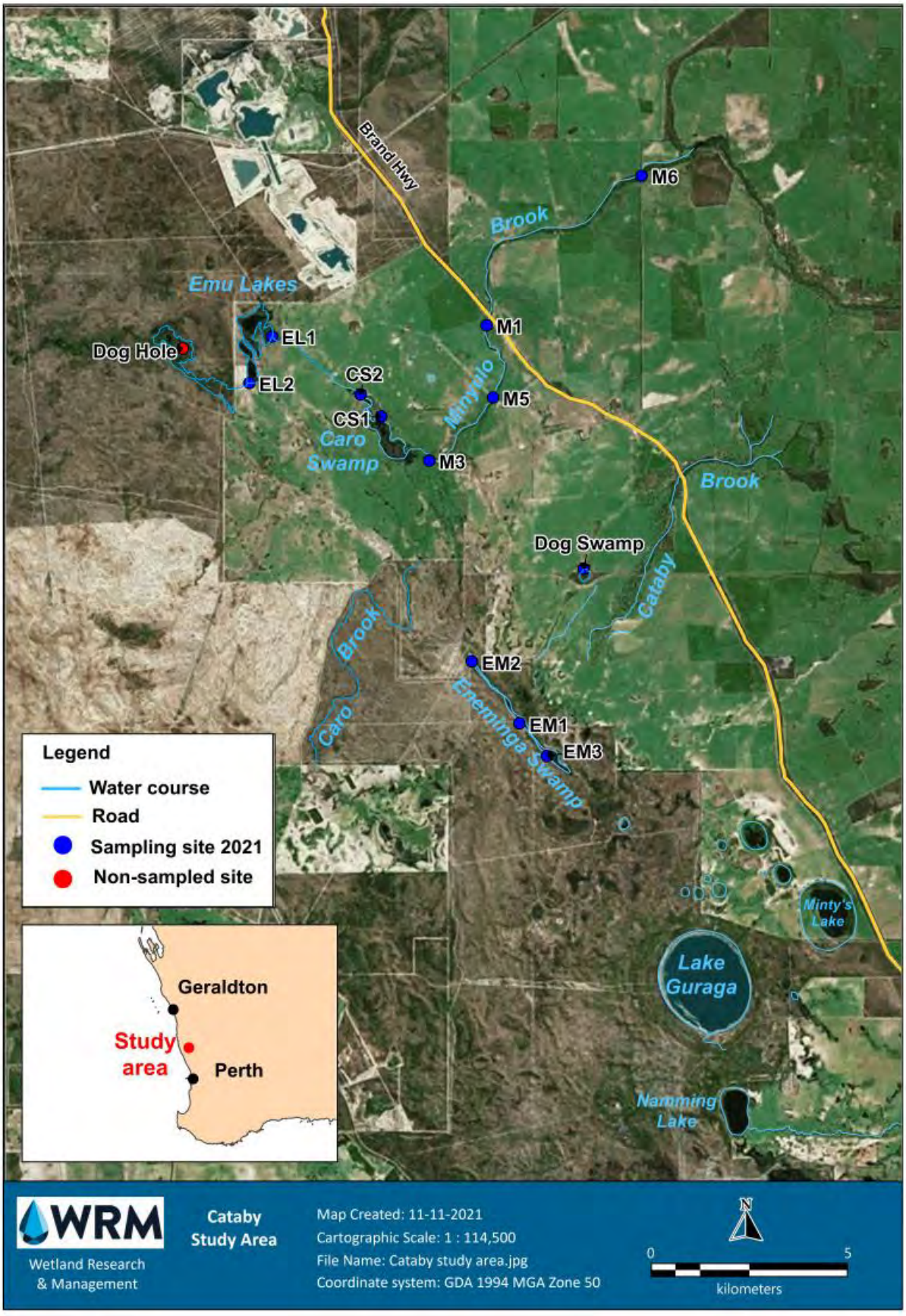



**Figure 1.** Cataby survey area and sampling sites.

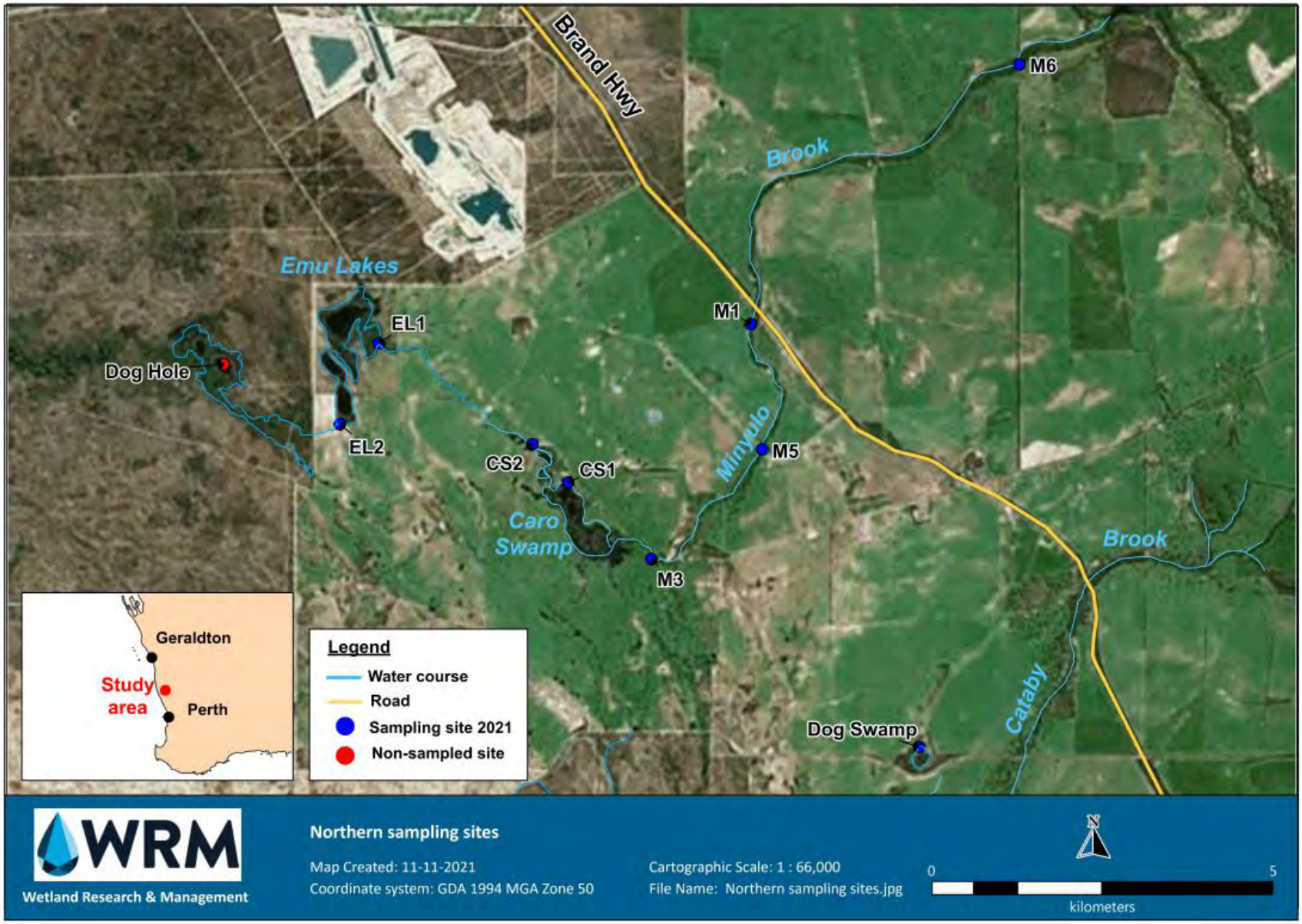



**Figure 2.** Minyulo Brook, Caro Swamp, Emu Lakes and Dog Hole survey area and sampling sites.

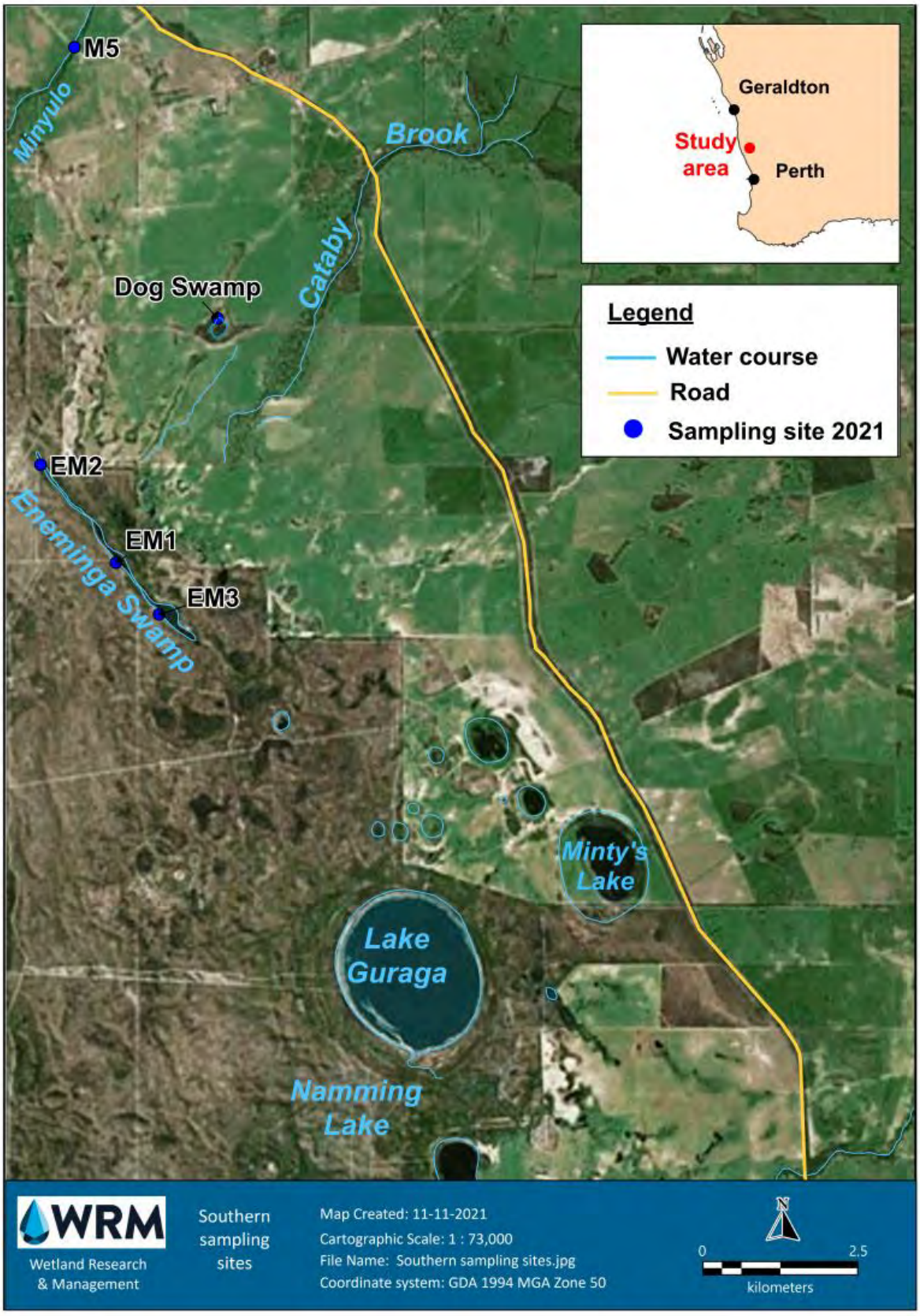



**Figure 3.** Eneminga Swamp and Dog Swamp survey area and sampling sites.

## 1.3 Legislation and Guidance

Environmental factors that must be considered as part of an environmental impact assessment (EIA) process, in relation to the aquatic ecosystem values of Minyulo Brook and wetlands adjacent to Cataby Mine, include *Inland Waters* and *Terrestrial Fauna*. Key environmental factors form the Western Australian Environmental Protection Authority (EPA)'s basis for the decision of whether a proposal's environmental impact is considered acceptable (EPA 2018).

For *Inland Waters*, this encompasses:

"The occurrence, distribution, connectivity, movement, and quantity (hydrological regimes) of inland water including its chemical, physical, biological and aesthetic characteristics (quality)" (EPA 2018).

For *Terrestrial Fauna*, this encompasses:

"Terrestrial fauna are defined as animals living on land or using land (including aquatic systems) for all or part of their lives. Terrestrial fauna includes vertebrate (birds, mammals including bats, reptiles, amphibians, and freshwater fish) and invertebrate (arachnids, crustaceans, insects, molluscs and worms) groups." (EPA 2016a).

*Inland Waters* are considered to include groundwater systems, wetlands, estuaries, and any river, creek, stream or brook (and its floodplain), including systems that "flow permanently, for part of the year or occasionally, and parts of waterways that have been artificially modified" (EPA 2018). The objective for this factor is "to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected" (EPA 2018). Environmental value is defined under the *Environmental Protection Act 1986* (EP Act) as a beneficial use or an ecosystem health condition. Aquatic fauna and flora and the ecological processes that support them are specifically listed in the *Inland Waters* Environmental Factor Guideline as one of the ecosystem health values that must be considered as part of the EIA process (EPA 2018). For the purposes of impact assessment for ecosystem health, the EPA focusses on impacts to significant ecosystems, which include (EPA 2018):

- Ramsar Wetlands of International Importance,
- Conservation category or Resource enhancement management wetlands mapped on the Swan Coastal Plain,
- wetlands listed in the Directory of Important Wetlands in Australia,
- wetlands protected by Environmental Protection Policies under the EP Act,
- wild rivers, as identified by the Australian Heritage Commission and DWER,
- wetland types which may be poorly represented in the conservation reserves system,
- springs and pools, particularly in arid areas,
- ecosystems which support significant flora, vegetation and fauna species or communities, including migratory waterbirds, bats, and subterranean fauna,
- ecosystems which support significant amenity, recreation and cultural values,
- saline lakes, estuaries and near shore ecosystems reliant on groundwater or surface water inputs, and
- downstream marine ecosystems.

The EPA's objective for the *Terrestrial Fauna* factor is "to protect terrestrial fauna so that biological diversity and ecological integrity are maintained" (EPA 2016a). EPA define ecological integrity as "the composition, structure, function and processes of ecosystems, and the natural range of variation of these elements". Considerations for EIA for the factor *Terrestrial Fauna* include, but are not necessarily limited to:

- application of the mitigation hierarchy to avoid or minimise impacts to terrestrial fauna, where possible,
- the terrestrial fauna affected by the proposal,
- the potential impacts and the activities that will cause them, including direct and indirect impacts,
- the implications of cumulative impacts,
- whether surveys and analyses have been undertaken to a standard consistent with EPA technical guidance,
- the scale at which impacts to terrestrial fauna are considered,
- the significance of the terrestrial fauna and the risk to those fauna,
- the current state of knowledge of the affected species/assemblages and the level of confidence underpinning the predicted residual impacts, and
- whether proposed management approaches are technically and practically feasible.

Despite the new updated Environmental Factor relating to Inland Waters (EPA 2018), there are still no prescriptive guidance statements at the state or Commonwealth level outlining surface water quality and aquatic fauna sampling design and methods. Therefore, the aquatic fauna sampling employs methods and general approaches / rationale were consistent with the following:

- EPA Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020);
- EPA Technical Guidance: Sampling of short range endemic invertebrate fauna (EPA 2016b);
- the National Monitoring River Health Program (NRHP) Australia River Assessment Scheme (AusRivAS);
- Wetlands of the Swan Coastal Plain: wetland classification on the basis of water quality and invertebrate community data (Davis *et al.* 1993);
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018), developed as art of the National Water Quality Management Strategy (NWQMS) (Australian Government 2018).

# 2 SPECIES OF CONSERVATION SIGNIFICANCE

Aquatic ecosystems in WA can support a diverse range of taxa with different local, regional, national and international distributions, and therefore taxa vary in their conservation status depending on their distribution and evolutionary origins. The conservation significance of aquatic fauna recorded was assessed by referring to:

- Threatened Fauna under the IUCN Redlist of Threatened Species (IUCN 2021),
- Scheduled Fauna listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999),
- Priority Fauna recognised by Department of Biodiversity, Conservation and Attractions (DBCA 2021), and
- Conservation status of Australian Fishes List (Australian Society of Fish Biology 2021).

One species of conservation significance was specifically targeted during this survey. Information on this species is outlined below.

## 2.1 Mud Minnow (*Galaxiella munda*)

The western mud minnow (*Galaxiella munda*) is currently listed as Vulnerable (BC Act 2016) (Schedule 3 of Wildlife Conservation Specially Protected Fauna Notice 2018) and Endangered on an international level (IUCN Redlist 2021). Adults generally live close to riparian vegetation in undisturbed, permanent streams and open water of pools that are tannin stained and acidic (pH typically 3 – 6). It is occasionally found in ponds, swamps and roadside drains. The lifecycle of the western mud minnow typically lasts for one year (Morgan *et al*. 1998).

The western mud minnow is restricted in its distribution, from Margaret River to Albany, with an isolated population in Gingin. The western mud minnow is threatened by salinisation, land clearing and the introduction of exotic fish species such as mosquitofish (Morgan *et al*. 1998).

# 3 STUDY AREA

## 3.1 Climate and Hydrology

The Cataby region currently supports a number of land uses, predominantly agriculture (grazing) and also has natural resource values, including remnant vegetation, streams, wetlands and lakes. The Cataby deposit lies along the foot-slopes of the Gingin Scarp on the eastern side of the Swan Coastal Plain bioregion, on the margins of the SWA1 (Dandaragan Plateau) and SWA2 (Perth) subregions. Several streams dissect and drain the western margin of the Dandaragan Plateau in the vicinity of the Cataby deposit, including the Minyulo, Cataby and Caren-Caren brooks. These ephemeral streams are generally only active during the winter months during periods of high surface water runoff and terminate within sumplands and wetlands to the west. Groundwater does not contribute to streamflow in these brooks (Iluka 2015). Minyulo Brook is strongly seasonal, with most flow between May and October. It flows westwards into permanent wetlands Caro Swamp, Emu Lake and Dog Hole. Cataby Brook flow is lower than Minulyo Brook and is driven by rainfall and runoff. It flows and terminates upstream of Eneminga Swamp, only connecting to the wetland in periods of high rainfall (Iluka 2015). Eneminga Swamp is groundwater dependent and is relatively permanent (Iluka 2015) although it does appear to dry out after longer periods without rain (Lane *et al.* 2015).

The majority of annual rainfall occurs between May and September (Figure 4). Higher than average rainfall was recorded in May 2021, with below average rainfalls recorded June through to September 2021. Despite this, surface water was present at all sites sampled in September 2021. However, water levels had receded and were low in Minyulo Brook but still had a low to moderate rate of flow.

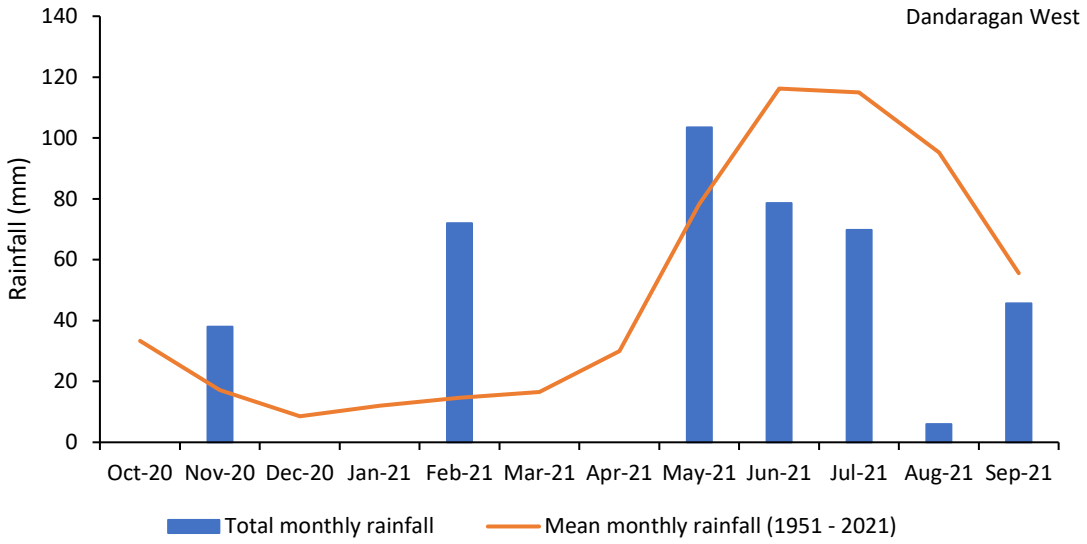



**Figure 4.** Mean monthly rainfall for the closest weather station to Cataby; Dandaragan West (009014). Source: Bureau of Meteorology website (http://www.bom.gov.au/, accessed 28 October 2021).

# 4 METHODS

This study was conducted under Department of Primary Industries and Regional Development (DPIRD) Fisheries Licence EXEM 3407 and DBCA licence to BA27000494. As a condition of these licences, taxa lists and reports are required to be submitted to DPIRD and DBCA.

Sampling was conducted over four consecutive days, 5th – 9th September 2021.

Aquatic fauna sampling by WRM is consistent with methodology used by others in similar surveys across Australia (*i.e*. Cheal *et al.* 1993, Storey *et al.* 1993, Edward *et al.* 1994), including the sampling of wetlands of the Swan Coastal Plain (SCP) by Murdoch University (Davis *et al.* 1993) and the National Monitoring River Health Initiative (Department of Environment Sport and Territories *et al*. 1994).

## 4.1 Sampling Sites

Comprehensive sampling for water quality and aquatic fauna was undertaken at eight sites in Minyulo Brook, Caro Swamp and Emu Lakes 2021 (Table 1 and Figure 1). In addition, opportunistic sampling was conducted at Dog Swamp (water quality and macroinvertebrates only) and three additional sites within Eniminga Swamp (two sites with all methods (EM1 and EM2 sampled for water quality, macroinvertebrates, fish and crayfish, and EM3 sampled for water quality and fish only) (Figure 1 and 3). Photographs of sites are provided in Appendix 1.

**Table 1.** Site locations for the 2021 survey.

| System | Site Code | MGA GDA94 Zone 50 | | Description |
|---|---|---|---|---|
| | | Easting | Northing | |
| Minyulo Brook | M1 | 357012 | 6601049 | At Brand Hwy bridge, shallow (ave. depth 0.3 m) flowing (fast) water |
| | M3 | 355600 | 6597605 | Shallow (max. depth 0.3 m), at road crossing (culvert), no inundated vegetation |
| | M5 | 357202 | 6599225 | Shallow (max. depth 0.3 m), at road crossing (culvert), no inundated vegetation |
| | M6 | 358581 | 6603540 | Shallow (max. depth 0.3 m), upstream of road crossing (culvert), no inundated vegetation |
| Caro Swamp | CS1 | 354366 | 6598706 | Deeper (max 1.5+ m), tannin stained, inundated fringing vegetation |
| | CS2 | 353834 | 6599254 | Deeper (max 1.5+ m, ave. 1 m), tannin stained, inundated fringing vegetation. At upstream channel into Emu Lakes |
| Emu Lakes | EL1 | 351563 | 6600694 | Deeper (max depth 1.5 m, ave. 0.6 m), tannin stained, dense Melaleuca spp and submerged vegetation |
| | EL2 | 351003 | 6599507 | Deeper (max 1.5+ m, ave. 1 m), tannin stained, inundated fringing vegetation. At outflow channel into Dog Hole. |
| Eneminga Swamp | EM1 | 357981 | 6590990 | Deep (max. depth 2 m+), inundated fringing vegetation on edges |
| | EM2 | 356747 | 6592539 | Deep (1.5 m), tannin stained, inundated fringing vegetation |
| | EM3 | 358684 | 6590171 | Deep (max. depth 2 m+), inundated fringing vegetation on edges |
| Dog Hole | DH1 | 349335 | 6600265 | No access, did not sample |
| Dog Swamp | DS1 | 359562 | 6594919 | Deep dam (2 m+) (overflow), tannin stained, surrounded by inundated vegetation |

## 4.2 Sampling Methods

### 4.2.1 Water Quality

*In situ* spot measurements of dissolved oxygen, pH, temperature and turbidity were made using hand-held Wissenschaftlich-Technische-Werkstätten (WTW) field meters, at a depth of approximately 10 cm below the water surface.

For stressors, such as conductivity, pH, dissolved oxygen, temperature and turbidity, which typically display naturally high variability, ANZG (2018) recommend the use of local DGVs where available, or development of site-specific GVs. Where neither local DGVs nor site-specific GVs are available, as is the case for the Cataby, ANZG (2018) recommend use of regional DGVs reported in ANZECC/ARMCANZ (2000), which are designed to protect at least 95% of species (Appendix 2). These have been applied for the current report.

### 4.2.2 Aquatic Habitat Evaluation and Characterisation

Qualitative visual observations of habitat characteristics were made at all sites sampled, to assist in interpreting any patterns in species assemblages. WRM have standard worksheets for this task so that recordings between sites and seasons remain as comparable as possible. Habitat characteristics recorded included percent cover by inorganic sediment, submerged macrophyte, floating macrophyte, emergent macrophyte, algae, large woody debris, detritus, roots and trailing vegetation. Details of substrate composition were also recorded and included percent cover by bedrock, boulders, cobbles, pebbles, gravel, sand, silt and clay. General observations regarding the condition of wetland habitat and disturbance were made, with site photographs taken.

### 4.2.3 Aquatic Invertebrates

All sites, except for EM3, were sampled for aquatic invertebrates. Aquatic invertebrate sampling methods were in accordance with those used by WRM (2012) for the 2011 survey. These methods have been extensively employed for numerous other wetland assessments conducted on behalf of the DBCA and the Department of Water and Environment (DWER) (refer Halse and Storey 1996, Halse *et al*. 2000, Storey *et al*. 1993, 2004a,b, Lynas *et al*. 2006).

#### 4.2.3.1 Macroinvertebrates

A 250 µm Freshwater Biological Association (FBA) 'D' frame style dip net was used to selectively collect benthic macroinvertebrates, and involved kick-sweep sampling over an equivalent 50 m x 0.3 m area within each site in order to provide a semi-quantitative measure of richness and abundance. All mesohabitats at a site were sampled, including trailing riparian vegetation, woody debris, open water column and benthic sediments, with the aim of maximising the number of species recorded. Each sample was washed through a 250 µm sieve to remove fine sediment, leaf litter and other debris, with any large coarse material (*i.e.* leaves, roots *etc*.), carefully washed in the sieve to remove attached fauna and discarded. Samples were then transferred to a 1L polypropylene container and preserved in 70% ethanol for laboratory enumeration and identification.

In the laboratory, each sample was sorted into different size fractions (1 mm, 500 µm and 250 µm) by washing through a series of sieves. Each size fraction was then sorted under high-power microscope to remove a maximum of 40 specimens of each family (or sub-family for Chironomidae). All specimens were identified to the lowest taxonomic level practicable (typically species or genus) and enumerated to $\log_{10}$ scale abundance per sample for all fractions combined (*i.e*. 1 = 1 individual, 2 = 2 - 10 individuals, 3 = 11 - 100 individuals, 4 = 101 - 1,000 individuals, *etc*.). In-house expertise was used to identify invertebrate taxa using available published keys and through reference to the established voucher collections held by WRM.

Taxa that could not be identified to species level generally were assigned a voucher number and lodged in the WRM voucher collection.

#### 4.2.4 Fish and Crayfish

All sites, except Dog Swamp, were sampled for fish and crayfish. A range of sampling methods were used in order to maximise the number of fish and crayfish caught at each site. Methods included dip nets, box traps, fyke nets, and visual observation. Box traps comprised of up to five large traps (21 x 47 x 60 cm, 3 mm mesh, mesh slit opening) and five small traps (26 x 26 x 46 cm, 20 mm mesh, 50 mm diam. opening), each baited with a mixture of cat biscuits and chicken pellets. The most effective method for surveying conservation listed minnow species is fyke nets and dip netting. A minimum of two fyke nets comprising a double 10 m leader/wing (7 mm mesh, 1.5 m drop) and a 5 m hooped net (75 cm diam. semi-circular opening, 10 mm mesh) were also set at each site overnight. A floating platform was placed at the cod-end (closest to the bank) to provide an air space for any freshwater turtles, or water rats if present.

All species were identified in the field, measured by standard length[1] (SL mm, for fish) or carapace length (CL mm, for crayfish) and then released alive. Any introduced species collected (*i.e.* yabbies *Cherax destructor*) were euthanised humanely on site in an ice slurry in an esky. Fish nomenclature followed that of Allen *et al.* (2002).

### 4.3 Data Analysis

All data collected were entered into Excel spreadsheets. Other data generated as part of the project included:

- an IBSA data package in line with 'Instructions – IBSA Data Packages' (EPA 2018);
- all field data and spatial data captured in a suitable format (GIS shapefiles, Excel spreadsheets, *etc.*).

#### 4.3.1 Assessment of Conservation Status of Fauna

Conservation significant species were identified as those:

- listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act),
- listed under the WA *Biodiversity Conservation Act 2016* (BC Act) as Threatened or Priority species, as listed on the DBCA Threatened and Priority Fauna List (DBCA 2021),
- listed as Near Threatened, Vulnerable, Endangered or Critically Endangered on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN 2021),
- listed on the Australian Society for Fish Biology Conservation List (ASFB 2018),
- potential or known short range endemic (SRE) freshwater invertebrate species, that have naturally small distributions of less than 10,000 km$^2$ (after Harvey 2002), as described by the EPA (2016c) for the purposes of environmental impact assessment, and/or
- stygofauna (groundwater) species that are also potential or known short range endemic (SRE) species, as described by the EPA (2016b) for the purposes of environmental impact assessment.

[1] Standard length (SL) = tip of the snout to the posterior end of the last vertebra (*i.e.* this measurement excludes the length of the caudal fin). Carapace length (CL) = anterior tip of the rostrum to the posterior median edge of the carapace.

### 4.3.2 Data Descriptives

Community summaries were derived for number of taxa (*i.e*. taxa richness) and number of specimens per sample (*i.e*. taxa abundance). In this context, "taxa" includes invertebrate specimens which could not be identified to species level, due to unresolved taxonomy and/or immaturity of specimens. Therefore, the total macroinvertebrate taxa richness is likely greater than reported here. Taxa richness for macroinvertebrates was also categorised according to the reference ranges used by DBCA for wetland biodiversity monitoring (see Cale *et al*. 2010). Again, this is in acknowledgement that these reference ranges are not specific to the SWA bioregion, but were developed for monitoring wetlands in increasingly salinised landscapes. The ranges were first used by Sim *et al.* (2008) as part of a trial of national indicators of wetland condition and originally developed by Jones *et al*. (2009). The reference ranges were developed using the 25$^{th}$ and 75$^{th}$ percentile richness values from wetlands surveyed by DBCA that were categorised by DBCA as near natural:

| | Taxonomic Richness Reference Range | | |
|---|---|---|---|
| | High condition | Medium condition | Low condition |
| Macroinvertebrate taxa richness: | > 35 | 18 - 35 | < 18 |

The reference ranges are intended to be applied at a single point in time. Ideally this point in time should correspond to peak water level in winter-spring.

There is minimal data for other wetlands in the area to provide regional context. Therefore, data were compared against historic dataset of Davis *et al.* (1993), who sampled Gingin Brook and Tangletoe Swamp (approximately 70 km south of Cataby), as a part of the much larger *Wetlands of the Swan Coastal Plain* study. The study examined physio-chemical and invertebrate community data. Highly eutrophic wetlands showed reduced species richness and tannin-stained wetlands had a high species richness and higher proportion of rare species.

# 5 RESULTS AND DISCUSSION

## 5.1 Water Quality

Waters appeared highly tannin-stained, with generally neutral to basic pH (pH 7.24 - 8.31), and low to brackish conductivity (388 - 3330 µS/cm) and variable dissolved oxygen (46.1 - 118.5 % saturation). Conductivity in Minyulo Brook, including Caro Swamp and Emu Lakes was also relatively high compared to Eneminga Lake and Dog Swamp (Table 2). The higher conductivity was possibly due to past and current pastoral practices, though it may also reflect upwelling of saline groundwater at this location.

Conductivity at Minyulo Brook, Caro Swamp and Emu Lake sites exceeded the ANZG (2018) DGV in 2021 (Appendix 2), while pH and dissolved oxygen was outside of the DGV range at a number of sites (Table 2). Exceedance of DGVs for stressors, such as conductivity, pH and dissolved oxygen, was not unexpected. ANZG (2018) note that it was not possible to develop universal DGVs for stressors that apply equally to all regions of Australia, and recommend that site-specific guidelines are developed wherever possible.

For parameters and sites sampled in all three years (M1 and M3 only), the main differences between sampling occasions, were the slightly higher conductivity and lower pH for sites sampled in 2003 and 2011 (Table 3).

**Table 2.** Surface water quality data measured in conjunction with aquatic fauna sampling in September 2021. Highlighting indicates exceedance of ANZG (2018) default guideline value (DGV) for various levels of species protection. Refer Appendix 2 tables for DGVs.

| 2021 surface water quality | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Minyulo Brook | | | | Caro Swamp | | Emu Lakes | | Eneminga Lakes | | | Dog Swamp |
| Parameter | M1 | M3 | M5 | M6 | CS1 | CS2 | EL1 | EL2 | EM1 | EM2 | EM3 | |
| Date | 6/9/2021 | 6/9/2021 | 7/9/2021 | 7/9/2021 | 7/9/2021 | 7/9/2021 | 8/9/2021 | 8/9/2021 | 6/9/2021 | 6/9/2021 | 6/9/2021 | 9/9/2021 |
| Time (hrs) | 13:00 | 13:30 | 9:00 | 8:30 | 14:40 | 15:30 | 16:00 | 14:30 | 15:40 | 15:00 | 16:15 | 10:00 |
| Max. water depth (m) | 1.0 | 0.3 | 0.3 | 1.0 | 1.5 | 1.5 | 1.5 | 1.5 | 2+ | 1.5 | 2+ | 2+ |
| pH (pH units) (field) | 7.95 | 8.31 | 8.17 | 7.87 | 7.37 | 7.41 | 7.78 | 7.24 | 7.26 | 7.65 | 7.26 | 7.31 |
| DO (%) (field) | 118.5 | 107.9 | 113.7 | 115.4 | 76.6 | 71.9 | 90.9 | 47.4 | 39.2 | 55.9 | 49.9 | 46.1 |
| DO (mg/L) (field) | 10.91 | 9.78 | 11.61 | 11.16 | 6.00 | 7.03 | 7.47 | 4.16 | 3.63 | 5.21 | 4.61 | 4.30 |
| Temp. (°C) (field) | 18.1 | 20.4 | 15.6 | 14.6 | 20.5 | 19.4 | 25.3 | 23.4 | 20.5 | 22.2 | 21.0 | 18.1 |
| EC (µS/cm) (field) | 3020 | 2959 | 2969 | 3016 | 3330 | 3280 | 3320 | 2408 | 559 | 388 | 519 | 535 |

**Table 3.** Surface water quality data measured in conjunction with aquatic fauna sampling in 2003 and 2008 (M1 and M3 only).

| Minyulo Brook surface water quality | | | | |
|---|---|---|---|---|
| Parameter | M1 | M1 | M3 | M3 |
| Date | 2003 | 2011 | 2003 | 2011 |
| Time (hrs) | Unknown | Unknown | Unknown | Unknown |
| Max. water depth (m) | Unknown | 0.6 | 0.45 | 0.45 |
| pH (pH units) (field) | 7.2 | 7.5 | 7.4 | 7.5 |
| DO (%) (field) | 114 | 90 | 113 | 97 |
| DO (mg/L) (field) | 8.5 | 7.1 | 8.3 | 7.4 |
| Temp. (°C) (field) | 14.2 | 15.5 | 17.2 | 16.3 |
| EC (µS/cm) (field) | 3480 | 3740 | 3460 | 3820 |

## 5.2 Aquatic Habitat Evaluation and Characteristics

As described by WRM (2012), much of the Minyulo Brook, Caro Swamp and Emu Lake surrounding habitat has been disturbed or lost due to vegetation clearing for agriculture. Within Minyulo Brook there is extensive erosion, with channel widening and bed down cutting at most sites. Pasture species dominate the riparian understorey vegetation with few other native species present. Most sites still retain remnant overstorey of eucalypts (*Eucalyptus rudis*, *E. todtiana* and *Corymbia calophylla*) and/or paperbarks (*Melaleuca rhaphiophylla* and *M. priessiana*). However, there is scarce in-stream habitat (riffles, snags, macrophytes, fringing sedge) for macroinvertebrates or fish, and the extensive mobile sand deposits would likely make colonisation by aquatic macroinvertebrates difficult.

Caro Swamp and Emu Lake are surrounded by moderately dense remnant overstorey of eucalypts and/or paperbarks, with a higher proportion of instream habitat (namely detritus, large woody debris and trailing vegetation). Emu Lake site EL1, was the only site to have emergent, submerged and floating vegetation types present. Riparian vegetation surrounding Emu Lakes was denser than that at Caro Swamp, with access into the deeper water unsuccessful. Sampling was undertaken within the inundated riparian vegetation, at approximately 0.5 - 1.0 m depth.

Water flow and direction was present at the time of sampling, with water flowing downstream from Minyulo Brook into Caro Swamp and then through to Emu Lakes, where the outflow from Emu Lakes to Dog Hole was observed. Dog Hole was not sampled in the 2021 survey, due to accessibility issues.

Eneminga Swamp is surrounded by dense fringing, minimally disturbed riparian vegetation, although the vegetation becomes more open upgradient of 3 - 5 m from the waterline. Past this point, and as water depth declines, there is little surrounding vegetation and instream habitat.

Dog Swamp is a man-made dam, surrounded by inundated moderately dense remnant overstorey of eucalypts and/or paperbarks. Small percentages of emergent and floating vegetation were present along the edges of the dam. Once water levels recede, little inundated habitat will remain in the open area of the dam.

All sites sampled in 2021 were dominated by sand substrates (Table 4). Habitat diversity was moderate to high, with all sites supporting four or more of the eight broad habitat types used to characterise aquatic ecosystems (Table 5). Lowest habitat diversity was at the Minyulo Brook and Caro Swamp sites, where there was no emergent, submerged or floating vegetation present.

**Table 4.** Substrate composition; percentage cover by bedrock, boulders, cobbles, pebbles, gravel, sand, silt and clay at each site in September 2021.

| Site | Bedrock (%) | Boulder (%) | Cobble (%) | Pebble (%) | Gravel (%) | Sand (%) | Silt (%) | Clay (%) |
|---|---|---|---|---|---|---|---|---|
| M1 | 10 | 2 | 6 | 6 | 10 | 41 | 5 | 20 |
| M3 | 0 | 0 | 0 | 0 | 0 | 95 | 5 | 0 |
| M5 | 0 | 0 | 0 | 0 | 0 | 80 | 10 | 10 |
| M6 | 0 | 0 | 0 | 0 | 0 | 85 | 10 | 5 |
| CS1 | 0 | 0 | 0 | 0 | 0 | 80 | 10 | 10 |
| CS2 | 0 | 0 | 0 | 0 | 0 | 85 | 15 | 0 |
| EL1 | 0 | 0 | 0 | 0 | 0 | 95 | 5 | 0 |
| EL2 | 0 | 0 | 0 | 0 | 0 | 85 | 10 | 5 |
| EM1 | 0 | 0 | 0 | 0 | 0 | 90 | 10 | 0 |
| EM2 | 0 | 0 | 0 | 0 | 0 | 75 | 10 | 15 |
| EM3 | 10 | 0 | 0 | 0 | 0 | 80 | 10 | 0 |
| Dog Swamp | 0 | 0 | 0 | 0 | 0 | 95 | 5 | 0 |

**Table 5.** Aquatic habitat diversity as a percentage cover at each site in September 2021.

| Site | Mineral (%) | Emergent Vegetation (%) | Submerged Vegetation (%) | Floating Vegetation (%) | Algae (%) | Detritus (%) | Trailing Vegetation (%) | Large Woody Debris (%) | Habitat Diversity Score |
|---|---|---|---|---|---|---|---|---|---|
| M1 | 65 | 0 | 0 | 0 | 0 | 10 | 15 | 10 | 4 |
| M3 | 70 | 0 | 0 | 0 | 0 | 10 | 10 | 10 | 4 |
| M5 | 75 | 0 | 0 | 0 | 0 | 5 | 10 | 10 | 4 |
| M6 | 65 | 0 | 0 | 0 | 0 | 15 | 5 | 15 | 4 |
| CS1 | 40 | 0 | 0 | 0 | 0 | 20 | 30 | 10 | 4 |
| CS2 | 35 | 0 | 0 | 0 | 0 | 30 | 20 | 15 | 4 |
| EL1 | 10 | 10 | 20 | 5 | 0 | 15 | 15 | 25 | 7 |
| EL2 | 20 | 0 | 2 | 3 | 0 | 30 | 20 | 25 | 6 |
| EM1 | 40 | 5 | 0 | 5 | 0 | 30 | 10 | 10 | 6 |
| EM2 | 30 | 5 | 0 | 0 | 0 | 30 | 5 | 30 | 5 |
| EM3 | 35 | 5 | 0 | 0 | 0 | 40 | 10 | 10 | 5 |
| Dog Swamp | 25 | 5 | 0 | 5 | 5 | 30 | 20 | 10 | 7 |

## 5.3 Macroinvertebrates

### 5.3.1 Species Richness and Taxonomic Composition

A total of 102 macroinvertebrate taxa were recorded from the 11 sites sampled in September 2021 (Appendix 3). Between site variability in taxa richness was relatively high, ranging from 13 at Dog Swamp to 47 at EM1 (Table 6).

Macroinvertebrate taxa richness for each site, except Dog Swamp and Eneminga Swamp, was higher than the two closest wetlands sampled by Davis *et al.* (1993); Gingin Brook and Tangletoe Swamp. Davis *et al*. reported taxa richness of 13 (January 1989), 15 (November 1989) and 16 (November 1990), for Gingin Brook, and 28 (November 1989) for Tangletoe Swamp. Both sites are approximately 70 km south of Cataby and are seasonal wetlands, with Tangletoe Swamp classified as saline. The full range in macroinvertebrate taxa richness for seasonal wetlands reported by Davis *et al*. (1993) was 21 - 68.

Singletons constituted a relatively high proportion (46%) of all macroinvertebrates recorded from the study area. A high proportion of singletons is quite common in seasonal and permanent freshwater systems in WA (see Pinder *et al*. 2005). The proportion of singletons is expected to be relatively higher in ephemeral wetlands, such as the current study area, due to the high turnover of species as natural succession progresses during the cycle of wetland filling and drying. Davis *et al*. (1993) found singletons constituted 24.1% of all taxa recorded, but don't provide percentages for micro- versus macroinvertebrates, or for seasonal versus permanent wetlands. However, they do note that coloured wetlands had a high proportion of rare (singleton) species and high species richness, as was found for the current study area. The most common taxa were the non-biting midge larvae *Chironomus* sp., amphipod *Austrochiltonia subtenuis,* segmented worms (Oligochaeta species) and marsh beetles (Scirtidae species).

Data show the macroinvertebrate assemblage to be characterised by a high diversity of taxa, based on the reference range developed by Jones *et al.* (2008) (see section 4.3.2). Insecta were the dominant group, as is common in most lentic and lotic waters across WA, with Diptera and Coleoptera the best represented taxa (Table 6). Davis *et al*. (1993) similarly found highest species richness in disturbed wetlands which were moderately eutrophic, and in coloured wetlands. Nutrient enrichment, and associated higher primary productivity, is one possible explanation for the high invertebrate diversity in these wetlands (Davis 1993). The source of enrichment is usually input from surrounding rural and urban lands, and abundant vegetation in less disturbed wetlands.

**Table 6**. Summary of higher-order macroinvertebrate taxa composition from the study area. *n* = number of sites sampled. Refer Appendix 3 for full taxa list.

| Macroinvertebrates | | Minyulo Brook | Caro Swamp | Emu Lake | Eneminga Lake | Dog Swamp |
|---|---|---|---|---|---|---|
| Scientifc name | Common name | *(n = 4)* | *(n = 2)* | *(n = 2)* | *(n = 2)* | *(n = 1)* |
| Cnidaria | Hydra | 1 | 0 | 0 | 0 | 0 |
| Platyhelminthe | Flatworms | 0 | 1 | 0 | 0 | 0 |
| Nematoda | Roundworms | 1 | 1 | 1 | 0 | 0 |
| Mollusca | Freshwater snails | 2 | 2 | 3 | 0 | 0 |
| Oligochaeta | Aquatic worms | 1 | 1 | 1 | 0 | 1 |
| Hirudinia | Leeches | 1 | 0 | 0 | 0 | 0 |
| Amphipoda | Amphipods | 1 | 1 | 1 | 0 | 0 |
| Decapoda | Shrimp | 0 | 0 | 1 | 0 | 0 |
| Isopoda | Isopod | 1 | 1 | 1 | 0 | 0 |
| Acarina | Water mites | 0 | 1 | 1 | 1 | 1 |

| Macroinvertebrates | | Minyulo Brook | Caro Swamp | Emu Lake | Eneminga Lake | Dog Swamp |
|---|---|---|---|---|---|---|
| Scientifc name | Common name | *(n = 4)* | *(n = 2)* | *(n = 2)* | *(n = 2)* | *(n = 1)* |
| Diplostraca | Clam shrimp | 1 | 1 | 1 | 1 | 0 |
| Collembola | Springtails | 2 | 2 | 2 | 0 | 1 |
| Hemiptera | True Bugs | 7 | 5 | 3 | 3 | 0 |
| Coleoptera | Aquatic beetles | 16 | 19 | 19 | 6 | 4 |
| Diptera | Two-winged flies | 16 | 11 | 20 | 9 | 5 |
| Odonata | Dragonflies & damselflies | 3 | 3 | 5 | 2 | 1 |
| | | **53** | **49** | **59** | **22** | **13** |

### 5.3.2 Listed Conservation Significant Macroinvertebrate Species

The majority of macroinvertebrate taxa recorded were common, ubiquitous species, with distributions extending across south-western Australia, Australasia, and the world (*i.e*. cosmopolitan species). No conservation significant macroinvertebrate species were recorded during the baseline surveys. Four south-west WA endemics were recorded including the aquatic beetles, *Hyderodes crassus*, *Limbodessus inornatus* and *Megaporus solidus*, and the damselfly *Austrolestes aleison*.

Pennifold (2018), under the direction of DBCA, developed a protocol for assessing how many freshwater invertebrates from the entire south-west of WA (a broad area defined as west of a line between Shark Bay and Cape Arid) may be candidates for listing on the WA Priority Fauna list, and provided an overview on a selection of those species for listing. Using DBCA records, a search was conducted to find species which only occurred west of a line between Shark Bay and Cape Arid, with restricted distributions. This process yielded a set of 49 aquatic invertebrate species, determined to be candidates for listing as priority species in need of further investigation (Pennifold 2018). One species on this list, the isopod *Paramphisopus palustris*, was recorded at M6, CS2, EM1 and EM2. This species is discussed in further detail below.

#### 5.3.2.1 Isopod *Paramphisopus palustris*

*Paramphisopus palustris* (family Amphisopodidae) is a south-west endemic isopod and is restricted to groundwater-fed wetlands of the Swan Coastal Plain. It's area of occupancy is restricted to approximately 44 km$^2$ (Pennifold 2018). This species takes refuge in interstitial waters of bed substrates as a short-term strategy to survive seasonal dry periods. The most significant threats to this species relate to groundwater abstraction and altered hydrology (Gouws and Stewart 2007).

Gouws and Stewart (2007) showed that population level genealogical and phylogenetic relationships of halotypes indicate the existence of unique and discrete lineages that are geographically defined. Genetic analysis would be required to confirm whether specimens from the current study area are the same species as specimens from other south west localities, and thereby confirm the extent of their distribution and whether or not they are SREs.

## 5.4 Fish & Crayfish

### 5.4.1 Fish

A total of 818 individual fish were caught during the survey. This included two native species including western minnow (*Galaxias occidentalis)* and the Swan River goby (*Pseudogobius olorum*), as well as two non-native species; mosquitofish (*Gambusia holbrooki*) and goldfish (*Carassius auratus*). Tadpoles were abundant at all sites but were not identified to species level as part of the current scope.

Western minnows were recorded at all sites except EM1 and EM3 and were the most abundant fish species recorded. The western minnow is one of the most common native fish in the southwest of WA, occurring across a wide range of habitats, from disturbed, nutrient enriched environments to those that are pristine.

The Swan River goby was recorded at CS1, CS2, EL1 and M5 and was the second most abundant fish recorded. It is typically an estuarine species that can migrate long distances inland up secondarily salinised rivers, and even occurs in some isolated hypersaline lakes. The species only lives for about a year and is thought to be sexually mature once they have attained ~25 mm total length, usually between five and seven months of age (Gill *et al.* 1996). Although studies have shown length may not necessarily be a good reflection of age because water temperature greatly affects growth rate and hence sexual maturity (Gill *et al.* 1996). Water temperatures within the range 20 – 25 °C appear most conducive to reproductive success.

Mosquitofish were recorded at CS1, EM1, EM3 and M1 and are considered a pest species because they can occur in high densities, competing with local species for food resources and space. Mosquitofish do not lay eggs, instead give birth to live young and can produces up to nine batches of young each year (Gill *et al.* 1999). Hambleton *et al*. (1996) noted that in wetlands near Capel, Western Australia, gambusia displayed agonistic behaviour towards native species, with many individuals of native species having extensive damage to their fins, attributed to fin-nipping by gambusia. Hambelton *et al*. (1996) suggested the heightened presence of gambusia may have resulted in the absence of native species from the Capel wetlands.

Goldfish were recorded at CS1, EL1 and M1. Goldfish were introduced in Australia in the 1860s as an ornamental fish (Allen *et al*. 2002), with fish most likely being released into the system as unwanted pets. Adults are omnivorous, consuming organic detritus, plant matter and aquatic invertebrates. Goldfish have the potential to prey on the eggs, larvae and adults of native fishes, as well as competing with native fish for space and food. The release of goldfish into natural waterways should be discouraged.

### 5.4.2 Listed Conservation Significant Fish Species

Morgan *et al.* (2000) reported the conservation significant mud minnow (*Galaxiella munda*) from Lennard Brook in the Gingin Brook catchment (approximately 80 km south-east of Cataby), but it is considered unlikely that mud minnows would be present in the current study area. *G. munda* are typically found in undisturbed waterbodies that are well vegetated and have permanent or semi-permanent flow. Although mud minnows occupy groundwater dependent ecosystems like those within Cataby and Minyulo brooks, they are often associated with permanent streams with low conductivity (mean 708 µS/cm) and low pH (although have been associated with pH levels up to 7.6) (Beatty and Morgan 2012). The maximum recorded conductivity for mud minnows is 5202 µS/cm and this appears to be a limiting factor for its distribution (Beatty and Morgan 2012). The highest recorded conductivity in the Minyulo Brook system during the current survey was 3330 µS/cm, although this value was recorded in spring, with values likely to increase with evapoconcentration through summer. Conductivity within Eneminga Swamp is within the range associated with mud minnows (388 – 559 µS/cm recorded in the current survey). The mud minnow relies on submerged vegetation for breeding and shelter (Beatty and Morgan 2012). At the time of

sampling, approximately 10 m of riparian vegetation was inundated along the banks of Eneminga Swamp. As water levels recede, it is unknown how much of this habitat structure will remain. Permanency of water with Eneminga Swamp is also considered a limiting factor, with the swamp drying out between 2015 – 2018 (M. Mannion pers. comm, Iluka 2012). The presence of mud minnows in either the Cataby Brook or Minyulo Brook systems, would be a range extension for the species.

### 5.4.3 Crayfish

One species of freshwater crayfish was recorded from the study area: the introduced yabby (*Cherax destructor*) (two individuals at CS1). The introduced yabby is extremely adaptable to site conditions and, is capable of burrowing down to the water table to survive dry conditions (Morrissy *et al.* 1984). Yabbies are also more tolerant than native crayfish species of extremes in temperature, hypoxia, and salinity (Morrissy *et al.* 1984, Holdich and Lowery 1988). Since its introduction, the yabby has proven to be a successful invasive species and is spread throughout much of the southwest of the state (Lynas *et al.* 2004, 2007). It has an aggressive nature and the potential for the yabby to out-compete native species has been well documented (Lynas *et al*. 2004, 2006, 2007). Due to their considerable negative impact on native freshwater species, there are restrictions on the farming and movement of yabbies in WA.

### 5.4.4 Other fauna

Although exclusion screens were on the nets to avoid capture of large turtles (that would predate on the catch and potentially skew results), two small south-western snake necked turtles (*Chelodina colliei)* were recorded within Caro Swamp (one at CS1 and one at CS2). This species is restricted to the south-west of Western Australia, between the Hill River in the north, Blackwood River in the south, and east to the Sussetta River (Cann 1998). Throughout this range, snake-necked turtles are known to occur in both permanent and seasonal habitats, including rivers, lakes, farm dams, swamps, damplands and natural and constructed wetlands (Balla 1994, Guyot and Kuchling 1998). They can migrate relatively long distances overland if local conditions deteriorate (Dr Gerald Kuchling, UWA, pers. comm.) and can aestivate for up to six months to avoid drought in seasonal waterbodies (Kuchling 1988, 1989). Since their diet includes tadpoles, fish, and aquatic invertebrates, south-western snake-necked turtles only eat when open water is present. In permanent waters, this species has two nesting periods (September-October and December-January), but in seasonal systems, nesting will only occur in spring. Females can travel inland as far as 1 km to find appropriate nesting sites at this time (Clay 1981, Kuchling 1998). They generally nest in sandy soils, and eggs take up to two hundred days to hatch. The main threats to these turtles are road deaths during movement in the nesting season and predation by feral animals (Bencini and Turnbull 2012).

# 6 SUMMARY AND CONCLUSIONS

Spot sampling for water quality indicated surface waters at all sites to be highly coloured (visually tannin-stained), with neutral to basic pH (pH 7.24 - 8.31), and highly variable conductivity from fresh (388 µS/cm) to brackish (3330 µS/cm). Conductivity in the Minyulo Brook complex was considerably higher than that of Eneminga Swamp and Dog Swamp.

Despite the sampling effort in 2021, conservation listed species *G. munda* (mud minnow) was not recorded. Although mud minnows can inhabit varying water quality variables, they generally inhabit acidic water (pH 3 – 6.5), and struggle to survive in waters with high conductivity. However, the maximum recorded conductivity for mud minnows is 5202 µS/cm, with a mean of 780 µS/cm (Beatty and Morgan 2012). The highest recorded conductivity in the Minyulo Brook system during the current survey was 3330 µS/cm, although this value was recorded in spring, with values likely to increase with evapoconcentration through summer. Conductivity within Eneminga Swamp is within the range associated with mud minnows (388 – 559 µS/cm recorded in the current survey). The mud minnow relies on submerged vegetation for breeding and shelter (Beatty and Morgan 2012). At the time of sampling, approximately 10 m of riparian vegetation was inundated along the banks of Eneminga Swamp. As water levels recede, it is unknown how much of this habitat structure will remain. The lifecycle of the mud minnow is limited to just one year (He 2021) and rely on permanent water to complete their lifecyle. Permanency of water with Eneminga Swamp is also considered a limiting factor, with the swamp drying out between 2015 – 2018 (M. Mannion pers. comm, Iluka 2012).

Pennifold (2018), under the direction of DBCA, developed a protocol for assessing how many freshwater invertebrates from the entire south west of WA, a broad area defined as west of a line between Shark Bay and Cape Arid, may be candidates for listing on the Western Australian Priority Fauna list, and provided an overview on a selection of those species for listing. This process yielded a set of 49 aquatic invertebrate species, determined to be candidates for listing as priority species in need of further investigation. One species on this list, *Paramphisopus palustris* was recorded at M6, CS2, EM1 and EM2. It is possible that the populations of *Paramphisopus palustris* recorded during this survey are distinct and unique to other known populations, this would need to be confirmed through DNA sequencing. This species is not currently listed under any State or Commonwealth legislation.

Overall, the study area is considered to support a high diversity of aquatic macroinvertebrate taxa, based on the reference ranges originally developed by DBCA for wetland evaluation (Jones *et al*. 2009). Diversity was also high relative compared to the only available data for other seasonal wetlands. This included two seasonal wetlands sampled by DBCA to north of the region for the large-scale *Wetlands of the Swan Coastal Plain* study (Davis *et al.* 1993).

The regional ecological value of the remnant aquatic habitat in the study area is considered to be moderate to high, given the extensive clearing of seasonal wetlands at the local and regional-scale for agriculture. The remnant wetland vegetation is likely to provide at least some of the energy, as food sources, that drives many aquatic processes, as well as providing food, shade and shelter for both terrestrial and aquatic fauna. The remnant vegetation still offers a good diversity of aquatic habitats (*i.e.* shrub thickets, fringing paperbarks, shallowly-inundated sedges and seasonally dry open waters) both within Eneminga Swamp, and across the Minyulo Brook, Caro Swamp, Emu Lake and Dog Hole complex.

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# APPENDICES

## Appendix 1. Site photographs from September 2021

**Minyulo Brook - M1**



**Minyulo Brook - M3**



**Minyulo Brook - M5**



**Minyulo Brook - M6**



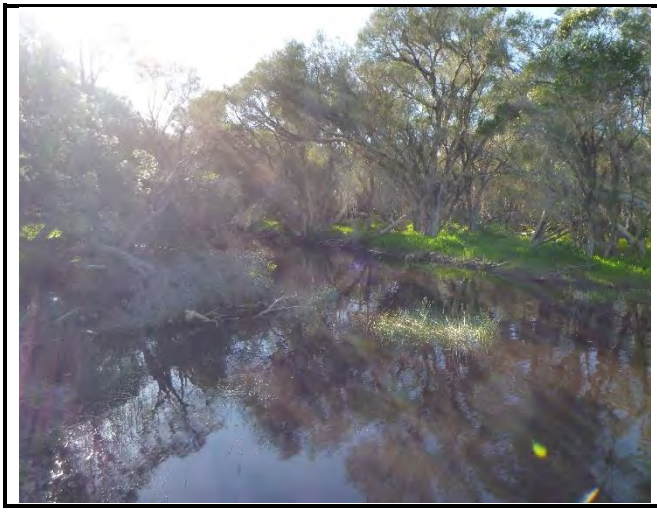
**Caro Swamp - CS1**



**Caro Swamp - CS2**



**Emu Lakes – EM1**



**Emu Lakes EM2**



**Eneminga Lake – EM1**



**Eneminga Lake – EM2**



**Eneminga Lake – EM3**



**Dog Swamp**



# Appendix 2. ANZG (2018) default guideline values for protection of aquatic systems in south west Western Australia

**Table A2-1.** Default guidelines for physical and chemical stressors for south-west Australia for slightly disturbed ecosystems, based on ANZECC/ARMCANZ 2000 guidelines. ANZG (2018) note that more specific regional guidelines are yet to be developed. recommend that stakeholders and managers site-specific guidelines for stressors wherever possible. There are currently no regional guidelines specific to the south west coast. Guidelines used for the current study are highlighted yellow.

| Ecosystem type | TP | FRP | TN | $N\text{-}NO_X$ | $N\text{-}NH_4^+$ | DO[b] | pH |
|---|---|---|---|---|---|---|---|
| | (ug/L) | (ug/L) | (ug/L) | (ug/L) | (ug/L) | (% sat.) | |
| Upland river[a] | 20 | 10 | 450 | 200 | 60 | 90 | 6.5 – 8.0 |
| Lowland river[a] | 65 | 40 | 1200 | 150 | 80 | 80 – 120 | 6.5 – 8.0 |
| Freshwater lakes & reservoirs | 10 | 5 | 350 | 10 | 10 | 90 | 6.5 – 8.0 |
| Wetlands | 60 | 30 | 1500 | 100 | 40 | 90 – 120 | 7.0 [c] – 8.5[c] |

a = all values derived during base river flow conditions not storm events.

B = dissolved oxygen values were derived from daytime measurements. Dissolved oxygen concentrations may vary diurnally and with depth. Monitoring programs should assess this potential variability.

c = in highly coloured wetlands (gilven > 52 $g_{440}$/m) pH typically ranges 4.5 – 6.5.

**Table A2-2.** Ranges for default guideline values for conductivity (EC, salinity) and turbidity indicative of South West Australia, as reported in ANZECC/ARMCANZ (2000). Values reflect high site-specific and regional variability. Explanatory notes provide detail on specific variability issues for ecosystem types. Note, ANZG (2018) recommend development of regional or site-specific guidelines for stressors wherever possible. There are currently no regional guidelines specific to the south west coast. Guidelines used for the current study are highlighted yellow.

| Ecosystem type | Salinity (µs/cm) | Explanatory notes |
|---|---|---|
| Upland & lowland Rivers | 120 – 300 | Conductivity in upland streams will vary depending on catchment geology. Values at the lower end of the range are typically found in upland rivers, with higher values found in lowland rivers. Lower conductivity values are often observed following seasonal rainfall. |
| Lakes, reservoirs & wetlands | 30 – 1500 | Values at the lower end of the range are observed during seasonal rainfall events. Values even higher than1500 µs/cm are often in saltwater lakes and marshes. Wetlands typically have conductivity values in the range 500-1500 µs/cm over winter. Higher values (> 3000 µs/cm) are often measured in wetlands in summer due to evaporative water loss. |
| | **Turbidity (NTU)** | |
| Upland & lowland Rivers | 10 – 20 | Turbidity and SPM are highly variable and dependent on seasonal rainfall runoff. These values representative of base river flow in lowland rivers |
| Lakes, reservoirs & wetlands | 10 – 100 | Most deep lakes and reservoirs have low turbidity. However, shallow lakes and reservoirs may have slightly higher turbidity naturally due to wind-induced resuspension of sediments. Lakes and reservoirs in catchments with highly dispersible soils will have high turbidity. Wetlands vary greatly in turbidity depending upon the general condition of the catchment or river system draining into the wetland and the water level in the wetland. |

## Appendix 3. Macroinvertebrate taxa

**Table A5-1.** Macroinvertebrate taxa collected in August 2008 and 2020. Values are $log_{10}$ abundance categories, where 1= 1 individual, 2 = 2-10 individuals, 3 = 11-100, 4 = 101-1000, and so on; L = larva, F = female, P = pupa, imm./dam. = immature or damaged specimen.

| Phylum/Order/Class | Family | Species | M1 | M3 | M5 | M6 | CS1 | CS2 | EM1 | EM2 | EB1 | EB2 | DOG SWAMP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CNIDARIA** | | | | | | | | | | | | | |
| **Anthoathecata** | **Hydridae** | *Hydra* spp. | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **PLATYHELMINTHES** | | | | | | | | | | | | | |
| | **Turbellaria** | Turbellaria sp. | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| **NEMATODA** | | Nematoda sp. | 0 | 0 | 0 | 2 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |
| **MOLLUSCA** | | | | | | | | | | | | | |
| **Gastropoda** | | | | | | | | | | | | | |
| **Hygrophila** | **Lymnaeidae** | Lymnaeidae sp. | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Planorbidae** | *Glyptophysa* (Glyptophysa) spp. | 1 | 0 | 0 | 2 | 2 | 0 | 0 | 2 | 0 | 0 | 0 |
| | | *Physa acuta* | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| | | *Gyraulus* sp. | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 |
| **ANNELIDA** | | | | | | | | | | | | | |
| **Oligochaeta** | | Oligochaeta sp. (imm/dam) | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 0 | 0 | 3 |
| **Hirudinida** | | Hirudinea sp. | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ARTHROPODA** | | | | | | | | | | | | | |
| **CRUSTACEA** | | | | | | | | | | | | | |
| **Branchiopoda** | | | | | | | | | | | | | |
| **Diplostraca** | **Lynceidae** | *Lynceus macleayanus* | 2 | 0 | 1 | 0 | 0 | 2 | 0 | 2 | 3 | 0 | 0 |
| **Arachnida** | | | | | | | | | | | | | |
| **Sarcoptiformes** | | Acarina sp. | 0 | 0 | 0 | 0 | 3 | 3 | 2 | 2 | 0 | 2 | 1 |
| **Malacostraca** | | | | | | | | | | | | | |
| **Amphipoda** | **Chiltoniidae** | *Austrochiltonia subtenuis* | 3 | 3 | 3 | 3 | 4 | 4 | 2 | 3 | 0 | 0 | 0 |
| **Decapoda** | **Palaemonidae** | *Palaemonetes australis* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| **Isopoda** | **Amphisopidae** | *Paramphisopus palustris* | 0 | 0 | 0 | 2 | 0 | 3 | 2 | 3 | 0 | 0 | 0 |
| **Collembola** | | | | | | | | | | | | | |

| Phylum/Order/Class | Family | Species | M1 | M3 | M5 | M6 | CS1 | CS2 | EM1 | EM2 | EB1 | EB2 | DOG SWAMP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Entomobryomorpha** | | Entomobryoidea sp. | 2 | 0 | 2 | 2 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| **Poduromorpha** | | Poduroidea sp. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| **Symphypleona** | | Symphypleona sp. | 0 | 0 | 0 | 2 | 0 | 1 | 1 | 2 | 0 | 0 | 0 |
| | | | | | | | | | | | | | |
| **Insecta** | | | | | | | | | | | | | |
| **Coleoptera** | | Curculionidae sp. | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Curculionidae sp. (L) | 2 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Dytiscidae** | *Allodessus bistrigatus* | 0 | 0 | 1 | 0 | 2 | 0 | 2 | 2 | 1 | 2 | 2 |
| | | *Antiporus gilberti* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | | *Antiporus* sp. (L) | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 |
| | | Bidessini sp. (L) | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| | | *Copelatus ferrugineus* | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | *Dytiscidae* sp. (L) | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| | | *Eretes australis* | 2 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| | | *Hyderodes crassus* | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 2 | 0 |
| | | *Hyderodes* sp. (L) | 0 | 0 | 1 | 0 | 2 | 2 | 0 | 1 | 2 | 2 | 2 |
| | | *Limbodessus inornatus* | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 |
| | | *Limbodessus shuckardii* | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | | *Megaporus solidus* | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 |
| | | *Megaporus* sp. (L) | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 0 | 0 |
| | | *Necterosoma* sp. (L) | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| | | *Onychohydrus scutellaris* | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| | | *Platynectes decempunctatus var. polygrammus* | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | *Platynectes* sp. (L) | 2 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | | *Rhantus suturalis* | 2 | 0 | 2 | 1 | 2 | 0 | 0 | 2 | 0 | 2 | 0 |
| | | *Sternopriscus* sp. (L) | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| | **Hydraenidae** | *Ochthebius* sp. | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Hydrophilidae** | *Berosus approximans* | 1 | 0 | 0 | 1 | 2 | 0 | 2 | 0 | 0 | 0 | 0 |
| | | *Berosus australiae* | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | *Berosus* sp. (L) | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 1 | 0 | 0 | 0 |

| Phylum/Order/Class | Family | Species | M1 | M3 | M5 | M6 | CS1 | CS2 | EM1 | EM2 | EB1 | EB2 | DOG SWAMP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Enochrus maculiceps* | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | *Hydrophilus albipes* | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | *Hydrophilus latipalpus* | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| | | *Limnoxenus* sp. (L) | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| | | *Paracymus pygmaeus* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| | | *Paracymus* sp. (L) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | **Noteridae** | Noteridae sp. (L) | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| | **Scirtidae** | Scirtidae sp. (L) | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 1 | 0 | 0 | 0 |
| | **Staphylinidae** | Staphylinidae sp. | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Diptera** | **Ceratopogonidae** | Ceratopogonidae sp. (P) | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 |
| | | Ceratopogoninae sp. | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| | | Dasyheleinae sp. | 0 | 0 | 0 | 2 | 0 | 0 | 3 | 1 | 0 | 0 | 0 |
| | **Chironomidae** | | | | | | | | | | | | |
| | **Chironominae** | *Gymnometriocnemus* sp. (V45) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | | *Anzacladius* sp. nr. *numbat* (V31) | 3 | 3 | 3 | 0 | 0 | 0 | 2 | 2 | 0 | 1 | 0 |
| | | Chironomidae sp. (P) | 2 | 0 | 0 | 2 | 1 | 2 | 2 | 2 | 1 | 0 | 1 |
| | | *Chironomus* sp. (WWC3) | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 2 | 3 | 5 | 5 |
| | | *Corynoneura* sp. (V49) | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 2 | 2 | 1 |
| | | *Corynoneura* sp. (WWO5) | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| | | *Dicrotendipes* sp. 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| | | *Larsia albiceps* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| | | *Limnophyes vestitus*(V41) | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| | | nr. *Microchironomus* | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| | | *Paralimnophyes pullulus* (V42) | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| | | *Paramerina ?levidensis* | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 1 | 1 | 2 | 0 |
| | | *Paratanytarsus* sp. (WWTS2) | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | *Polypedilum nubifer* | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | *Procladius paludicola* | 0 | 1 | 1 | 2 | 3 | 3 | 3 | 0 | 0 | 0 | 3 |
| | | Tanytarsini sp. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 |

| Phylum/Order/Class | Family | Species | M1 | M3 | M5 | M6 | CS1 | CS2 | EM1 | EM2 | EB1 | EB2 | DOG SWAMP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Tanytarsus sp. | 0 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Tanytarsus sp. (ORC1) | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 |
| | | *Thienemanniella* sp. (V19) | 2 | 3 | 3 | 2 | 0 | 0 | 3 | 1 | 0 | 0 | 0 |
| | **Culicidae** | *Aedes* sp. | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| | | *Anopheles* sp. | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | | *Culex* sp. | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 3 | 2 |
| | | Culicidae sp. (P) | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 3 | 0 |
| | **Empididae** | Empididae sp. | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | **Ephydridae** | Ephydridae sp. | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 0 |
| | **Muscidae** | Muscidae sp. | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 |
| | **Simuliidae** | Simuliidae sp. | 4 | 3 | 3 | 1 | 0 | 0 | 3 | 2 | 0 | 0 | 0 |
| | | Simuliidae sp. (P) | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Tipuliidae** | Tipulidae sp. | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Hemiptera** | | | | | | | | | | | | | |
| | **Corixoidea** | *Agraptocorixa eurynome* | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Corixoidea sp. (imm/dam.) | 2 | 0 | 0 | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 0 |
| | **Micronectidae** | *Micronecta robusta* | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 1 | 0 |
| | | Micronecta sp. F | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Nepidae** | *Ranatra diminuta* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | **Notonectidae sp.** | *Anisops* sp. F | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | *Anisops thienemanni* | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Notonectidae sp. (imm/dam.) | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 2 | 0 | 2 | 0 |
| | **Veliidae** | *Microvelia* sp. F | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| | | *Microvelia oceanica* | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Odonata** | | | | | | | | | | | | | |
| **Anisoptera** | **Aeshnidae** | *Hemianax papuensis* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| **Zygoptera** | **Coenagrionidae** | *Ischnura aurora* | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | **Corduliidae** | *Hemicordulia tau* | 2 | 0 | 1 | 3 | 0 | 0 | 1 | 0 | 2 | 0 | 2 |
| | **Lestidae** | *Austrolestes aleison* | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| | | *Austrolestes analis* | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |

| Phylum/Order/Class | Family | Species | M1 | M3 | M5 | M6 | CS1 | CS2 | EM1 | EM2 | EB1 | EB2 | DOG SWAMP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Austrolestes annulosus* | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 2 | 0 | 0 | 0 |
| | | *Austrolestes aridus* | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| | | Anisoptera sp. (imm/dam.) | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| | | Zygoptera sp. (imm/dam.) | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| | | **Taxa Richness** | **27** | **16** | **22** | **34** | **29** | **33** | **47** | **32** | **14** | **17** | **13** |

# APPENDIX F – SMA SUNNY CENTRAL UP SPECIFICATIONS

SC 4000 UP / SC 4200 UP / SC 4400 UP




### Efficient

- Up to 4 inverters can be transported in one standard shipping container
- Overdimensioning up to 150% is possible
- Full power at ambient temperatures of up to 35°C

### Robust

- Intelligent air cooling system OptiCool for efficient cooling
- Suitable for outdoor use in all climatic ambient conditions worldwide

### Flexible

- One device for all applications
- DC-coupled battery-storage system, optionally including charging from the utility grid

### Easy to Use

- Improved DC connection area
- Connection area for customer equipment
- Integrated voltage support for internal and external loads

# SUNNY CENTRAL UP

## The new Sunny Central: more power per cubic meter

With an output of up to 4400 kVA and system voltages of 1500 V DC, the SMA central inverter allows for more efficient system design and a reduction in specific costs for PV and battery power plants. A separate voltage supply and additional space are available for the installation of customer equipment. True 1500 V technology and the intelligent cooling system OptiCool ensure smooth operation even in extreme ambient temperature as well as a long service life of 25 years.

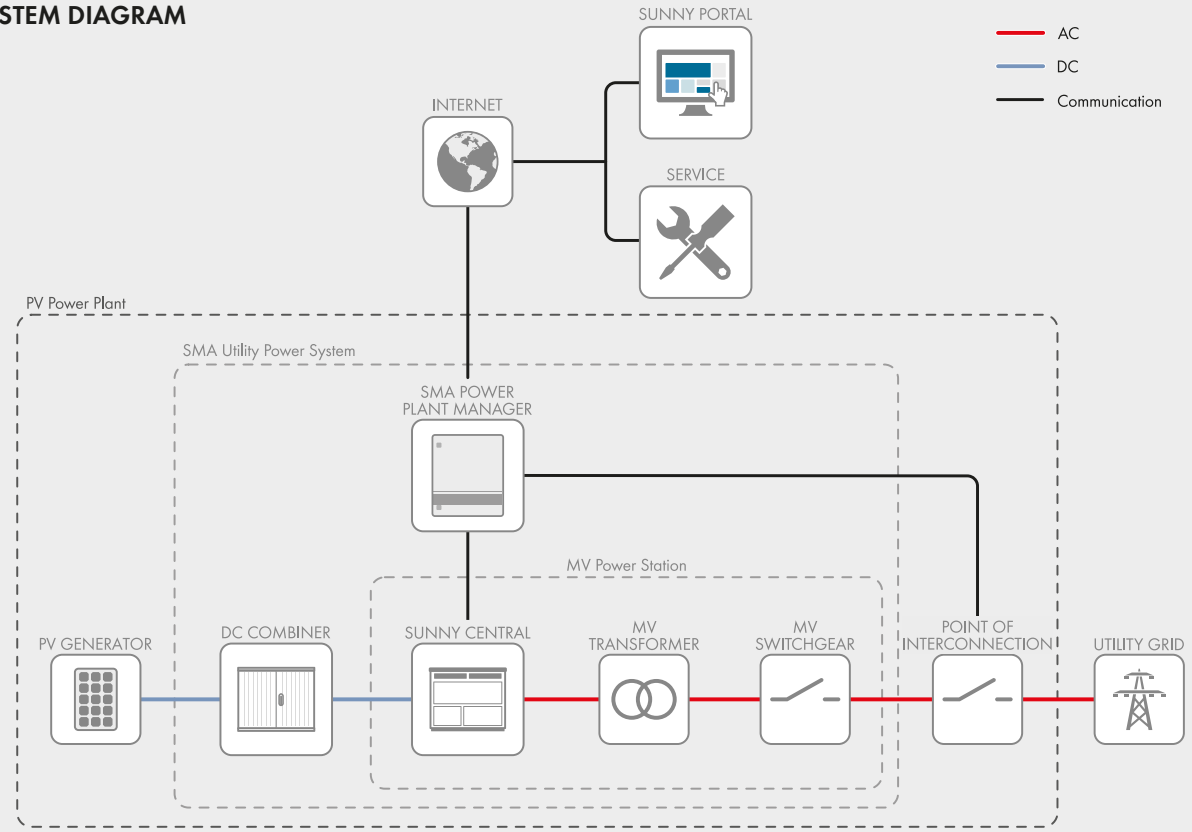
# SUNNY CENTRAL UP

| Technical Data | SC 4000 UP | SC 4200 UP |
|---|---|---|
| **DC side** | | |
| MPP voltage range $V_{DC}$ (at 25 °C / at 50 °C) | 880 to 1325 V / 1050 V | 921 to 1325 V / 1050 V |
| Min. DC voltage $V_{DC, min}$ / Start voltage $V_{DC, Start}$ | 849 V / 1030 V | 891 V / 1071 V |
| Max. DC voltage $V_{DC, max}$ | 1500 V | 1500 V |
| Max. DC current $I_{DC, max}$ | 4750 A | 4750 A |
| Max. short-circuit current $I_{DC, SC}$ | 8400 A | 8400 A |
| Number of DC inputs | Busbar with 26 connections per terminal, 24 double pole fused (32 single pole fused) | |
| Number of DC inputs with optional DC coupled storage | 18 double pole fused (36 single pole fused) for PV and 6 double pole fused for batteries | |
| Max. number of DC cables per DC input (for each polarity) | 2 x 800 kcmil, 2 x 400 mm² | |
| Integrated zone monitoring | ○ | |
| Available PV fuse sizes (per input) | 200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A | |
| Available battery fuse size (per input) | 750 A | |
| **AC side** | | |
| Nominal AC power at cos φ =1 (at 35°C / at 50°C) | 4000 kVA[12] / 3600 kVA | 4200 kVA[12] / 3780 kVA |
| Nominal AC active power at cos φ =0.8 (at 35°C / at 50°C) | 3200 kW[12] / 2880 kW | 3360 kW[12] / 3024 kW |
| Nominal AC current $I_{AC, nom}$ (at 35°C / at 50°C) | 3850 A / 3465 A | 3850 A / 3465 A |
| Max. total harmonic distortion | < 3% at nominal power | < 3% at nominal power |
| Nominal AC voltage / nominal AC voltage range[1] [8] | 600 V / 480 V to 720 V | 630 V / 504 V to 756 V |
| AC power frequency / range | 50 Hz / 47 Hz to 53 Hz<br>60 Hz / 57 Hz to 63 Hz | |
| Min. short-circuit ratio at the AC terminals[9] | > 2 | |
| Power factor at rated power / displacement power factor adjustable[8] [10] | 1 / 0.8 overexcited to 0.8 underexcited | |
| **Efficiency** | | |
| Max. efficiency[2] / European efficiency[2] / CEC efficiency[3] | 98.8% / 98.6% / 98.5% | 98.8% / 98.7% / 98.5% |
| **Protective Devices** | | |
| Input-side disconnection point | DC load break switch | |
| Output-side disconnection point | AC circuit breaker | |
| DC overvoltage protection | Surge arrester, type I & II | |
| AC overvoltage protection (optional) | Surge arrester, class I & II | |
| Lightning protection (according to IEC 62305-1) | Lightning Protection Level III | |
| Ground-fault monitoring / remote ground-fault monitoring | ○ / ○ | |
| Insulation monitoring | ○ | |
| Degree of protection: electronics / air duct / connection area (as per IEC 60529) | IP54 / IP34 / IP34 | |
| **General Data** | | |
| Dimensions (W / H / D) | 2815 / 2318 / 1588 mm (110.8 / 91.3 / 62.5 inch) | |
| Weight | < 3700 kg / < 8158 lb | |
| Self-consumption (max.[4] / partial load[5] / average[6]) | < 8100 W / < 1800 W / < 2000 W | |
| Self-consumption (standby) | < 370 W | |
| Internal auxiliary power supply | ○ Integrated 8.4 kVA transformer | |
| Operating temperature range (optional)[8] | (−40 °C) −25°C to 60°C / (−40 °F) −13°F to 140°F | |
| Noise emission[7] | 65.0 dB(A) | |
| Temperature range (standby) | −40°C to 60°C / −40°F to 140°F | |
| Temperature range (storage) | −40°C to 70°C / −40°F to 158°F | |
| Max. permissible value for relative humidity (condensing / non-condensing) | 95% to 100% (2 month/year) / 0% to 95% | |
| Maximum operating altitude above MSL[8] 1000 m / 2000 m[11] / 3000 m[11] | ● / ○ / ○ | ● / ○ / – |
| Fresh air consumption | 6500 m³/h | |
| **Features** | | |
| DC connection | Terminal lug on each input (without fuse) | |
| AC connection | With busbar system (three busbars, one per line conductor) | |
| Communication | Ethernet, Modbus Master, Modbus Slave | |
| Enclosure / roof color | RAL 9016 / RAL 7004 | |
| Supply for external loads | ○ (2.5 kVA) | |
| Standards and directives complied with | AR-N 4110, AR-N 4120, Arrêté du 23/04/08, CE, IEC / EN 62109-1, IEC / EN 62109-2, IEEE1547, UL 840 Cat. IV | |
| EMC standards | IEC 55011, IEC 61000-6-2, FCC Part 15 Class A | |
| Quality standards and directives complied with | VDI/VDE 2862 page 2, DIN EN ISO 9001 | |
| ● Standard features ○ Optional – not available | | |
| Type designation | SC 4000 UP | SC 4200 UP |

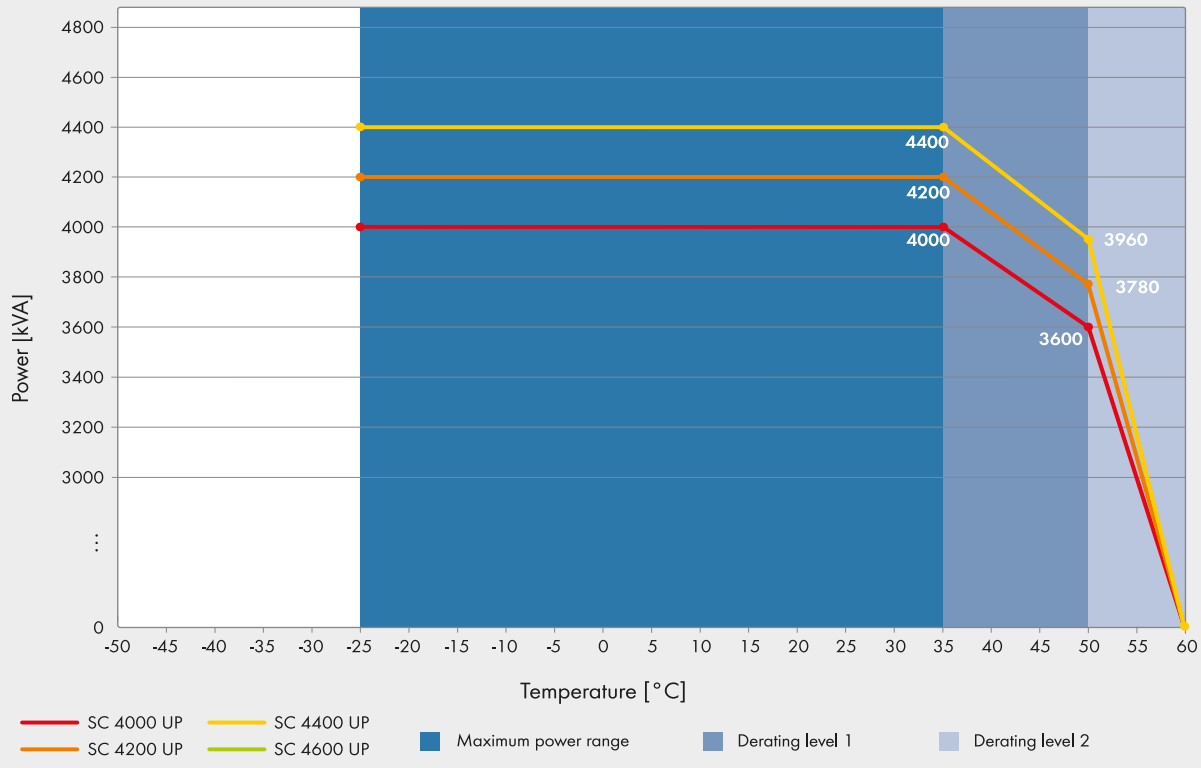
1) At nominal AC voltage, nominal AC power decreases in the same proportion
2) Efficiency measured without internal power supply
3) Efficiency measured with internal power supply
4) Self-consumption at rated operation
5) Self-consumption at < 75% Pn at 25°C
6) Self-consumption averaged out from 5% to 100% Pn at 25°C
7) Sound pressure level at a distance of 10 m
8) Values apply only to inverters. Permissible values for SMA MV solutions from SMA can be found in the corresponding data sheets.
9) A short-circuit ratio of < 2 requires a special approval from SMA
10) Depending on the DC voltage
11) Earlier temperature-dependent de-rating and reduction of DC open-circuit voltage
12) Nominal AC power at 35°C achievable up to a maximum of 1050 $V_{DC}$

| Technical Data | SC 4400 UP |
|---|---|
| **DC side** | |
| MPP voltage range $V_{DC}$ (at 25 °C / at 50 °C) | 962 to 1325 V / 1050 V |
| Min. DC voltage $V_{DC, min}$ / Start voltage $V_{DC, Start}$ | 934 V / 1112 V |
| Max. DC voltage $V_{DC, max}$ | 1500 V |
| Max. DC current $I_{DC, max}$ | 4750 A |
| Max. short-circuit current $I_{DC, SC}$ | 8400 A |
| Number of DC inputs | Busbar with 26 connections per terminal, 24 double pole fused (32 single pole fused) |
| Number of DC inputs with optional DC coupled storage | 18 double pole fused (36 single pole fused) for PV and 6 double pole fused for batteries |
| Max. number of DC cables per DC input (for each polarity) | 2 x 800 kcmil, 2 x 400 mm² |
| Integrated zone monitoring | ○ |
| Available PV fuse sizes (per input) | 200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A |
| Available battery fuse size (per input) | 750 A |
| **AC side** | |
| Nominal AC power at cos φ =1 (at 35°C / at 50°C) | 4400 kVA[13] / 3960 kVA |
| Nominal AC active power at cos φ =0.8 (at 35°C / at 50°C) | 3520 kW[13] / 3168 kW |
| Nominal AC current $I_{AC, nom}$ (at 35°C / at 50°C) | 3850 A / 3465 A |
| Max. total harmonic distortion | < 3% at nominal power |
| Nominal AC voltage / nominal AC voltage range[1] [8] | 660 V / 528 V to 759 V |
| AC power frequency / range | 50 Hz / 47 Hz to 53 Hz<br>60 Hz / 57 Hz to 63 Hz |
| Min. short-circuit ratio at the AC terminals[9] | > 2 |
| Power factor at rated power / displacement power factor adjustable[8] [10] | ● 1 / 0.8 overexcited to 0.8 underexcited |
| **Efficiency** | |
| Max. efficiency[2] / European efficiency[2] / CEC efficiency[3] | 98.8% / 98.7% / 98.5% |
| **Protective Devices** | |
| Input-side disconnection point | DC load break switch |
| Output-side disconnection point | AC circuit breaker |
| DC overvoltage protection | Surge arrester, type I & II |
| AC overvoltage protection (optional) | Surge arrester, class I & II |
| Lightning protection (according to IEC 62305-1) | Lightning Protection Level III |
| Ground-fault monitoring / remote ground-fault monitoring | ○ / ○ |
| Insulation monitoring | ○ |
| Degree of protection: electronics / air duct / connection area (as per IEC 60529) | IP54 / IP34 / IP34 |
| **General Data** | |
| Dimensions (W / H / D) | 2815 / 2318 / 1588 mm (110.8 / 91.3 / 62.5 inch) |
| Weight | < 3700 kg / < 8158 lb |
| Self-consumption (max.[4] / partial load[5] / average[6]) | < 8100 W / < 1800 W / < 2000 W |
| Self-consumption (standby) | < 370 W |
| Internal auxiliary power supply | ○ Integrated 8.4 kVA transformer |
| Operating temperature range (optional)[8] | (−40 °C) −25°C to 60°C / (−40 °F) −13°F to 140°F |
| Noise emission[7] | 65.0 dB(A) |
| Temperature range (standby) | −40°C to 60°C / −40°F to 140°F |
| Temperature range (storage) | −40°C to 70°C / −40°F to 158°F |
| Max. permissible value for relative humidity (condensing / non-condensing) | 95% to 100% (2 month/year) / 0% to 95% |
| Maximum operating altitude above MSL[8] 1000 m / 2000 m[11] / 3000 m[11] | ● / ○ / – |
| Fresh air consumption | 6500 m³/h |
| **Features** | |
| DC connection | Terminal lug on each input (without fuse) |
| AC connection | With busbar system (three busbars, one per line conductor) |
| Communication | Ethernet, Modbus Master, Modbus Slave |
| Enclosure / roof color | RAL 9016 / RAL 7004 |
| Supply for external loads | ○ (2.5 kVA) |
| Standards and directives complied with | AR-N 4110, AR-N 4120, Arrêté du 23/04/08, CE, IEC / EN 62109-1, IEC / EN 62109-2, IEEE1547, UL 840 Cat. IV |
| EMC standards | IEC 55011, IEC 61000-6-2, FCC Part 15 Class A |
| Quality standards and directives complied with | VDI/VDE 2862 page 2, DIN EN ISO 9001 |
| ● Standard features ○ Optional – not available | |
| Type designation | SC 4400 UP |

## SYSTEM DIAGRAM




## TEMPERATURE BEHAVIOR (at 1000 m)

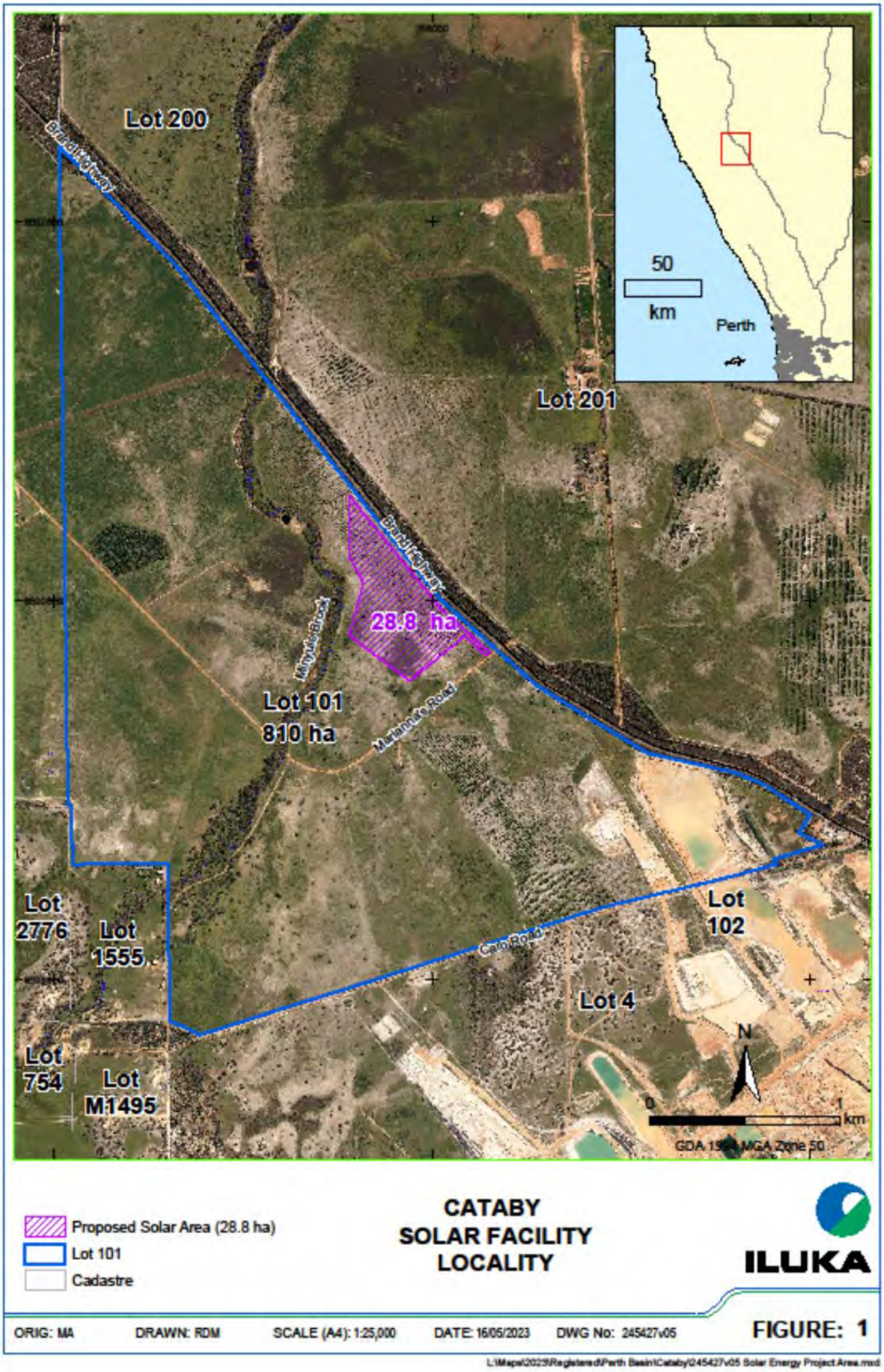



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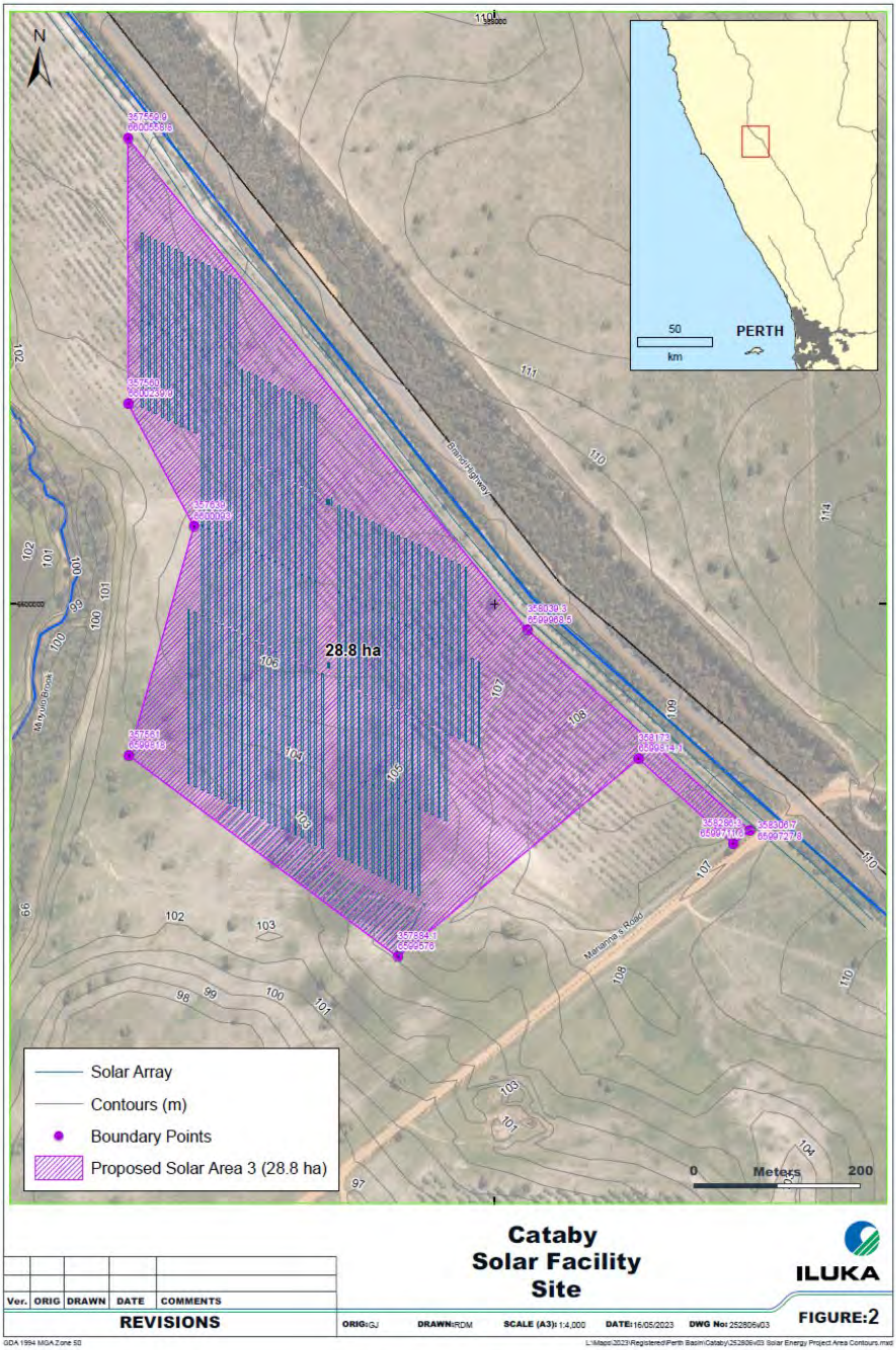
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18. Simulation of proposed project sitting within the landscape from the South (showing surrounding paddock) - Plate AG ..... 19

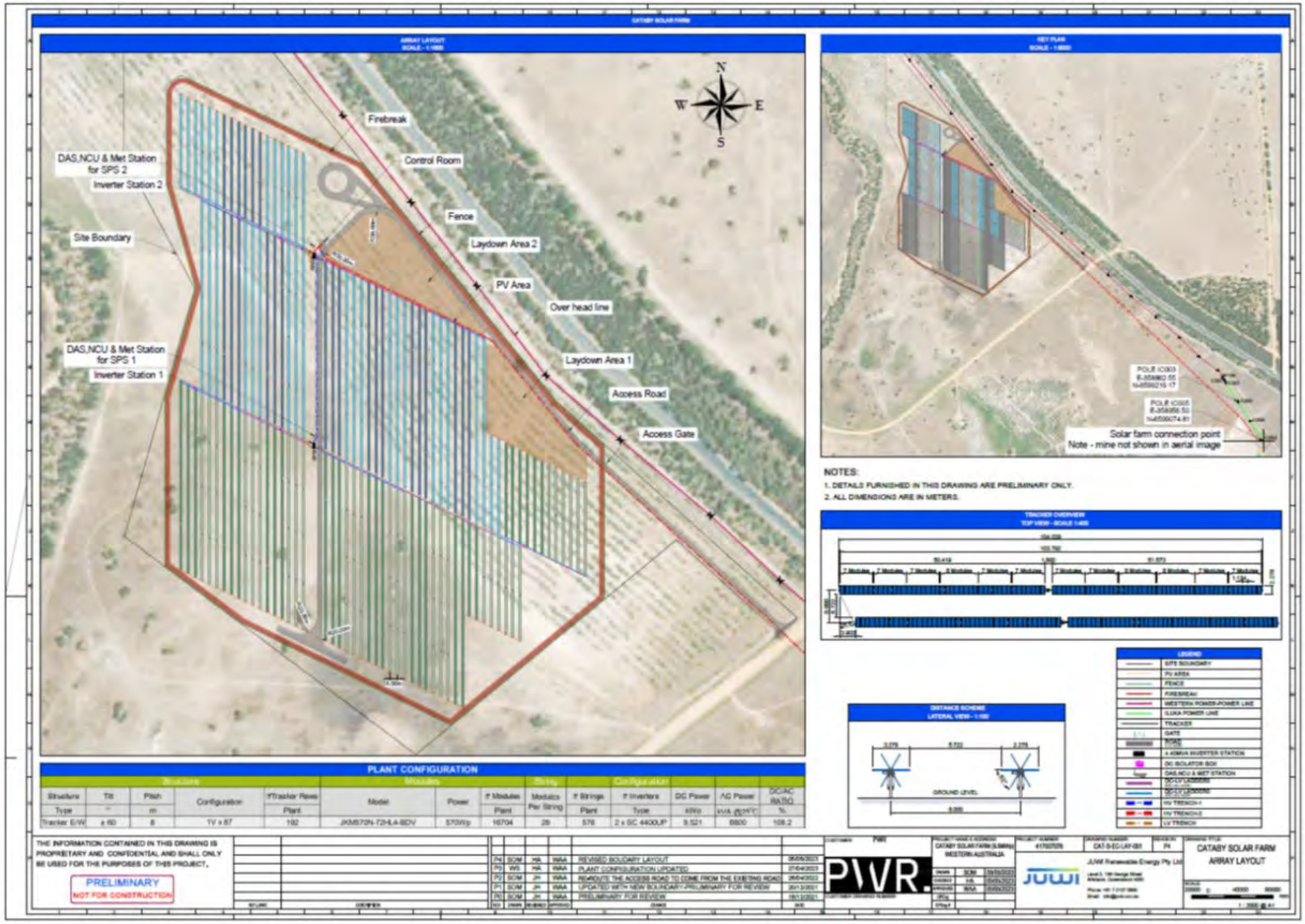

*(Please note references apply to Solar Facility Cataby Western Australia. Development Application. Compliance Report June 2023)*



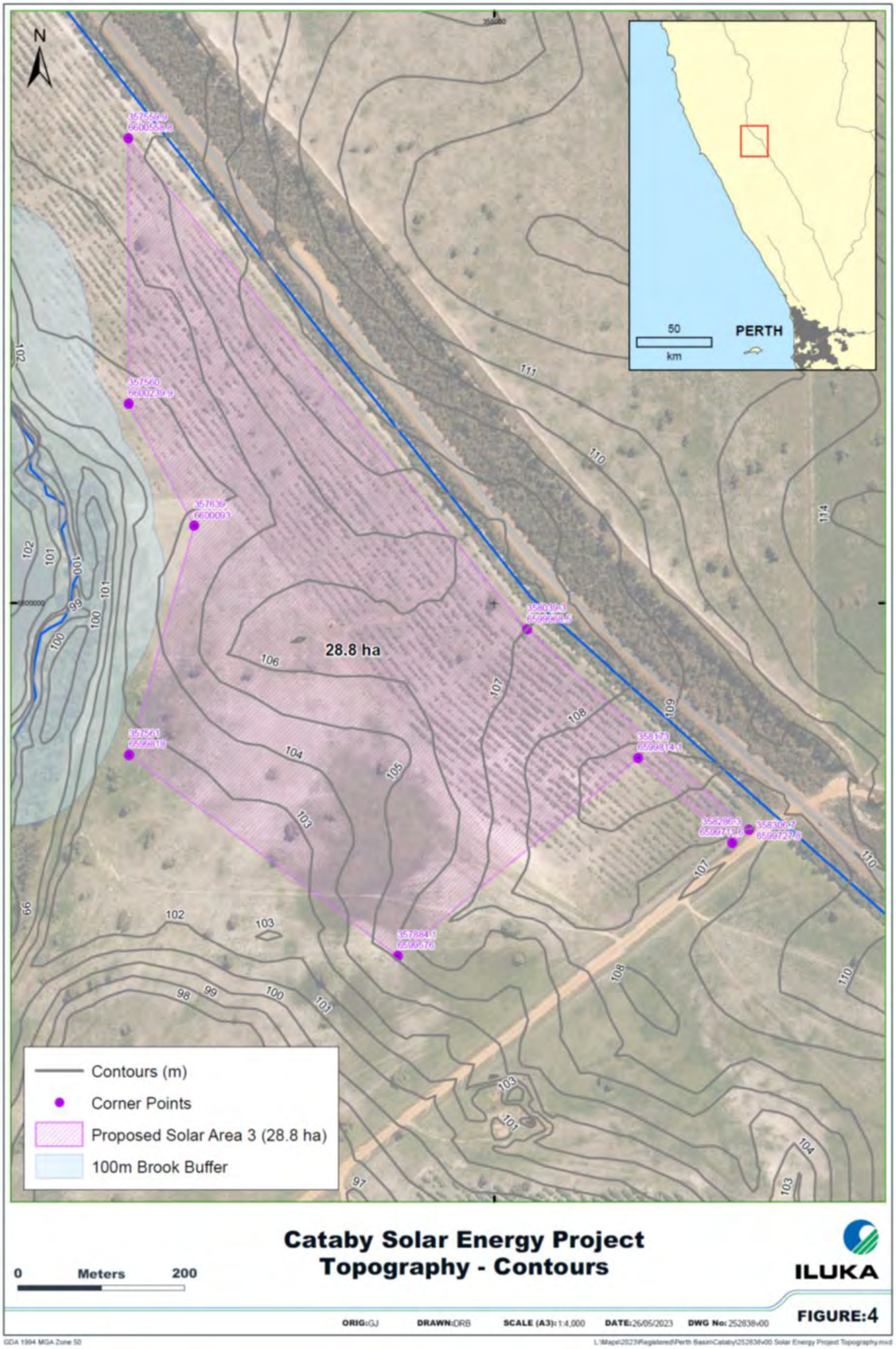

1. **Proposed Solar Facility (Locality) – Reference Figure 1**




2. **Proposed Solar Facility (Site) – Reference Figure 2**



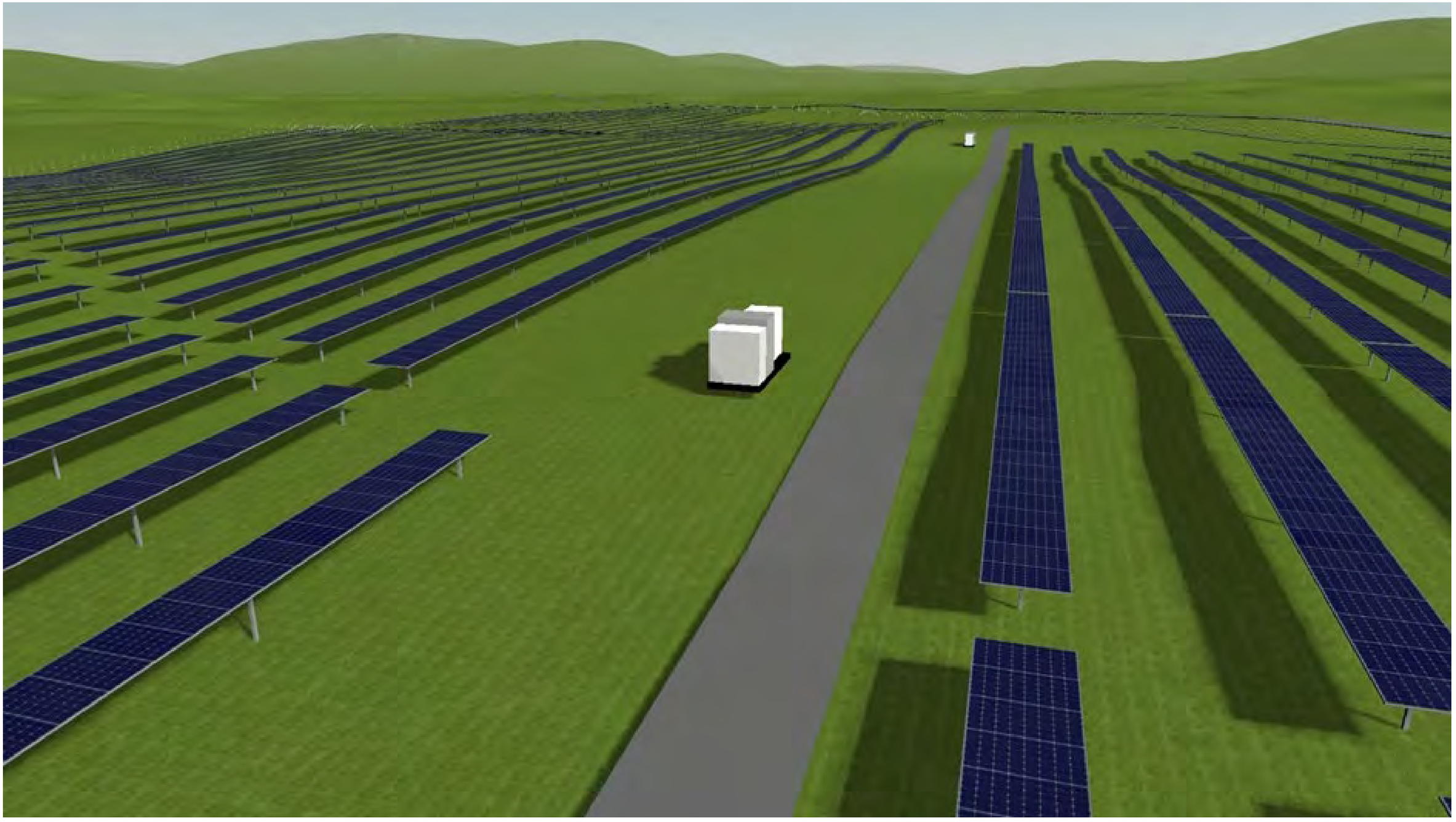

3. **Proposed Solar Facility (Features) – Reference Figure 3**



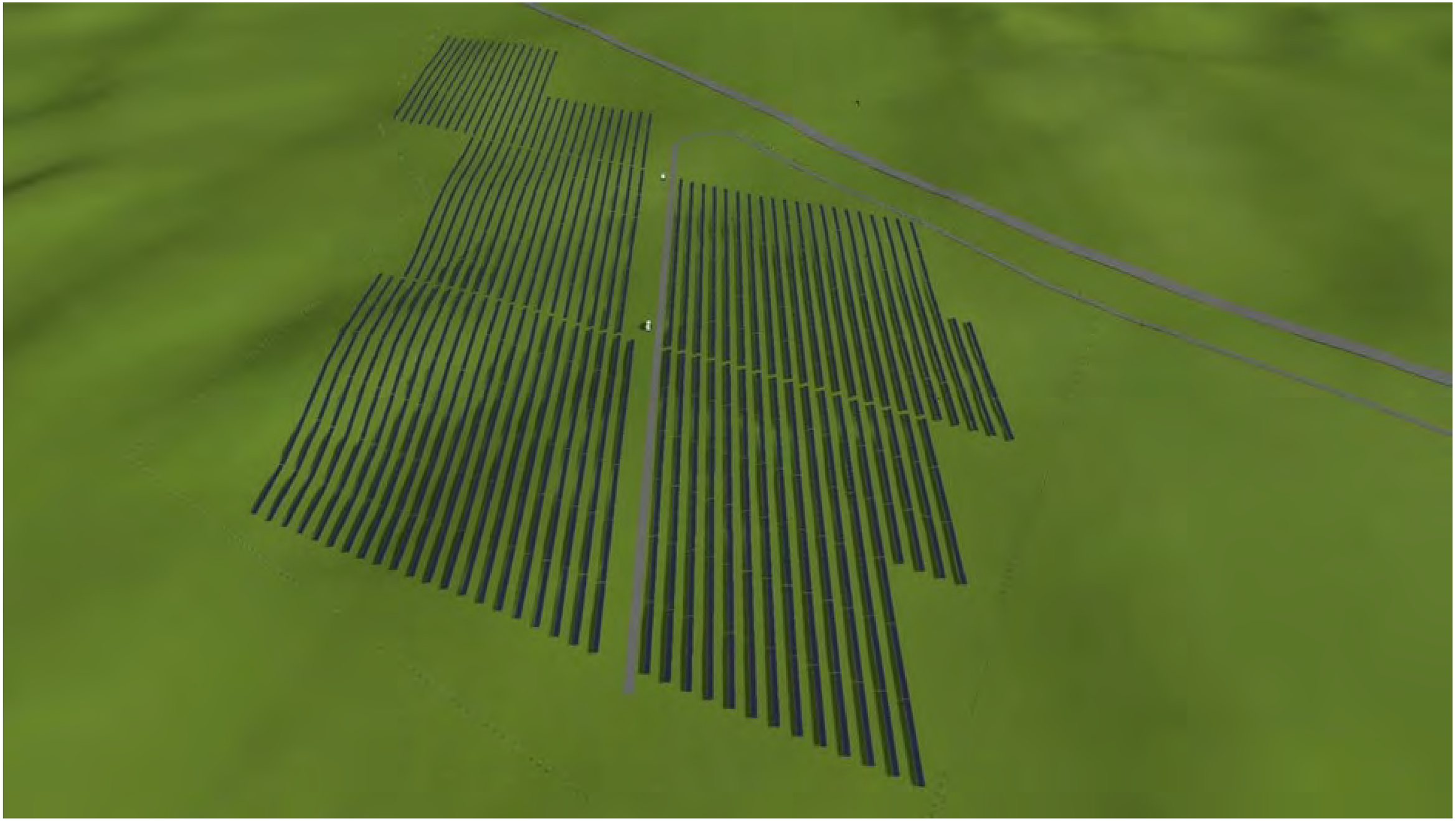

4. **Topography – Contour Plan – Reference Figure 4**



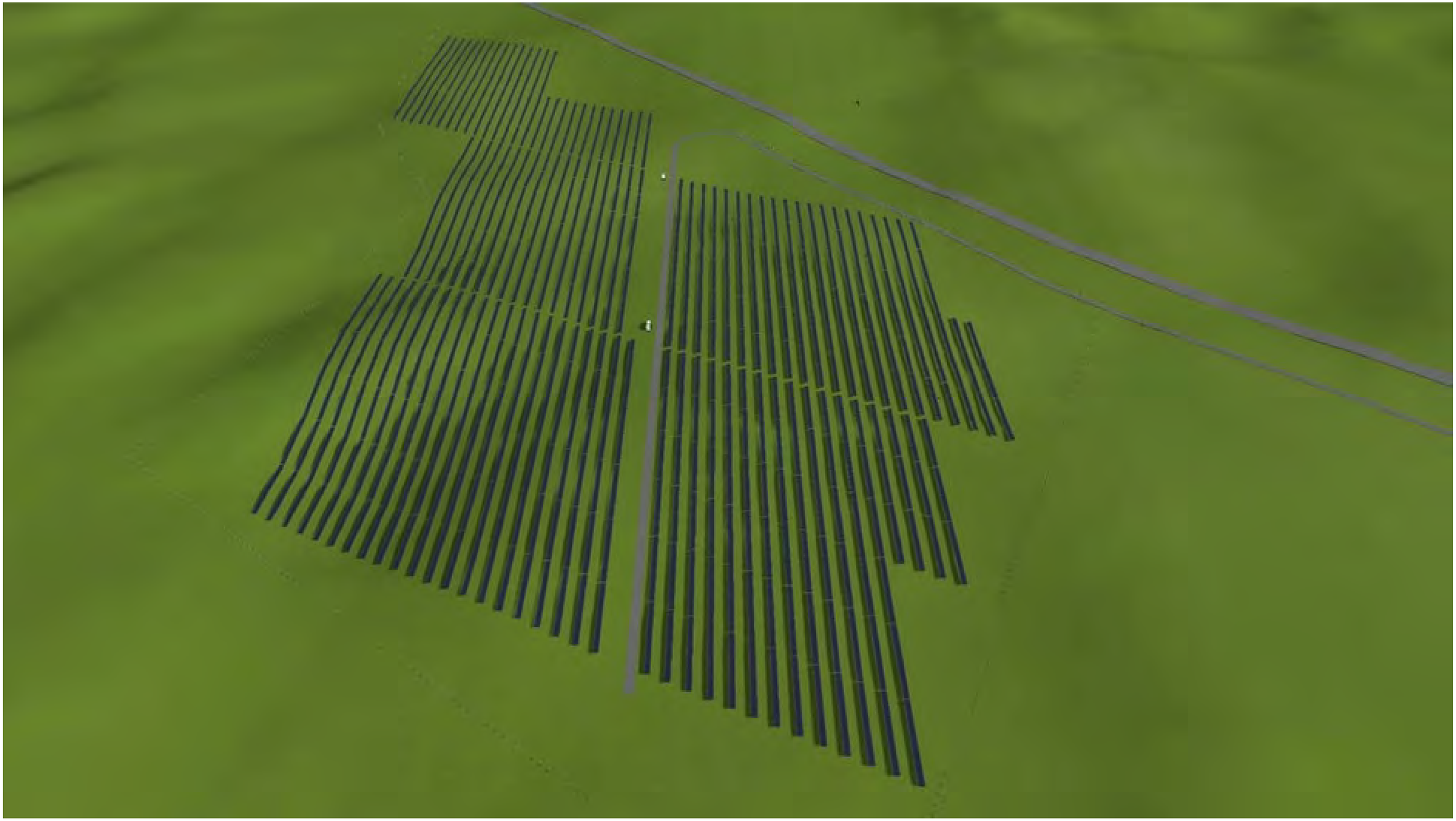
5. **Aerial of solar facility site and major features (Brand Highway to the right, Marianna's Road in the immediate foreground and Minyulo Brook green tree line) - Reference Plate N**



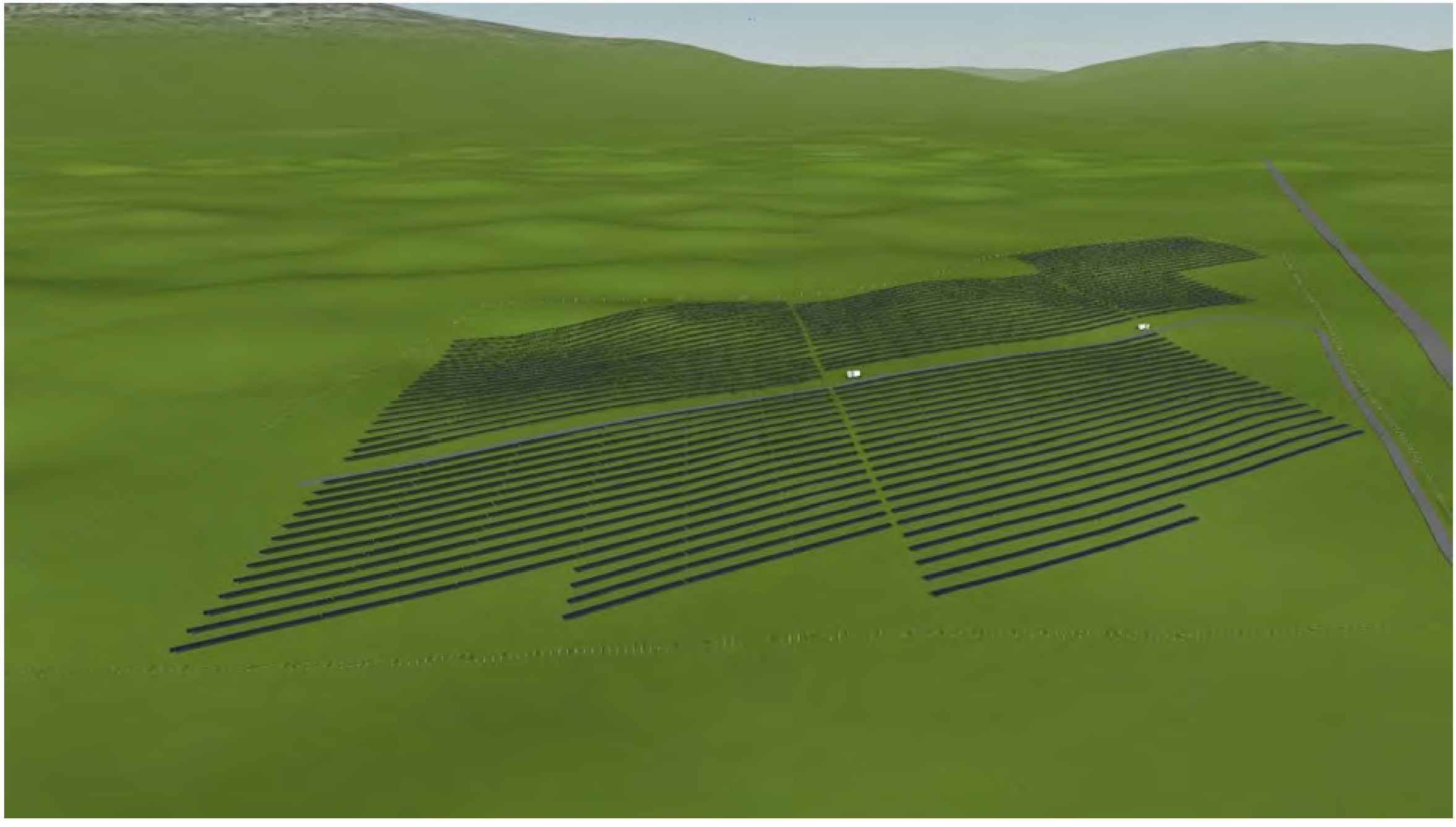
**6. Generated image of the proposed development on the site – Reference Plate M**



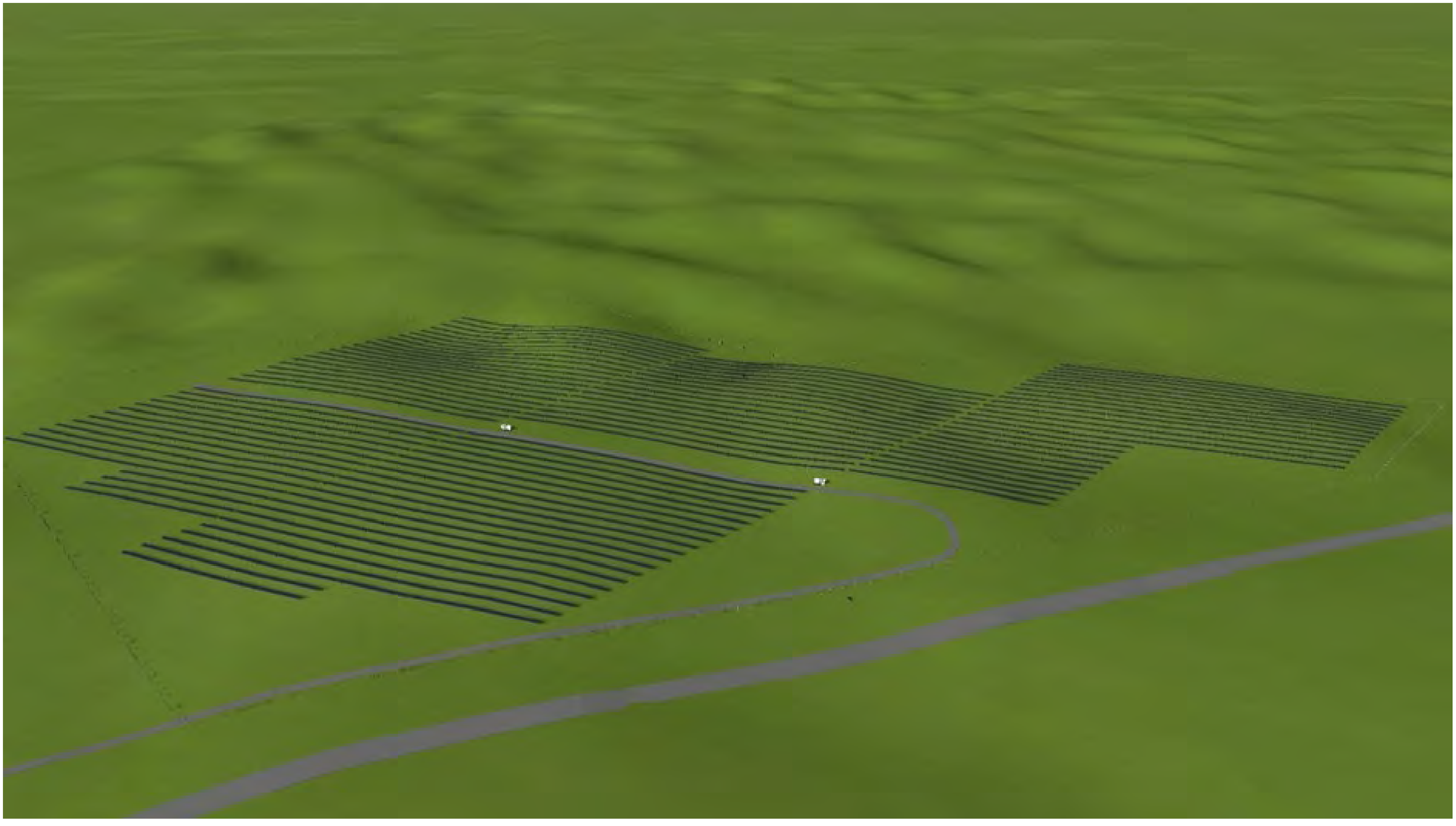
**7. Simulation Aerial from the north (Minyulo Brook tree line to the right, Marianna's Road top and Brand Highway to left) – Reference Plate P**



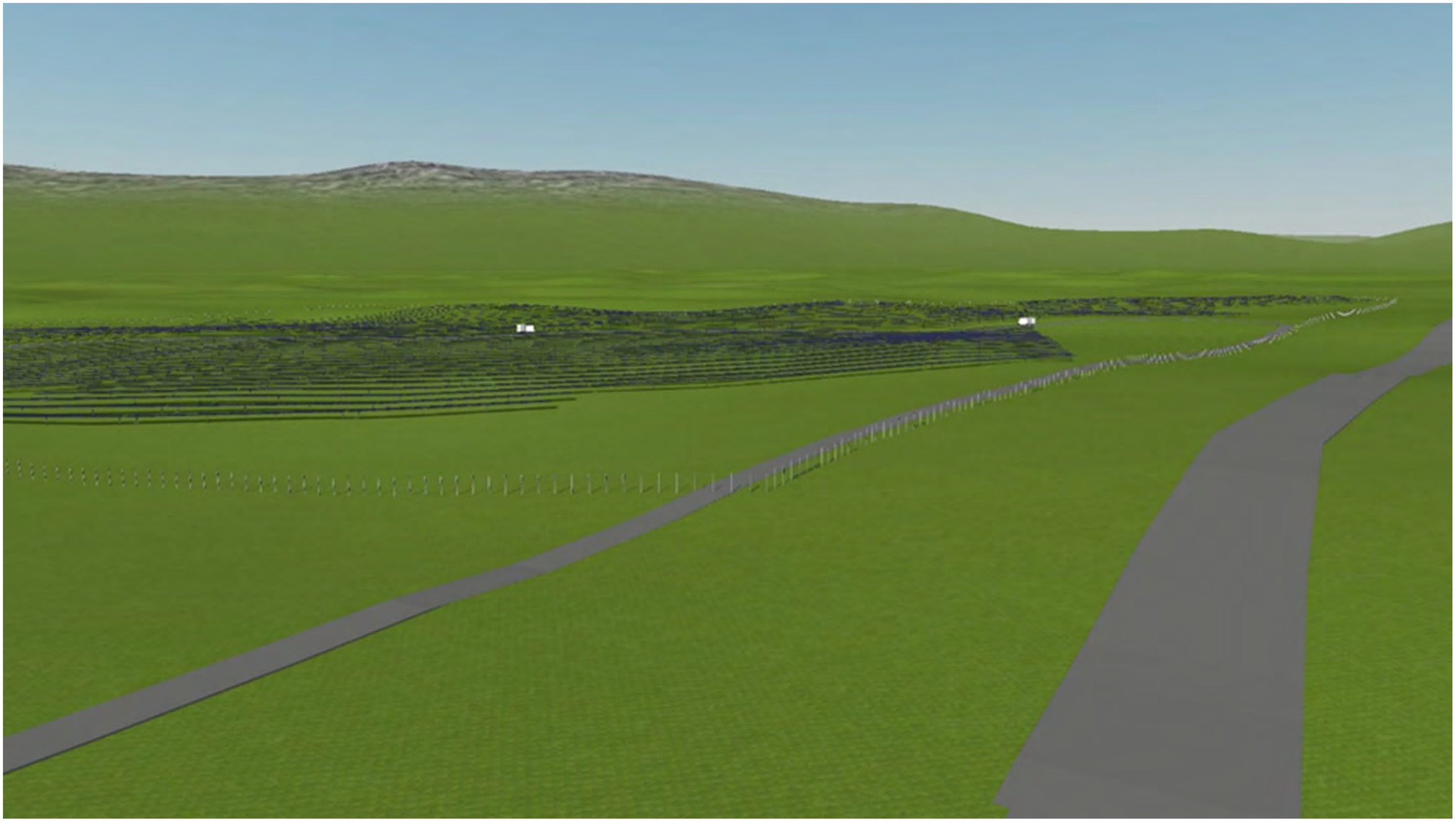
**8. From the South simulation – Reference Plate Q**



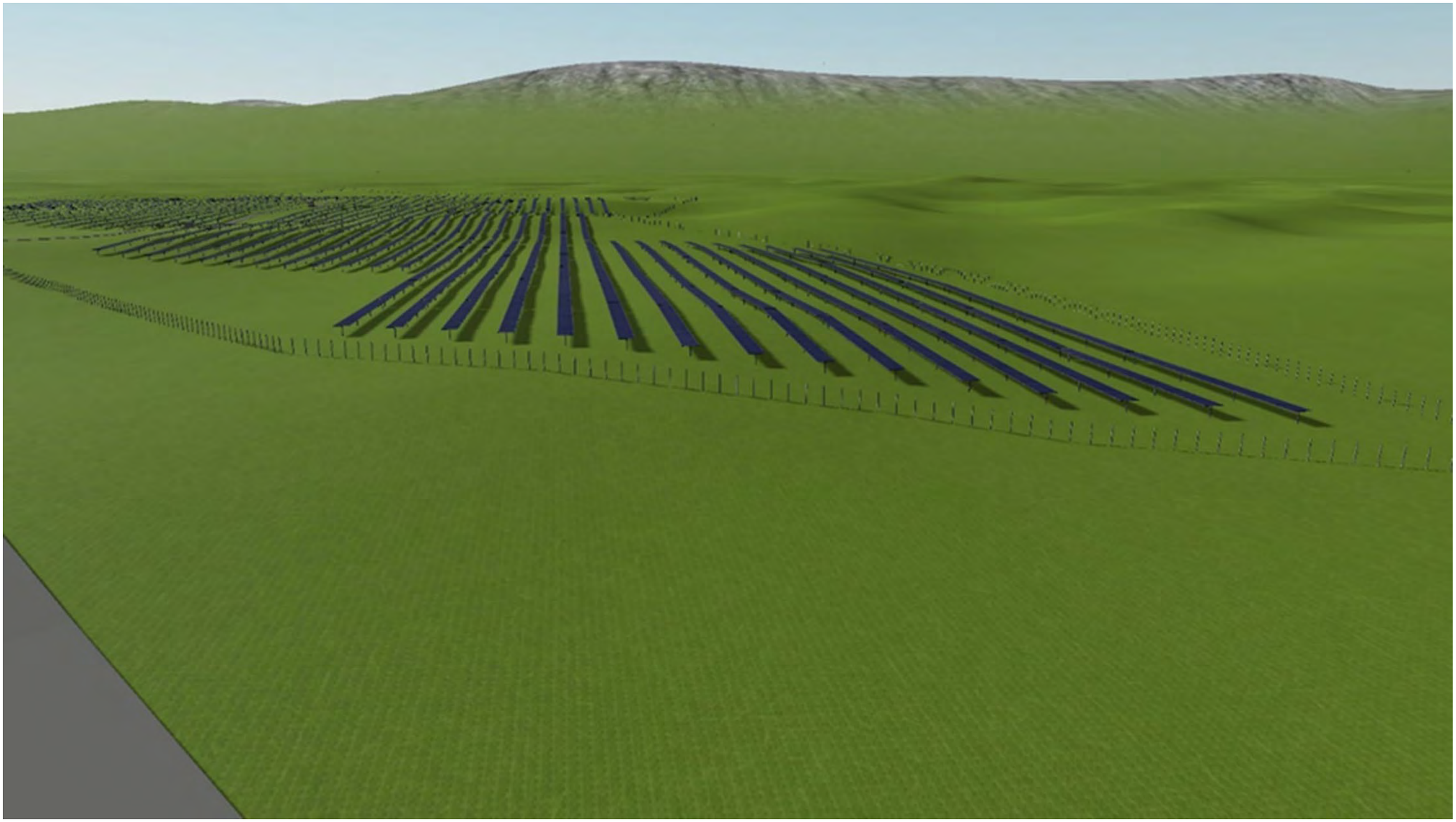
**9. From the East simulation – Reference Plate R**



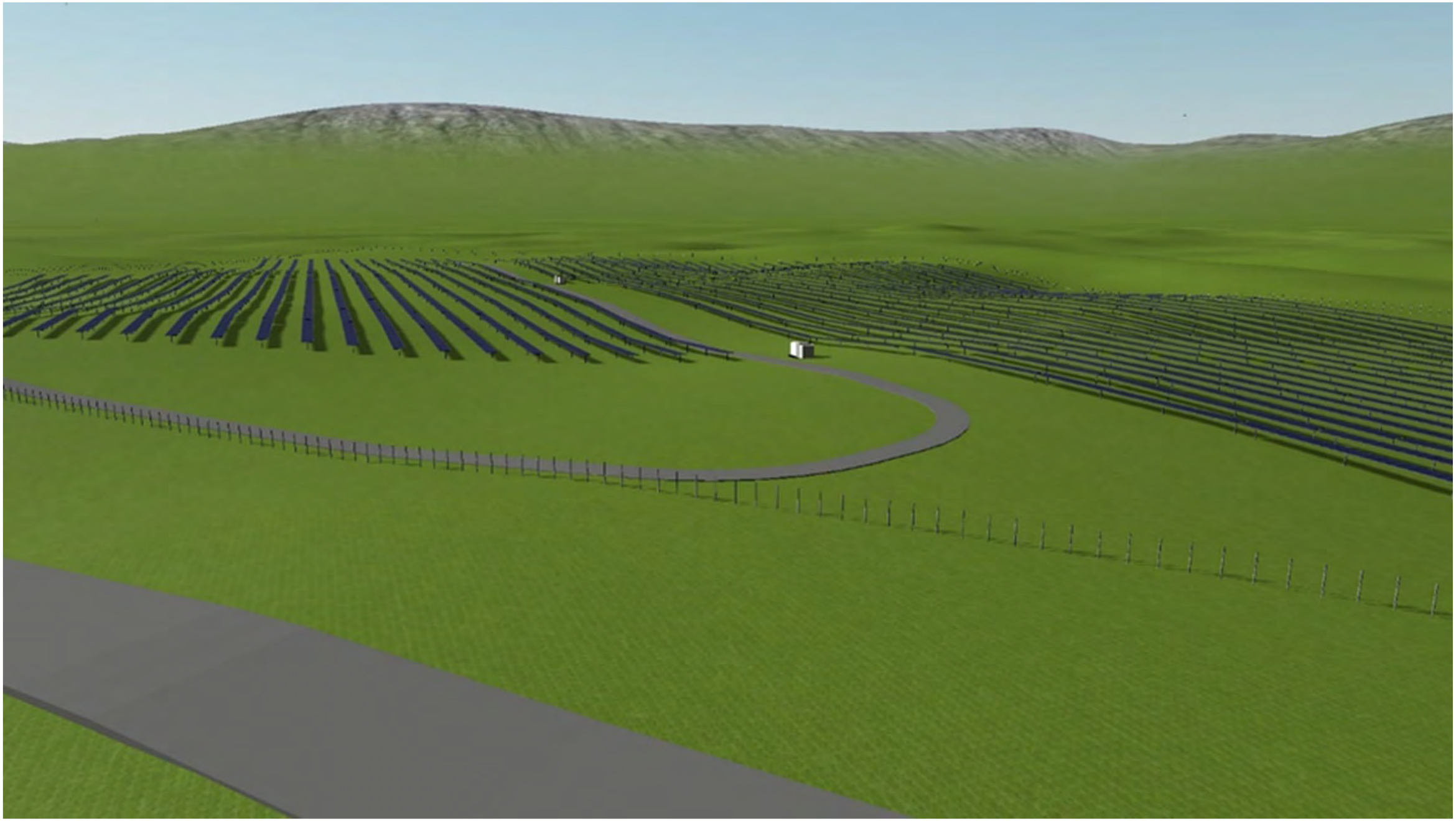
**10. From the North simulation – Reference Plate S**



**11. Aerial View from road (Brand Highway) facing East from south perspective – Reference Plate AA**



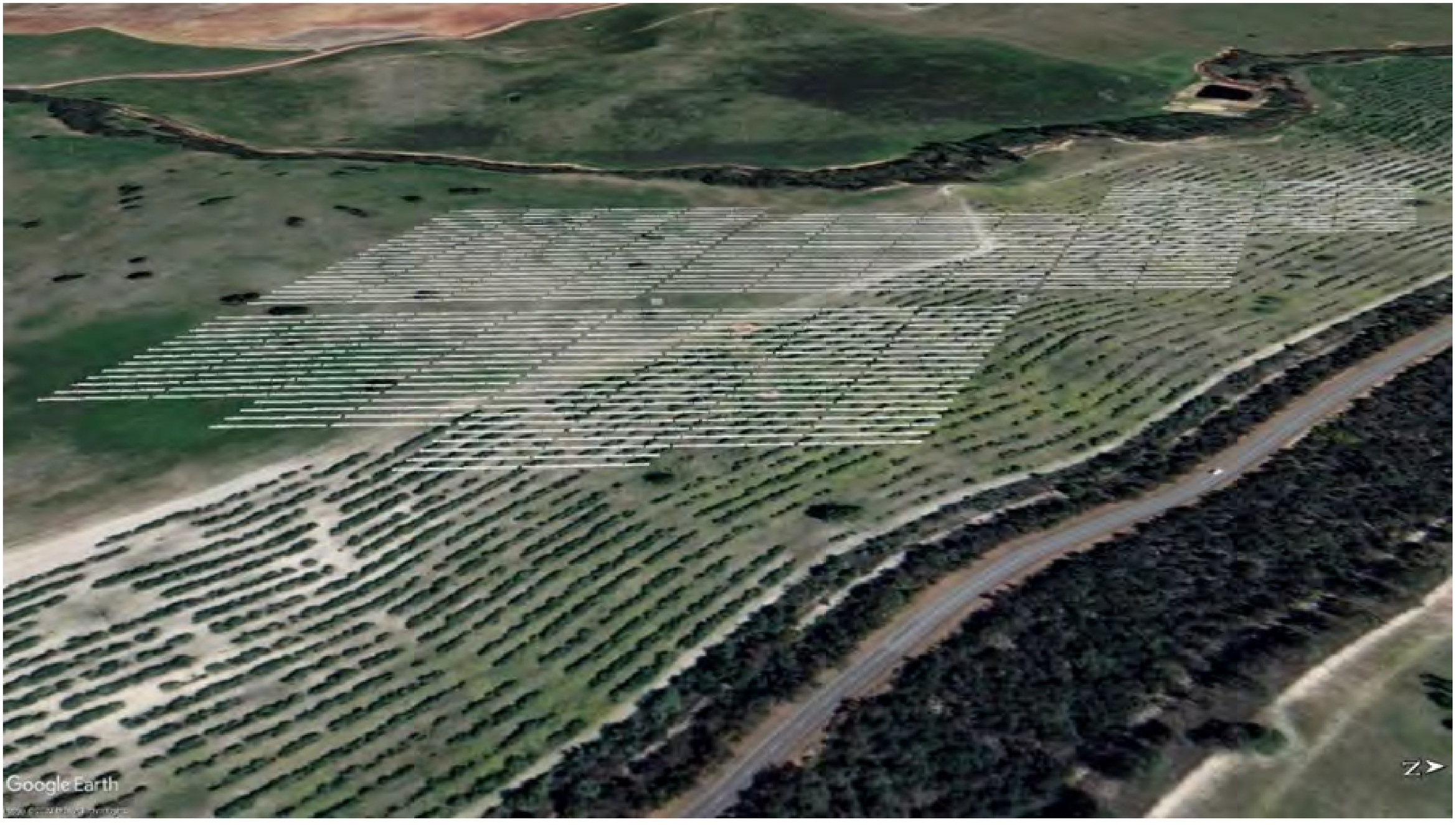
**12. Aerial View from road (Brand Highway) facing East from north perspective - Plate AB**



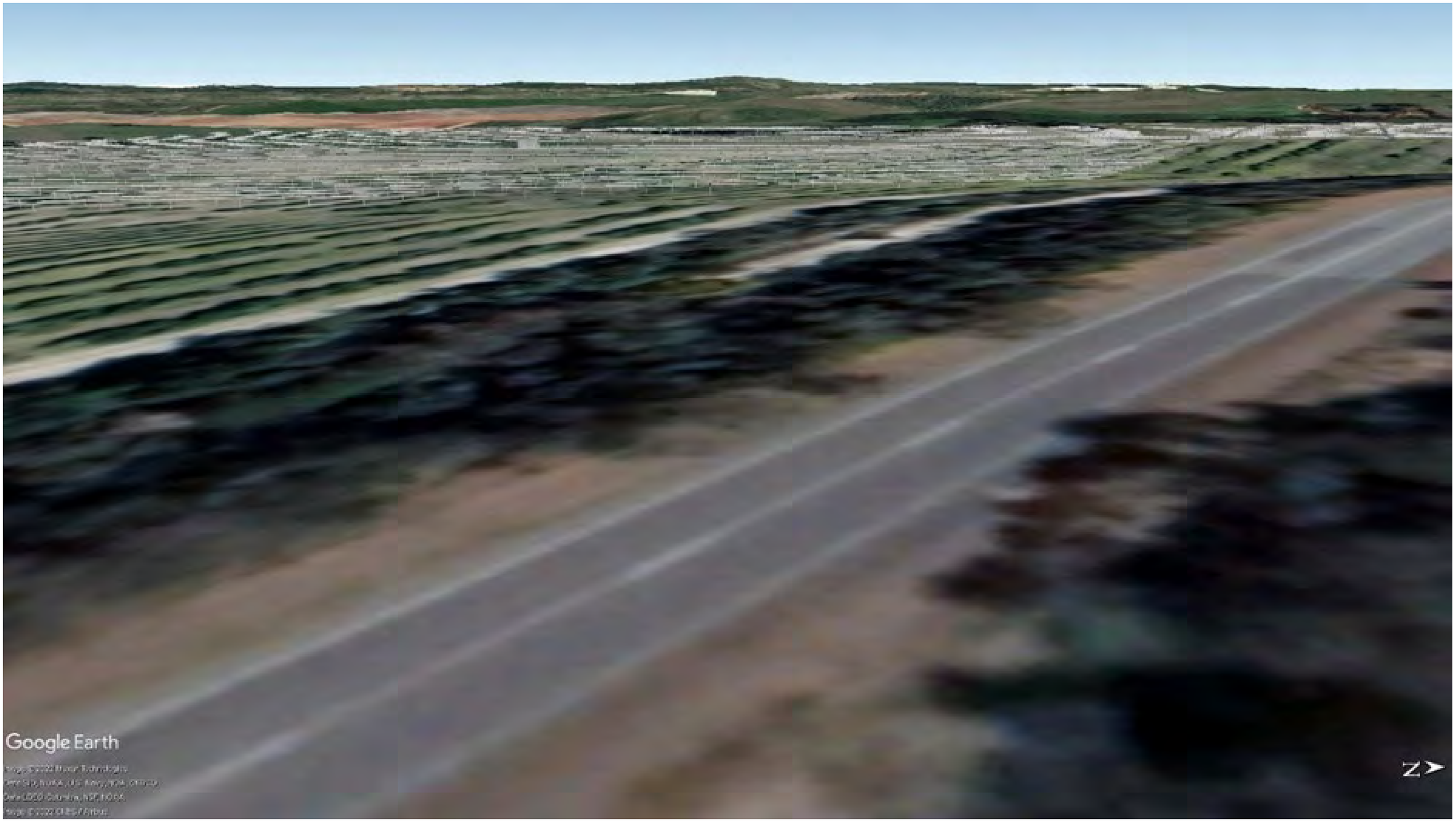
**13. Aerial View from road (Brand Highway) facing south – Reference Plate AC**



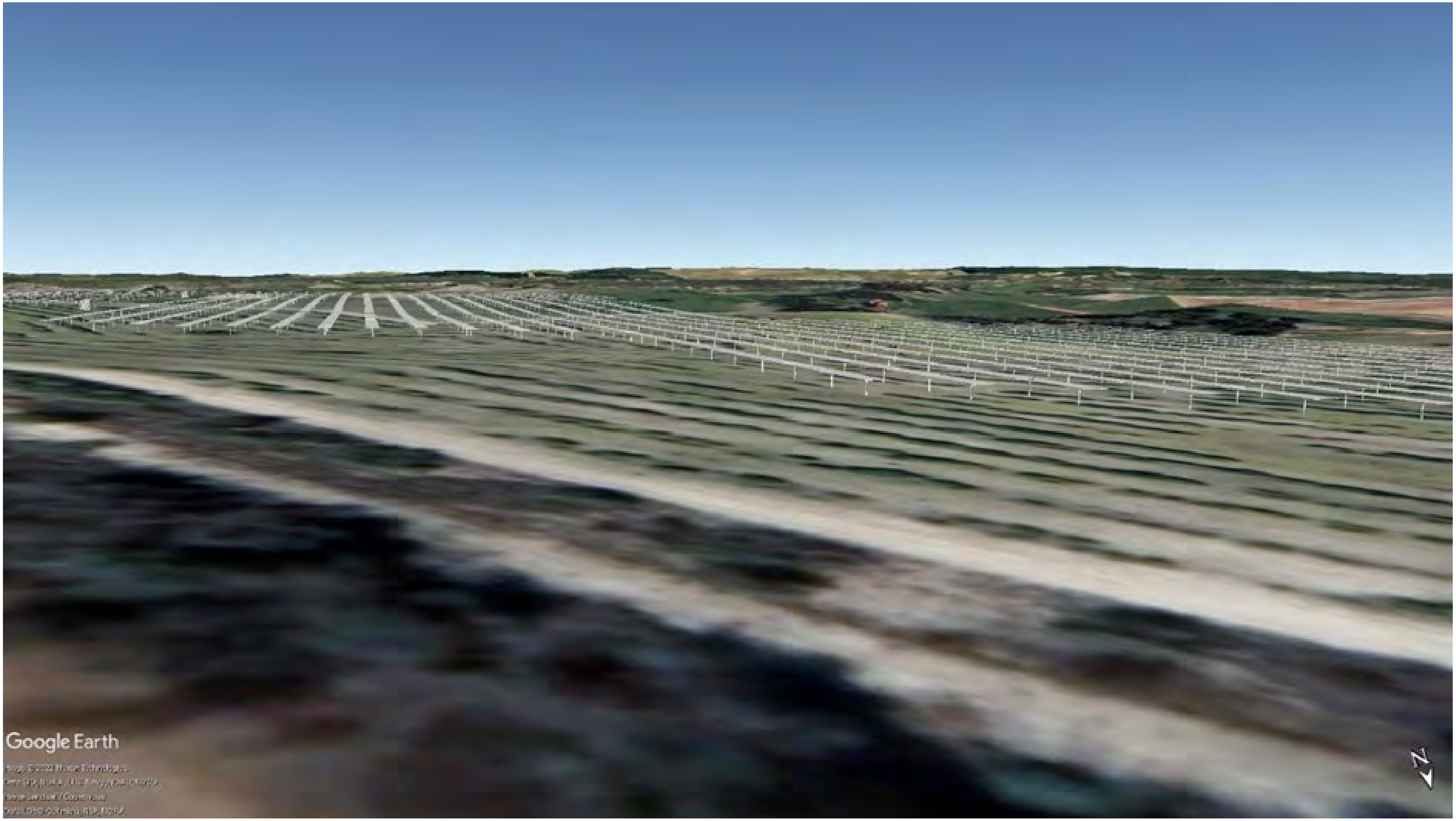

**14. Simulation Aerial from the north (Minyulo Brook tree line to the right, Marianna's Road top and Brand Highway to left) – Reference Plate P**




**15. Simulation Aerial from the east looking toward Minyulo Brook - Plate W**




**16. Aerial View from road (Brand Highway) facing East - Plate Z**




**17. Simulation of proposed project sitting within the landscape from the south – Reference Plate AF**




**18. Simulation of proposed project sitting within the landscape from the South (showing surrounding paddock) - Plate AG**

## Schedule of Referral Responses – Proposed Solar Photovoltaic Facility– Lot 101 (No.11019) Brand Highway, Cataby

| Agency | Comments | Officer comments |
|---|---|---|
| Department of Plannings, Lands & Heritage (Aboriginal Heritage) | A review of the Register of Places and Objects as well as the Department of Planning, Lands and Heritage's Aboriginal Heritage Database confirms that the proposed work area as shown in the reports attached to your email do not intersect with the boundary of any known and recorded Aboriginal Heritage place. It is noted that the proposed work area is adjacent (55 m at closest point) to registered Aboriginal site ID 28326 (Minyulo Brook (Bilya)).<br>As of 1 July 2023, we will be operating under the new Aboriginal Cultural Heritage Act 2021. Under the Act, proponents are required to perform a Due Diligence Assessment, to determine the scope and potential impact of the works, and to determine if there will be any impact to any known or potentially unrecorded Aboriginal Cultural Heritage. From this Due Diligence Assessment, the proponent will be able to follow the most appropriate approvals pathway (if needed).<br>I've attached some information sheets that I hope will help guide the proponent's Due Diligence Assessment, and they can find more information here:<br>https://www.wa.gov.au/organisation/department-of-planning-lands-and-heritage/aboriginal-cultural-heritage-act-2021#aboriginal-cultural-heritage-guidelines | Noted. |
| Department of Biodiversity, Conservation and Attractions | DBCA Midwest have reviewed the Shire's below application regarding the proposed solar farm, in which they have no comment response to this referral. | Noted. |
| Department of Primary Industries and Regional Development | DPIRD does not object to the proposal and offers the following comments:<br>1. As the Development Application Compliance Report states the Study Area occurs within the Bassendean and Yeermullah Soil-Landscape Zones (p25). The soils associated with these landscape zones tend to be acidic, are prone to subsoil compaction and have a high risk to wind erosion. A review of aerial photography and NDVI show that the site, historically, has low pasture production over winter and consequently limited potential for grazing. The cropping potential of this area will also be low. DPIRD suggests that, after the construction phase is complete, appropriate perennial species should be sown to establish ground cover. This will assist with the control of wind erosion.<br><br>2. The development application (p92) states that "At the end of its life the solar facility would be decommissioned, and the land would revert to the landuse of "agriculture" long term." DPIRD was not able to assess the | 1. A recommended condition of development approval will require a post construction landscape plan to be submitted and approved by the Shire and thereafter implemented for the development site to prevent soil erosion by wind and stormwater (Condition 6).<br><br>2. A further recommended condition of development approval will require that a decommissioning and |

| | | |
|---|---|---|
| | decommissioning and rehabilitation plans as the development application did not provide any information about this aspect of the project. Given the area being used for the proposed facility, historically, has low potential for cropping or pastures, revegetating maybe preferred on this site. DPIRD suggests that the area is assessed to determine its (post decommissioning) optimum use. DPIRD requests that the approval of the proposal should be conditional upon the preparation of a decommissioning and rehabilitation plan to ensure the land is restored to an improved environmental potential, both after construction is complete and for the future when these facilities are no longer in use and are decommissioned. | rehabilitation management plan be submitted and approved by the Shire and thereafter implemented prior to the commencement of decommissioning the development (Condition 7). |
| Main Roads WA | Following meeting with the Shire of Dandaragan and Iluka mine, and further information provided by the Iluka mine, Main Roads has no objections subject to the following conditions being imposed:<br>Conditions<br>1. Prior to the start of construction of the PV Facility, the existing driveway access with the Brand Highway shall be upgraded by the applicant to Main Roads satisfaction, to facilitate the turning movement of the longest vehicle.<br>Justification for Condition<br>Public safety and protection of the Primary Regional Road Reservation.<br><br>2. The existing driveway access with the Brand Highway shall be sealed from edge of the Brand Highway Road surface for an appropriate length into Lot 101.<br>Justification for Condition<br>Public safety and protection of the Primary Regional Road Reservation.<br>Main Roads requirements for Driveways are available on the Main Roads website.<br>An unsealed internal driveway/trafficable area has the potential for material to be carried on to sealed roads, especially from larger vehicles. This material has the potential to crack windscreens and effect traction of vehicles passing on the road, creating an unsafe environment. Material that is carried onto sealed roads by vehicles is the responsibility of the owner of the driveway.<br><br>3. The applicant shall be responsible for all costs associated with the upgrade of the existing driveway access.<br><br>4. No manoeuvring within the Brand Highway road reserve shall be permitted as part of site operations.<br>Justification for Condition<br>Public safety and protection of the Primary Regional Road Reservation. | In relation to proposed conditions 1, 2, 3, 4 and 7 a recommended condition of development approval will ensure that the site access and egress is constructed to this extent prior to construction of the solar PV facility, with all works and associated costs to be borne by the proponent (Condition 3).<br><br>In relation to proposed condition 5 a further recommended condition of development approval will require that a construction management plan be submitted and approved by the Shire and thereafter implemented prior to the commencement of construction (Condition 4). Construction dust management will form part of this management plan.<br><br>In relation to proposed condition 6 a further recommended condition of development approval will require a post construction landscape plan to be submitted and approved by the Shire and thereafter implemented for the development site to prevent soil erosion by wind and stormwater (Condition 6). |

| | | |
|---|---|---|
| | 5. A Dust Management Plan shall be completed to Main Roads and the Shire of Dandaragan requirements and satisfaction. The plan and its implementation shall prevent dust material being deposited into on the state road network from internal operations within the lot.<br>Justification for Condition<br>Public safety and protection of the Primary Regional Road Reservation.<br><br>6. Stormwater discharge from the property shall be contained within the lot boundaries.<br>Justification for Condition<br>Public safety and protection of the Primary Regional Road Reservation.<br><br>7. The landowner/applicant shall make good any damage to the existing verge vegetation within the road reserve.<br>Justification for Condition<br>Public safety and protection of the Primary Regional Road Reservation<br><br>Advice<br>a) Condition 1 & 2: The upgrade to the existing driveway access with the Brand Highway shall facilitate the turning movement of the longest vehicle, that the applicant has advised is 26m B Double. The existing driveway access with the Brand Highway shall be sealed from the edge of the Brand Highway Road surface for 50m in Lot 101, considering the length of the longest vehicle.<br><br>b) Prior to submitting an Application to undertake works within the road reserve, the applicant shall complete a plan to Main Roads satisfaction detailing the existing driveway access upgrade in accordance with Main Roads Driveway Policy.<br><br>c) Condition 1,2 & 3: No works are permitted within the Brand Highway Road Reservation, unless Main Roads has accepted the Application to undertake works within the road reserve. Application forms and supporting information about the procedure can be found on the Main Roads website > Technical & Commercial > Working on Roads.<br><br>d) According to Main Roads Driveway Policy maintenance of existing access (crossover) remains the responsibility of the lot owner. Should it become apparent that damage is being done to the Brand Highway as a result of the vehicle turning movements or a change in the usage of the access, Main Roads reserves the right to ask the applicant to maintain or improve the access as necessary. | |

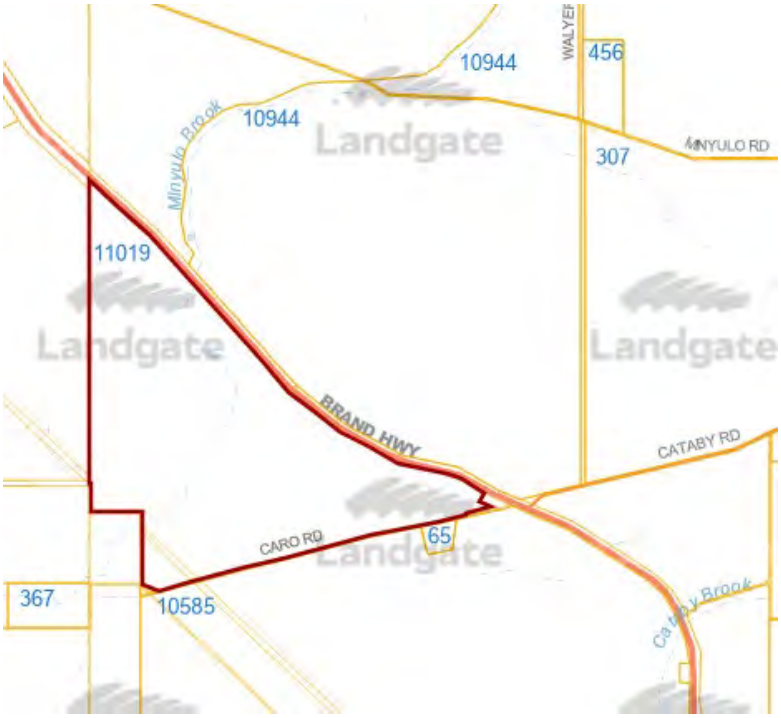
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| | Main Roads support of the proposal is valid for a period of two (2) years from the date of this letter. Any changes or date extensions relating to this development application must be referred to Main Roads for comment and recommendation.<br><br>Should the Shire of Dandaragan disagree with or resolve not to include as part of its conditional approval any of the above conditions or advice, Main Roads requests an opportunity to meet and discuss the application further, prior to a final determination being made.<br><br>Main Roads encourages the Local Government in liaising with applicants to promote and capitalise on this free advisory service offered by the road authority prior to lodgement of strategic or statutory planning proposals, especially where development plans involve land adjacent to or have the potential to impact on the State Road network. Further information on the pre-lodgement consultation process can be found on Main Roads website at mainroads.wa.gov.au > Technical & Commercial > Planning & Development. | |

## 9.3.1 PROPOSED SOLAR PHOTOVOLTAIC FACILITY – LOT 101 (NO.11019) BRAND HIGHWAY, CATABY

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| Location: | Lot 101 (No.11019) Brand Highway, Cataby |
| Applicant: | PWR Hybrid (Cataby) Pty Ltd |
| Landowner: | Iluka Resources Ltd |
| File Ref: | SODR-1262144384-18293 |
| Disclosure of Interest: | Nil |
| Date: | 3 August 2023 |
| Author: | Rory Mackay, Principal Planning & Building Officer |
| Senior Officer: | Louis Fouche, Executive Manager Development Services |

PROPOSAL

For Council to consider a development application for a 9.5MW solar photovoltaic facility upon Lot 101 (No.11019) Brand Highway, Cataby and make a recommendation to the Regional Joint Development Assessment Panel (DAP).




Location map of Lot 101 (No.11019) Brand Highway, Cataby

BACKGROUND

As the development has an estimated cost over the $10 million regional local government development decision threshold, the development application is required to be determined by the DAP. Therefore, Council can only a make a recommendation to the DAP, which is the purpose of this report.

The applicant, PWR Hybrid seeks development approval for the construction of a 9.5MW solar photovoltaic facility on a 29ha portion of Lot 101 (No.11019) Brand Highway, Cataby. The development will consist of the following components:

- 16,704 PV modules across 192 east/west tracker rows
- 2 Inverters and transformers
- Substation compound (metering building)
- Meteorological station

- Control room
- Underground cabling with a transmission system connecting into the Cataby substation for Iluka's mining site
- Gravel access road with site entry from internal property accessway (Marianna's Road)
- 2 hardstand areas for parking and laydown/maintenance works
- Fencing and access gates

The produced electricity will be used to power Iluka Resources' neighbouring mine site operations for the life of the mine. At the end of the mine site's life, the produced electricity will be transmitted to the public electricity supply market for the remainder of the development's expected 25-year lifespan. At cessation of the development, the development site will be returned to its current 'agriculture extensive' land use.

The development site borders Iluka Resources' Cataby mining operation which commenced operation in 2019 and has a mine life of up to 14 years. Prior to this, the subject property and the balance of the locality was and is currently used for broadacre farming ('agriculture extensive').

The subject property is situated within Iluka Resources' mining tenement; however, the proposed development site is not within the mining envelope approved by the Department of Mining Industry Regulation and Safety (DMIRS) or the Environmental Protection Authority (EPA). As such, the proposed development will be independent from Iluka Resources' mine site and will be operated by PWR Hybrid under the lease agreement from the landowner (Iluka Resources).

The development site has been leased for the grazing of cattle and sheep since the commencement of mining operations adjacent and is largely covered with tagasaste (tree lucerne), grasses and some eucalyptus trees.

COMMENT

Key considerations for determination of the development proposal against the applicable planning framework are outlined below.

Development site and visual amenity

The proposed development site is on cleared broadacre farming land and requires no clearing of identified significant species of flora or vegetation. The development will not be visually intrusive to views from Brand Highway due to the road reserve buffer vegetation and public power line between the development site and the highway.

Traffic and accessways

The site will be accessed from Brand Highway via "Marianna's Road" which is a non-gazetted gravel accessway which has a Brand Highway crossover. This accessway provides adjoining farmers

and enterprises alternative Brand Highway access while a portion of Caro Road is temporary closed to enable Iluka Resources' mining activities.

The Shire of Dandaragan resolved to temporarily close a portion of Caro Road for a period of 10 years or at the cessation of mining activities (whichever occurs sooner) at the request of Iluka Resources on 26 April 2018 under Section 3.50 of the *Local Government Act 1995.* This temporary closure was approved subject to the requirement that Iluka Resources provides alternative access to neighbouring land managers who utilised the portion of Caro Road temporarily closed for mining.

The sight distances at the intersection of Brand Highway and ungazetted Marianna's Road is estimated to be: 305m southbound and 390m northbound.

No significant increase in traffic movements is expected over the life of the development, except for construction traffic, which is estimated to be 10-20 vehicle movements per day for a period of around 10 months. Construction hours are expected to be 6am – 6pm. The peak traffic peak period is expected to be in the morning and evening when sub-contractors move from accommodation to site and vice versa. These vehicles will be predominantly light vehicles. To minimise traffic, carpooling will be actively encouraged, and vehicle movements will be staggered where possible during peak periods. Nonetheless, these vehicle movements are not expected to cause any congestion or potential conflicts with other traffic. The largest vehicle to access the development during construction will be a B-double road train which will be intermittently for the delivery of solar facility components and not during any peak periods. The road trains will travel from the south to the site. It is recommended that construction traffic management forms part of a construction management plan as discussed below.

A further recommended condition of development approval will ensure that the site access is appropriately constructed prior to operation of the solar facility, with all works and associated costs to be borne by the proponent.

During operation the solar facility will have no personnel on site. It will be managed and monitored remotely from PWR Hybrid's Perth headquarters. Irregular site visits may be conducted (possibly monthly) for a duration of a few hours or as and if required by PWR Hybrid technicians in a light vehicle.

<u>Construction management plan</u>
The applicant has provided the following overview of construction activities:

- New access road (compacted gravel single lane)
- Earthworks and preparation of the site including array area and laydown areas

- Erection of reinforced foundations
- Delivery of solar panels to laydown area
- Assembly of the solar array using cranes
- Installation of underground electrical services between the solar arrays and substation to Iluka Cataby mine site
- Outbuildings for construction and maintenance as and if required (temporary)

A recommended condition of development approval requires a construction management plan prior to the commencement of site works to coordinate the above build stages, traffic to and from the site, and to minimise any site and locality disturbances (noise, dust, waste).

Operational management plan

A condition requiring an operational management plan is recommended, which includes the emergency protocols amongst general operating procedures for the solar facility.

Soil erosion

The property borders the Bassendean Sand Special Control Area (BSSCA) of the Scheme:

*The Bassendean Sands is an important environmental unit in the central coast area, noted as a significant area comprising deep porous sands hydrologically connected to a number of wetlands. It is particularly vulnerable to pollution, eutrophication and salination due to its low nutrient-holding ability and the potential for winter waterlogging. It contains areas of native vegetation and wetlands that provide habitat for threatened species and communities, notably Banksia woodlands and black cockatoos.*

Although the development site is not required to comply with the BSSCA provisions of the Scheme the management of stormwater is a relevant consideration given the site also borders the Minyulo Brook. To avoid impacts on this waterway and associated wetlands and groundwater, stormwater from the development site will be managed by gravel windrows bordering the site as well as vegetation cover.

DPIRD has advised that the typical soil conditions of the development site are also at high risk of wind erosion due to their acidic nature and subsoil compaction. To manage the impacts of wind erosion, DPIRD has recommended that the development site be planted with an appropriate perennial species post construction. In response to this recommendation, a recommended condition of development approval requires the proponent to submit to the Shire for approval and thereafter implement, a post construction landscape management plan for the development site to prevent soil erosion by wind and stormwater.

Aboriginal cultural heritage

The applicant has concluded that no impacts to Aboriginal cultural heritage are expected by the development. Although, Minyulo Brook which borders the development site is a Registered Site (28326) declared under the *Aboriginal Heritage Act 1972*, the proponent has consulted with the Yued Traditional Owners, and with their support, provisioned a 100m buffer from the brook to the development site to protect the registered site, particularly from stormwater flows. A scar tree located to the south of the development site (Register item 20227 Iluka Cataby 04 under assessment) will not be impacted by the development.

Use not listed compatibility with the Rural zone

*State Planning Policy 2.5 Rural Planning* and the associated guidelines outlines rural zones are highly flexible and can cater for a wide range of land uses and notes that a local planning strategy and/or scheme should demonstrate or express what land uses are considered appropriate in a given local government's Rural zone.

In this circumstance, the Shire's *Local Planning Strategy 2020* (Strategy) provides for the diversification of the Rural zone to enable renewable energy developments and to promote sustainable energy resources in the medium to long term where it does not compromise high priority agricultural land. As the proposed solar facility will be developed on segregated Rural land not identified for prime agriculture use; will provide an additional clean energy fuel source in the Shire (which already has two like developments on Rural land); while also allowing limited extensive agriculture on the balance of the property in the medium to long term; the development is consistent with the intent of SPP2.5, the stated Strategy objectives, and is therefore deemed compatible with the Scheme's objective for the Rural zone.

The proposed use is also considered to be compatible with other land uses permissible in the Rural Zone in the land use table of the *Shire of Dandaragan Local Planning Scheme No.7*.

Decommissioning of the development

In regard to the decommission of the solar PV facility at the end of its useful life, DPIRD has advised that rehabilitation of the development site back to its current extensive agriculture land use may be less optimum than revegetating the site. This due to the historical low potential for cropping or pastures on the typical soil conditions of the development site. DPIRD has recommended that the development site be assessed to determine its post decommissioning optimum use in future years.

In response to this recommendation, a recommended condition of development approval requires the proponent to submit to the Shire for approval and thereafter implement, a decommissioning and rehabilitation management plan for the development site prior to the commencement of decommissioning the development.

Conclusion

It is in the proponent's best interest that the development is operated safely with little disturbance to the locality and in doing so, that any potential adverse impacts on the locality are significantly reduced. Nonetheless, best practice management is reinforced by recommended management plans to ensure such occurs for the life of the development.

Based on the above assessment, it is concluded that the proposed development if managed accordingly, will have no significant detrimental impacts on the amenity of the surrounding area and will be consistent with orderly and proper planning under the applicable planning framework. Therefore, the development application is recommended for approval subject to relevant conditions.

CONSULTATION

The development application was advertised from 22 June 2023 to Friday 11 August 2023 to surrounding landowners via letter and the general public through the Shire's newsletter in all local papers, the Shire's website and the Shire's Facebook page. No public submissions were received.

The development application was also referred to the following agencies for a period of 42 days in accordance with clause 66 of the Deemed Provisions:

- Department of Biodiversity, Conservation and Attractions (DBCA);
- Main Roads Western Australia (Main Roads);
- Department of Primary Industries and Regional Development (DPIRD); and
- Department of Planning, Lands and Heritage (DPLH).

The comments received from the above listed agencies, and the officer's response to each are detailed in the attached Schedule of Referral Responses. It is noted that no objections were received from these agencies.

STATUTORY ENVIRONMENT

- Local Planning Scheme No.7

Part 3 — Zones and the use of land:

*3.2 Rural Zone*

*To provide for a range of rural activities such as broadacre and diversified farming so as to retain the rural character and amenity of the locality, in such a way as to prevent land degradation and further loss of biodiversity.*

*3.4.2. If a person proposes to carry out on land any use that is not specifically mentioned in the Zoning Table and cannot reasonably be determined as falling within the type, class or genus of activity of any other use category the local government may:*

*a) determine that the use is consistent with the objectives of the particular zone and is therefore permitted;*

*b) determine that the use may be consistent with the objectives of the particular zone and thereafter follow the advertising procedures of clause 64 of the deemed provisions in considering an application for development approval; or*
*c) determine that the use is not consistent with the objectives of the particular zone and is therefore not permitted.*

POLICY IMPLICATIONS

- State Planning Policy 2.0 Environment and Natural Resources Policy
- State Planning Policy 2.5 Rural Planning & Guidelines
- WAPC Position Statement Renewable Energy Facilities
- WAPC Visual Landscape Planning in Western Australia – A manual for Evaluation, Assessment, Siting and Design
- WAPC Draft Operational Policy 1.12 Planning Proposals adjoining Regional Roads in Western Australia

FINANCIAL IMPLICATIONS

The proponent has paid a total fee of $40,457 for the development application. $10,604 has been paid to the DAP for their services, with the remaining $29, 853 to be retained by the Shire.

STRATEGIC IMPLICATIONS

- Shire of Dandaragan Local Planning Strategy 2020 (Strategy)
  *Strategic Directions – Rural*
  *Support non-rural uses that are compatible with, and complement, the primary use of the land.*

  *Strategic Directions – Economy*
  *Work with industry to investigate and identify opportunities for renewable energy projects based on the Shire's competitive advantages (i.e.: coastal winds and flat terrain).*

  *Actions – Economy*
  *Promote opportunities for renewable energy across the Shire, based on the Shire's favourable climactic and environmental attributes and investigate how agricultural projects may benefit.*

  *Strategic Directions – Utility Infrastructure*
  *Encourage alternative energy generation to support the growth of energy intensive agricultural activities where compatible with other rural uses and character.*

  *Actions – Utility Infrastructure*
  *When assessing proposals for wind farms and other alternative energy infrastructure, the Shire will consider visual landscape issues and other relevant matters set out in the Western Australian Planning Commission's Position Statement on Renewable Energy Facilities.*

  *Strategic Directions – Environment and Natural Resources*

*Maintain the quantity and quality of surface water and groundwater resources as key assets for biodiversity, economic activities and drinking water.*

*Actions – Native Title and Historic/Cultural Heritage Acknowledge and work with the Yued Noongar people as designated Native Title holders to understand their requirements in regard to land use planning.*

Strategic Community Plan – Envision 2029

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|---|---|
| 02 – Prosperity | The region will experience economic and population growth with increasing economic opportunities, diversifying primary production and a vibrant visitor economy. |
| Priority Outcomes | Our Roles |
| Our Shire has a contemporary land use planning system that responds to, and creates, economic opportunities. | Ensuring that our planning framework is modern and meets the needs of industry, small business and emerging opportunities.<br>Identify and activate underutilised economic and land assets to promote employment and economic activity. |
| 03 – Environment | The Shire will be a responsible custodian of the environment, working with community groups and other entities to increase renewable energy initiatives, vegetation cover and rehabilitate degraded public land throughout the local region. |
| Priority Outcomes | Our Roles |
| Our region is recognised as the centre of renewable energy in WA. | Support renewable energy initiatives and encourage further renewable industry development. |

ATTACHMENTS.

Circulated with the agenda are the following items relevant to this report:

- Development Proposal Report (Doc Id: SODR-1262144384-18297)
- Development Plans (Doc Id: SODR-1262144384-18298)
- DAP/23/02315 Schedule of Referral Responses (Doc Id: SODR-1262144384-19715)
- Draft DAP/23/02315 Responsible Authority Report (Doc Id: SODR-1262144384-18322) *(Available electronically only due to size)*

***(Marked 9.3.1)***

VOTING REQUIREMENT

Simple majority

**OFFICER RECOMMENDATION / COUNCIL DECISION**

**Moved Cr Gibson, seconded Cr Glasfurd**

**That Council recommends that the Regional Joint Development Assessment Panel:**

1. **Determines that the "solar photovoltaic facility" land use applied for in DAP application reference DAP/23/02515 is compatible with the objectives of the Rural zone in**

**accordance with Clause 3.4.2(a) of the *Shire of Dandaragan Local Planning Scheme No.7*; and**

**2. Approves DAP Application reference DAP/23/02515 and accompanying plans for a solar photovoltaic facility on Lot 101 Brand Highway, Cataby in accordance with Clause 68 of Schedule 2 (Deemed Provisions) of the Planning and Development (Local Planning Schemes) Regulations 2015 subject to the following conditions and advice notes:**

**Conditions**

**1. This decision constitutes development approval only and is valid for a period of four years from the date of approval. If the subject development is not substantially commenced within the specified period, the approval shall lapse and be of no further effect.**

**2. All development shall be in accordance with the approved development plans and accompanying documentation submitted by PWR Hybrid dated June 2023, which forms part of this development approval, to the specifications and satisfaction of the Shire of Dandaragan, subject to any modifications required as a consequence of any condition(s) of this approval.**

**3. Prior to commencement of the approved use, access and egress to the subject site and any associated road works shall be located and constructed to the satisfaction of the Shire of Dandaragan and include all necessary drainage and signage. Costs applicable to the construction of the access point onto the site and related issues shall be borne by the proponent.**

**4. Prior to commencement of construction, the proponent must submit and have approved by the Shire of Dandaragan, and thereafter implement to the satisfaction of the Shire of Dandaragan, a Construction Management Plan addressing the following matters:**

**a) How materials and equipment will be delivered and removed from the site;**
**b) How materials and equipment will be stored on the site;**
**c) Traffic management arrangements for contractors;**
**d) Construction waste disposal strategy and location of waste disposal bins;**
**e) How risks of wind and/or water borne erosion and sedimentation will be minimised during and after the works; and**
**f) Other relevant matters likely to impact on the surrounding properties.**

**5. Prior to commencement of the approved use, the proponent must submit and have approved by the Shire of Dandaragan, and thereafter implement to the satisfaction of the Shire of Dandaragan, an Operational Management Plan addressing the operating strategy and emergency management on the site.**

6. **Prior to commencement of the approved use, the proponent must submit and have approved by the Shire of Dandaragan, and thereafter implement to the satisfaction of the Shire of Dandaragan, a post construction Landscape Management Plan addressing the potential impacts of wind and stormwater soil erosion.**
7. **Prior to commencement of decommissioning the approved use, the proponent must submit and have approved by the Shire of Dandaragan, and thereafter implement to the satisfaction of the Shire of Dandaragan, a Decommissioning and Rehabilitation Management Plan addressing the rehabilitation of the development site post decommission of the approved use.**

**Advice Notes**

1. **Should the Applicant be aggrieved by the decision (in part or whole) there is a right pursuant to the *Planning and Development Act 2005* to have the decision reviewed by the State Administrative Tribunal. Such an application must be lodged within twenty-eight (28) days from the date of the decision.**
2. **This approval is not an authority to ignore any constraint to development on the land which may exist through contract or on title, such as an easement, memorial or restrictive covenant. It is the responsibility of the applicant and landowner and not the Shire of Dandaragan to investigate any such constraints before commencing development. This approval will not necessarily have regard to any such constraint to development, regardless of whether or not it has been drawn to the Shire of Dandaragan's attention.**
3. **This is a development approval of the Shire of Dandaragan under its *Local Planning Scheme No.7.* It is not a building permit or an approval to commence or carry out development under any other law. It is the responsibility of the applicant/landowner to obtain any other necessary approvals, consents, permits and licenses required under any other law, and to commence and carry out development in accordance with all relevant laws.**
4. **Failure to comply with any of the conditions of this development approval constitutes an offence under the provisions of the *Planning and Development Act 2005* and the *Shire of Dandaragan Local Planning Scheme No.7* and may result in legal action being initiated by the Shire of Dandaragan.**

**CARRIED 7 / 0**