Technical Advice

TO	Richard Seymour (Infinergy Pacific Ltd)
COPIED	Rob Cawley (ELA)
FROM	Richard Cresswell & Rizwana Rumman
DATE	6 June, 2018
SUBJECT	**Opinion on potential flood risk from development of the proposed Meningoort Solar Farm near Bookaar, Victoria**

This advice

Infinergy Pacific Ltd has proposed to build and operate a Solar Farm (the Project) near Bookaar, approximately 250 km west of Melbourne, Victoria. Eco Logical Australia (ELA) has been engaged by Infinergy Australia Pty Ltd to undertake a desktop assessment to investigate potential drainage and flood risk at the Project Site for the proposed development.

ELA is well placed to undertake this work with extensive experience in hydrological assessments pertaining to renewable energy projects, including solar farm installations. Specific recent experience includes high-level flood modelling for a proposed array near Inverell and flood modelling as part of Infinergy's Environmental Impact Statement (EIS) for the proposed utility-scale photovoltaic solar farm near Armidale, NSW.

The objective of this assessment is to provide a high-level assessment of the flooding and drainage risks relevant to the Project Site and surrounding sites in relation to the proposed development activities and to provide recommendations should any mitigation activities be required. To achieve this, a desktop drainage and flood-risk assessment was carried out which focusses on: a) identifying the existing drainage conditions and associated flooding risks, and b) providing initial advice on the assessment and management of these risks.

Specific questions investigated in this assessment are:

1. How will the proposed development affect local land catchment hydrology?
2. What level of flood risk does the proposed development pose to downstream landholders?
3. Are any stages of development of greater risk than others?
4. Are there any mitigation actions that should be considered?

This advice reflects our opinion on the above questions and has drawn on documents cited throughout this review.

Dr Richard Cresswell
Principal Hydrogeologist

Regulatory environment

This section provides an overview of the key legislation and policy documents which form the regulatory framework for surface water resources and flooding/drainage assessments in Victoria. More detailed assessments will need to specifically address criteria and guidelines set out in these documents. This assessment provides a high-level review of site conditions and the following is provided for context only.

Water Act 1989

The Water Act 1989 is a key piece of legislation that establishes the framework for the management of water resources in Victoria, principally dealing with sustainable, efficient and equitable water resources management. In the context of flooding and drainage, *Section 12* of the Water Act states that any activity, or any change in the use of land that may affect the existing drainage regime, must make the authorisation or permission subject to any conditions that are required to ensure the conservation of waterways, wetlands and aquifers.

Environment Protection Act 1970

The Environment Protection Act empowers the Environment Protection Authority Victoria (EPA Victoria) to implement regulations, maintain State Environment Protection Policies (SEPPs) and protect the environment from pollution and the management of wastes. The Act regulates the discharge or emission of waste to water, land or air by a system of Works Approvals and licences. It has the objectives of preventing and managing pollution and environmental damage, and the setting of environmental quality goals and programs.

Draft Victorian Rural Drainage Strategy 2017

The draft Victorian Rural Drainage Strategy proposes a series of legislative policies and actions designed to enable landholders to choose how to manage their drainage and their drainage systems into the future. This Project falls under the category listed in *Section 4.3* of the draft Victorian Rural Drainage Strategy: “Drainage managed collectively through amicable agreements”; as drainage from the Project Site is likely to involve more than one property boundary but with only a small number of landholders involved and a relatively simple system. That is, the guideline suggests that any potential disputes over water courses at this scale should be managed collectively through amicable agreements, or through written agreements under advice from relevant statutory authorities and supported by the Dispute Settlement Centre of Victoria.

Drainage and waterways

The Project falls within the western portion of the Corangamite Shire and within the Glenelg Hopkins CMA region. The closest main watercourses are Mount Emu Creek and Blind Creek that run approximately 5 km west and 2.5 km south of the Site, respectively (**Figure 1**). Lake Bookaar is located approximately 2.5 km east of the Project Site and is listed as a Ramsar site under a “permanent saline” wetland in Western District Lakes (Western District Lakes Ramsar Sites, 2002).

There are existing articulated drainage lines located across the Project Site (**Figure 1**). These paddock drainage lines direct overland flow to the south and west into Blind Creek.

Aerial imagery shows some localised depressions/ farm dams located downstream outside the southern boundary of the Project Site (**Figure 1**).

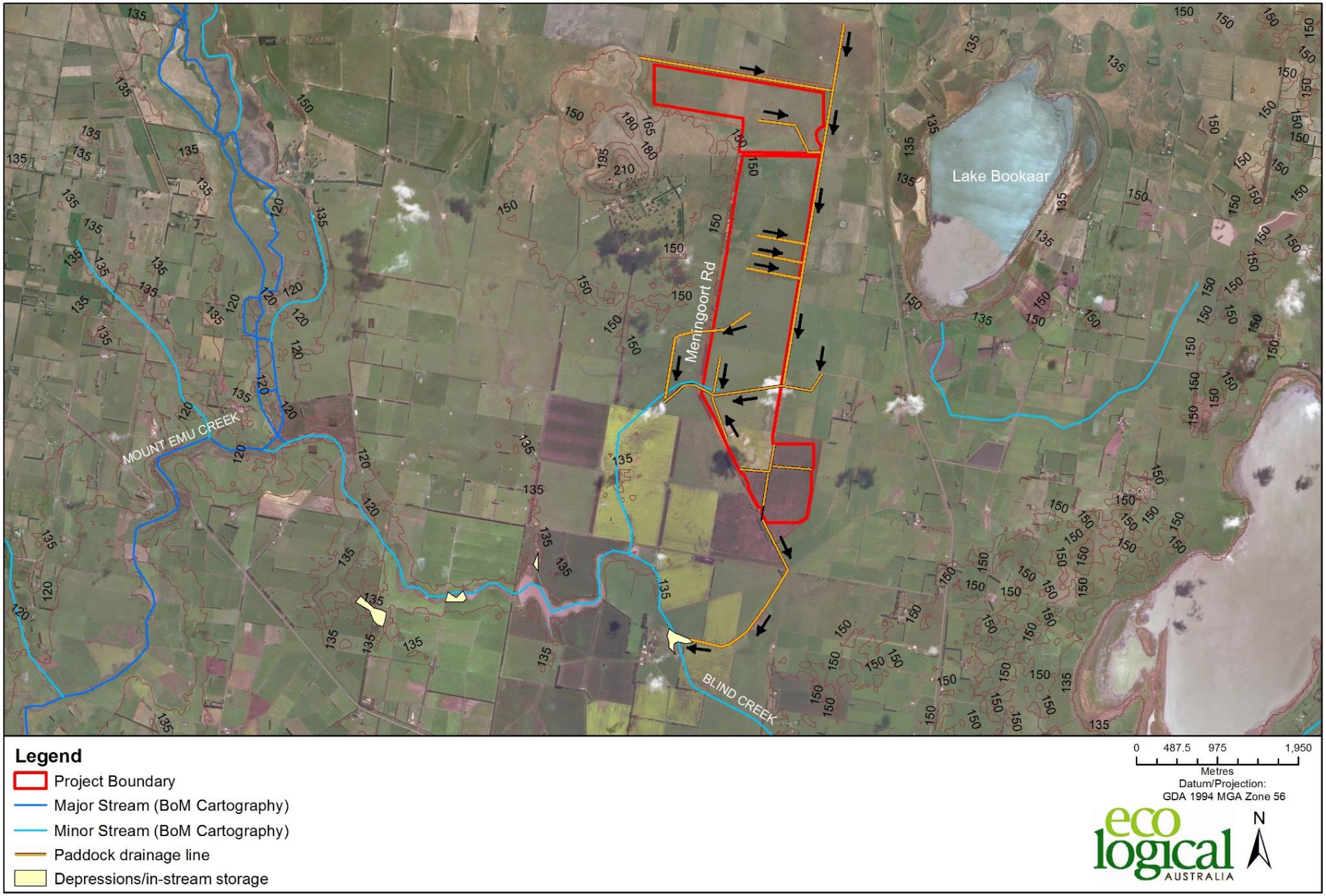

Figure 1: Site location, topography and significant water features

Flooding and drainage characterisation

Topography

The topography of the Project Site and surrounding areas is gently undulating, with a locally prominent hill (Mt Meningoort) just west of the Site. The local landscape gently drops to the west of Mt Meningoort towards Mount Emu Creek; to the south towards Blind Creek and east towards Lake Bookaar (**Figure 1**).

Climate

Rainfall data were obtained from the Bureau of Meteorology (BoM) online climate database for Kolora (Wooriwyrite) weather station (BoM site 90085), located approximately 10.2 km north-west of the Project Site. The average annual rainfall is 639.2 mm occurring with a seasonal distribution showing greater rainfall in the winter months (**Figure 2**). Greatest risk for flooding is therefore expected to be during the winter months.

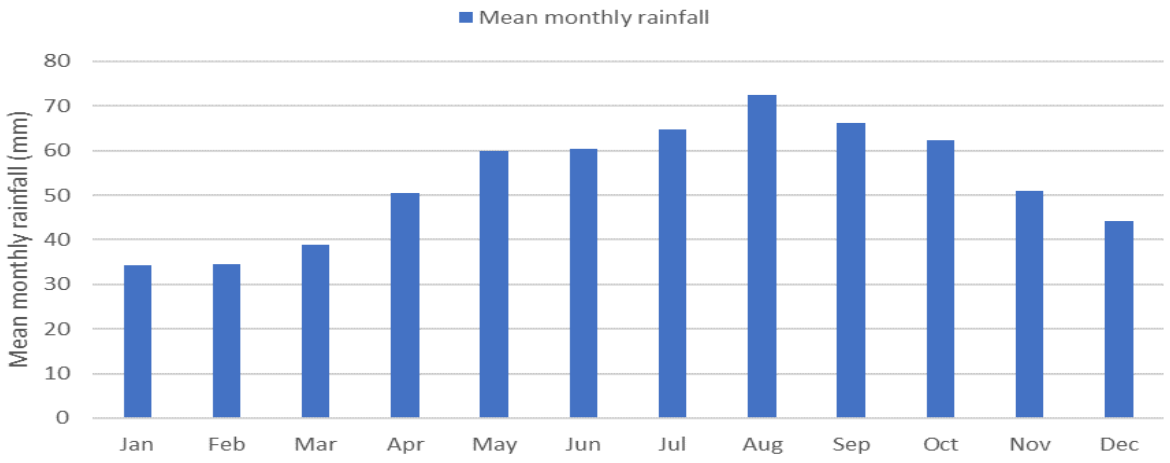

Figure 2: Mean monthly rainfall at the Kolora (Wooriwyrite) weather station (BoM site 90085)

Overland flow paths within the Project Site

Consideration of the local topography revels that the Project Site encompasses three natural overland flow directions (**Figure 3**). The main overland flow constitutes a general easterly flow from Mt Meningoort and Meningoort Road towards the eastern boundary of the Project. This flow channels the overland flow generated from the higher elevations located west of the Site. To the east of the Project area, flow tracks from outside the east boundary near the Darlington-Camperdown Road and traverses south towards the south-east boundary of the site collecting flow from the Project area. Surface water exiting the Project site converges to the south and joins a third flow path originated from the south-western corner of the Project boundary. This flow drains further south following the course of Blind Creek.

Artificial drainage lines exist along paddock boundaries in the region and several cross the Project (**Figure 1** and **Figure 3**). These can 'short-circuit' the natural drainage and local flow may trace against the natural flow direction. Thus, flow is directed away from the Project area and towards the tributaries of Blind Creek to the south and south-west.

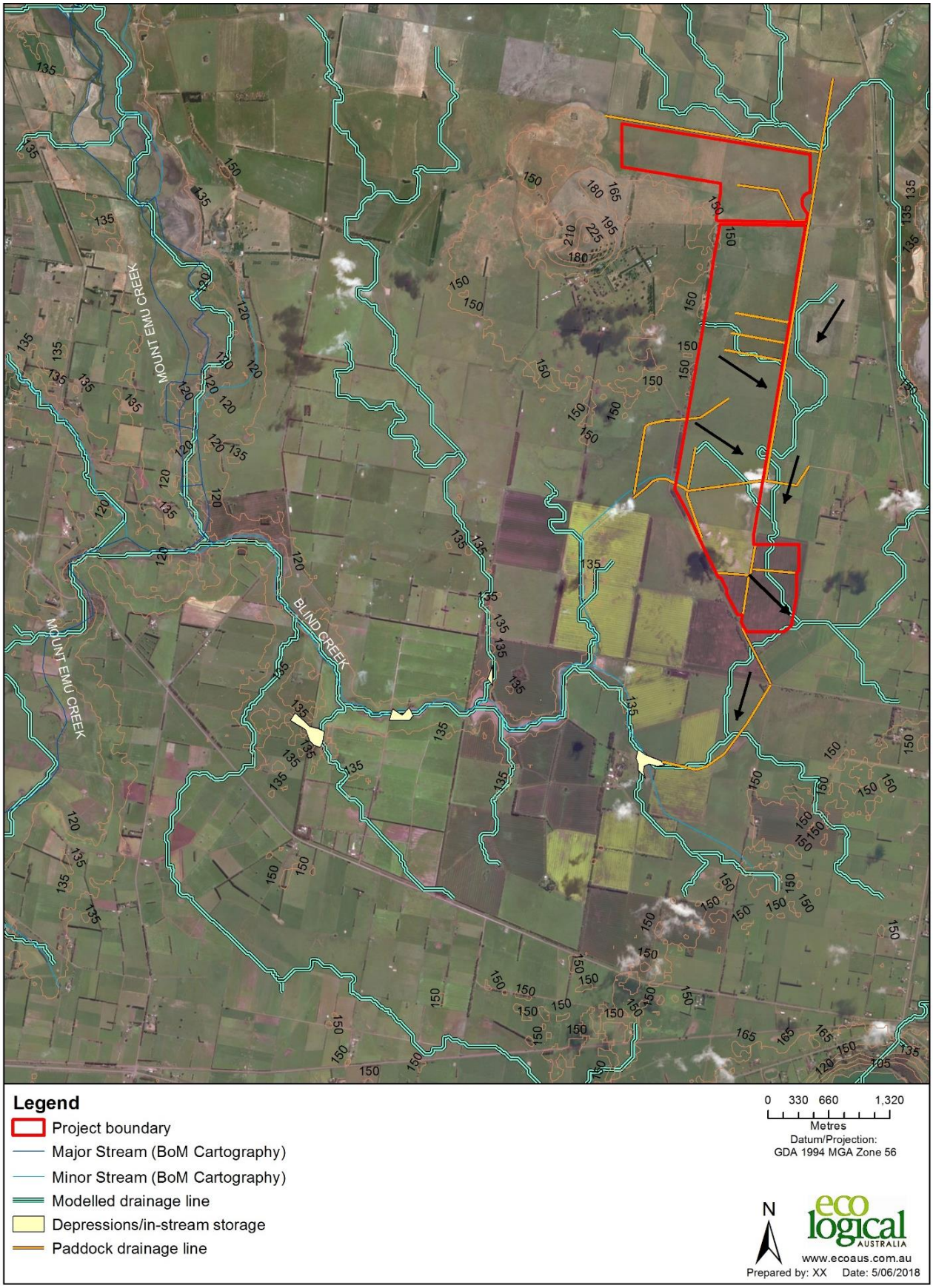

Figure 3: Modelled overland flow based on local topography

Potential flooding hydrology around the Project Site

The Department of Environment, Land, Water & Planning (DELWP) has mapped modelled flood extents, historic flood extents and probable maximum floods (PMF) in Victoria (data available at: https://www.data.vic.gov.au/data/dataset/1-in-100-year-flood-extent). **Figure 4** shows 1:100,000 mapping of 1% AEP – Annual Exceedance Probability, i.e., 100 ARI (Annual Recurrence Interval) flood extent, statistically derived using hydrological models, historic flood extents and heights (DWELP, 2018).

The Project is located in a region that is characterised by low rolling hills and undulating plains with no areas of significant floodplain identified within the Project area, nor immediately downstream (**Figure 3** and **Figure 4**). The flood extent map shows that the Site falls outside the flood extents of any 100 ARI event. The Project Site also falls outside the historic flood extent mapped for this area (**Figure 4**) and the extent of PMF (not visible in the map).

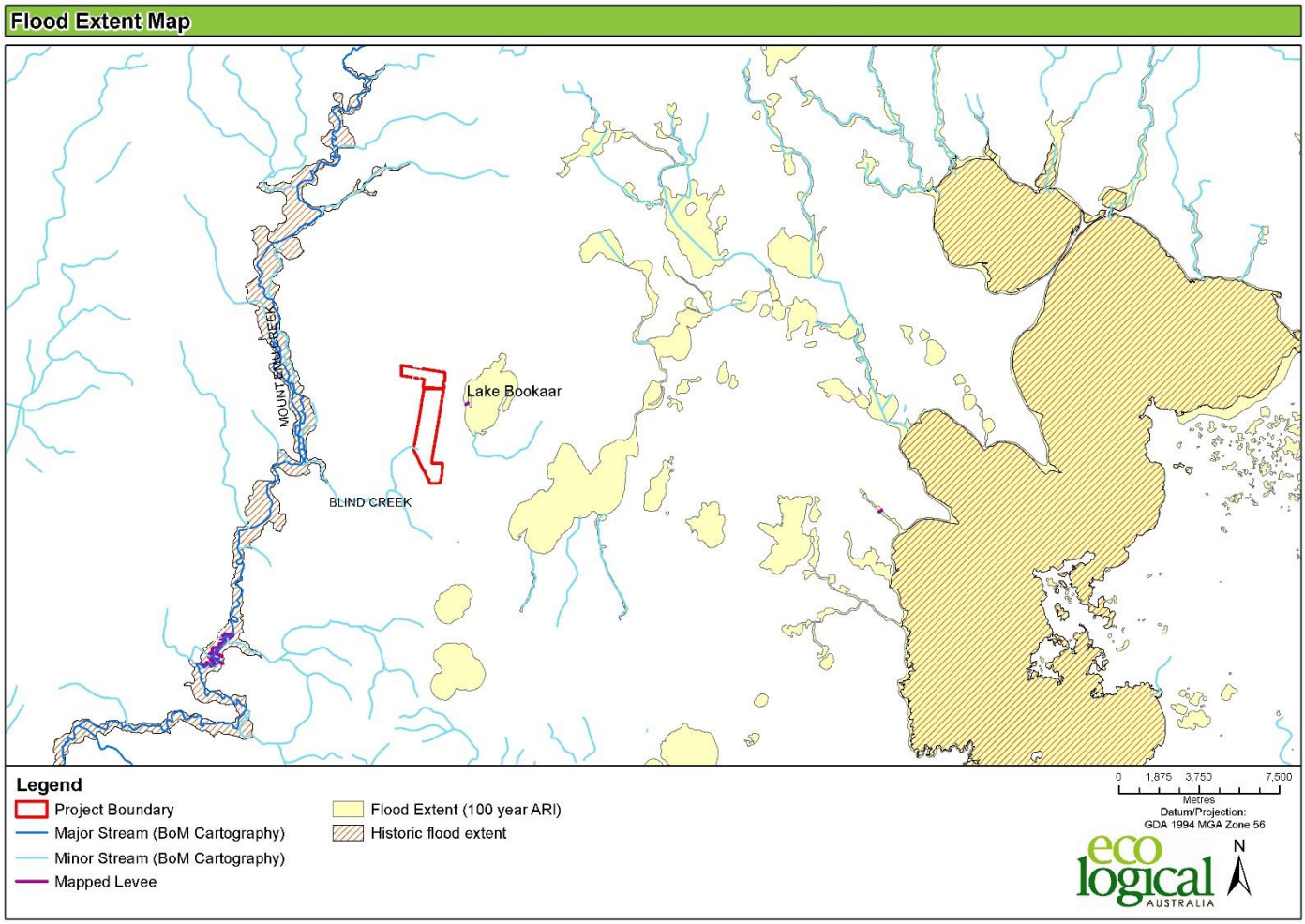

Figure 4: 100 Annual Recurrence Interval (ARI) flood extent and historic flood extent in the Lake Bookaar region

Drainage and Flood-risk assessment

An assessment of drainage associated with the Project Site conditions and proposed development activities has been undertaken for the Project Site and surrounding area and a high-level flood risk assessment carried out detailing the most recent available database for the Project area.

The array of proposed PV solar panels will be located above the ground surface and the driven piles will be water resistant with minimal impediment to the movement of any overland flow. Potential impervious areas include the substation, support buildings and inverter sites (**Figure 5**), with the latter located along access tracks that may also present as impervious areas. No impervious bunded areas are proposed to be constructed within the Site. The total potentially impervious area will constitute less than eight percent of the total Project site. This eight percent includes tracks and access areas, which constitute most of this area (up to seven percent of the total area).

Our assessment therefore is that no significant change is envisaged in the hydrological regime due to the proposed development activities within the Project Site.

Run-off from the Project Site is unlikely to pose a risk to the downstream landholders with appropriate stormwater management as discharge from the drainage will traverse downstream to the south and drain eventually to Blind Creek (**Figure 3**). No significant increase in drainage/runoff from the articulated paddock drainage lines located south-west corner and southern section of the Site is envisaged as no alterations to the existing drainage regime is expected.

Should additional drain requirements be proposed during detailed design of the site these should be conditioned through planning controls to ensure the continuation of the status quo.

Activities close to identified surface water flow paths, particularly the proposed temporary laydown area, on-site HV sub-station platform and area for batteries located at the western boundary (mid-section) of the Project Site will require appropriate drainage and civil construction (**Figure 5**). Surface water runoff may potentially cause localised ponding in isolated areas during rainfall events, especially in the middle and the south-west sections of the Site. Appropriate stormwater management will be required to reduce risk of overland flow and ensure flow is contained within the identified flow-paths.

Appropriate stormwater/drainage management should be undertaken during the construction period to ensure:

a) There are no alterations to the existing drainage regime and

b) Sediment laden runoff from construction activities, spillage from commonly used on-site chemicals, fuels, lubricants and herbicides etc. are contained during the construction activities and are appropriately discharged.

The on-site hydrological impacts due the proposed activities are therefore considered to be minor and will depend upon detailed project design and activities. Following construction, the Project Site will have slightly increased impervious area compared to its current rural settings. Drainage design criteria should therefore account for these potential impacts, channelling flow around the impervious areas.

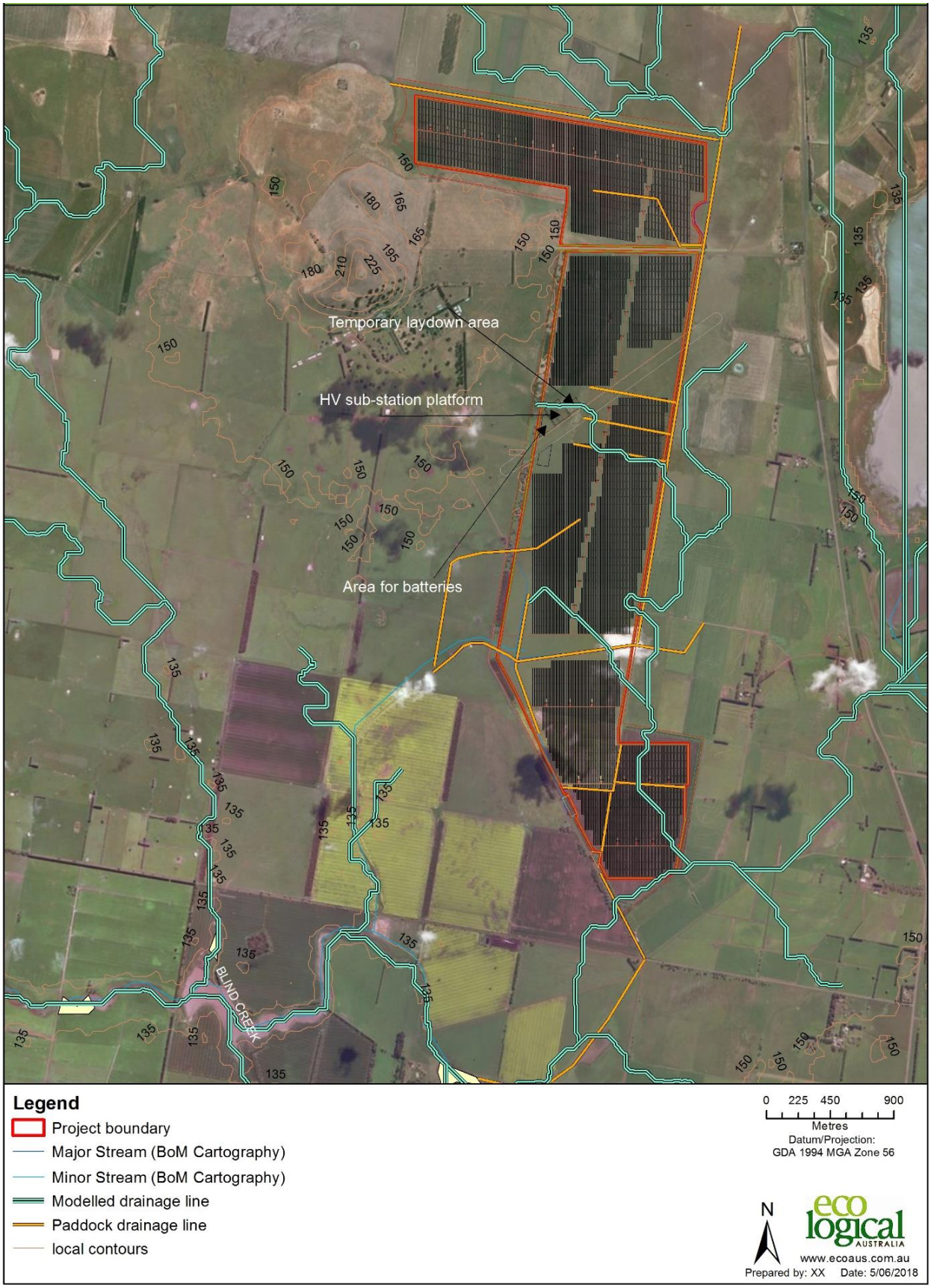

Figure 5: Proposed development infrastructure and site drainage lines

Conclusions and recommendations

A desktop drainage and flood-risk assessment for the proposed development of the Meningoort Solar Farm has been carried out and has determined that:

- The proposed development will pose minimal impact to existing catchment hydrology.
- There will be no significant impact to the neighbouring landholders located downstream to the Project Site as no alteration of existing hydrology is envisaged and the identified drainage flow paths will traverse downstream to the south and drain to Blind Creek.
- The construction phase of the proposed development poses greater risk associated to flooding and drainage. The proposed works involve a range of activities that could disturb soils and potentially lead to sediment laden runoff, affecting local water ways, during rainfall events. On-site use of fuels and other chemicals also pose a risk of surface water contamination in the event of a spill. With appropriate on-site stormwater management, it is expected that drainage conditions will quickly return to normal post construction allowing surface penetration and/or run-off to occur in a typical manner.
- Activities close to the identified surface water flow paths will require appropriate drainage consideration and civil construction.

Recommendations

The following recommendations are made in relation to hydrology, existing drainage condition and flooding, to better inform the Project:

- The proposed development designs should be assessed against the location of the identified surface water flow lines across the Project area.
- As part of the detailed design phase, drainage plans should incorporate a detailed survey of the land and the location of proposed impervious areas at the Site. Any modifications to drains within the Development Footprint should not result in any significant changes to drainage flows outside the Project area.
- Civil design criteria should include provision for the potential future impacts from climate change.

References

DWELP 2018. 1 in 100-year Flood Extent Maps, Department of Environment, Land, Water & Planning, The State of Victoria, 2018.

Draft Victorian Rural Drainage Strategy, 2017. Department of Environment, Land, Water and Planning, The State of Victoria, 2017.

Western District Lakes Ramsar Site. 2002. Western District Lakes Ramsar Site - Strategic Management Plan, Department of Natural Resources and Environment, The State of Victoria, 2002.