Appendix H

Surface Water Assessment

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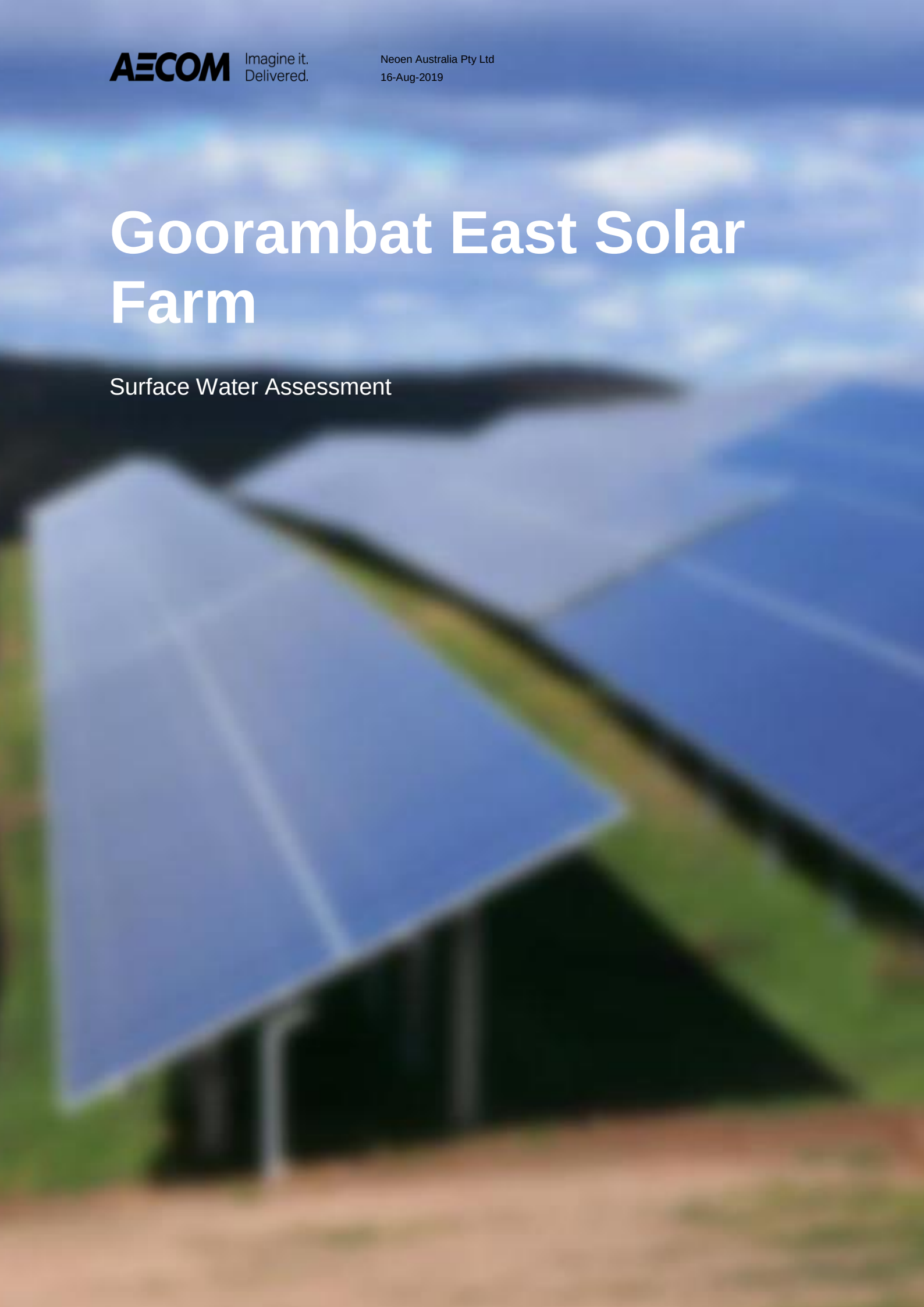
Neoen Australia Pty Ltd
16-Aug-2019

Goorambat East Solar Farm

Surface Water Assessment



Goorambat East Solar Farm

Surface Water Assessment

Client: Neoen Australia Pty Ltd

ABN: 31 117 519 570

Prepared by

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16-Aug-2019

Job No.: 60591336

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Quality Information

Document Goorambat East Solar Farm

Ref 60591336

Date 16-Aug-2019

Prepared by Peter Meyers

Reviewed by Rocco Vivarelli

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	09-Aug-2019	Final draft	David Knight	Principal Environmental Planner
A	16-Aug-2019	Final for Submission	David Knight	Principal Environmental Planner

Table of Contents

1.0 Introduction

1.1 Site Context

This desktop surface water assessment has been prepared by AECOM Australia Pty Ltd (AECOM) on behalf of Neoen Australia Pty Ltd (the applicant) (Neoen) in relation to a planning permit application for the development and use of a Renewable Energy Facility (solar) within the district of Goorambat.

The solar farm site is located approximately 215 kilometres to the northeast of the Melbourne Central Business District within the Rural City of Benalla and the project is referred to as the Goorambat East Solar Farm (the Project). The location of the site is shown in **Appendix A**.

The purpose of the Renewable Energy Facility (solar) is to supply electricity generated from solar radiation into the National Energy Market. The Project is expected to have a network capacity of up to 250 Megawatts (MW) provided by solar photovoltaic (PV) panels/modules.

1.2 Scope of Work

The following tasks have been undertaken in preparing this surface water assessment:

- Identify all waterways, watercourses and waterbodies within and adjacent to the study area using publicly available mapping and databases.
- Identify the environmental values related to the surface water environment.
- Assess the baseline water quality, hydrological and geomorphic characteristics of the surface water environment.
- Determine potential changes to stormwater discharging from the site resulting from development of the solar farm.
- Provide a high-level review of flooding for the site.
- Assess qualitative potential impacts from the project (through discharge of stormwater) on the surface water environment (soil erosion/loss, water quality, stream flows, stream geomorphic stability).
- Identify strategies to minimise and manage any adverse impacts resulting from the discharge of stormwater from the site to the surface water receiving environment.
- Application for development conditions with the Goulburn Broken Catchment Management Authority.

The assessment is based on desktop investigations and no site inspection has been undertaken.

2.0 Existing Waterways and Surface Water Features

2.1 Site Features

The site is currently used for cropping and has generally flat terrain with shallow water courses. The site has pre-European wetlands and numerous farm dams which capture local surface runoff. There are also several farm tracks.

Data provided on the Goulburn Broken Catchment Management Authority (GBCMA) website indicates that there are two designated waterways that bisect the site (see **Appendix A**).

Preliminary advice from GBCMA on designated waterways is included in **Appendix B**. It is anticipated that this preliminary advice from GBCMA will be formalised shortly.

Flood maps available on the GBCMA website indicating the extent of the one per cent (1%) Annual Exceedance Probability (AEP) storm event are provided in **Appendix A**.

2.2 Catchment Overview

The site is located to the north of the Broken River, one of the main tributaries to the Goulburn River. This section of the Broken River flows westward across riverine plains and joins the Goulburn River south of Shepparton. When flowing at its maximum capacity, the Broken River is the fastest river in Australia, however over summer-periods the flow falters, revealing to deep pools joined by thin runs, and in droughts it reduces further to isolated water holes. While it is natural for the river to experience significantly reduced flows during summer months, ongoing and severely-reduced flows seriously compromise the health of the Broken River.

Most of the Broken River Basin has been cleared for agriculture which supports grazing in the south, and mixed cereal and livestock farming in the central region. A large part of the northern section of the Basin is within the Goulburn-Murray Irrigation District, with irrigation for fruit growing, dairying and livestock production.

Reliability of rainfall varies notably over the catchment. Streamflow within the Broken River Basin is extremely variable over the seasons of the year, and between years. The three months July to September account for over half of average annual flow.

The Broken Creek has been identified as a priority waterway and is listed on the Directory of Important Wetlands in Australia. The proximity of Broken Creek to the site is indicated in **Appendix A.**

2.3 Flood Characteristics

While there is significant flooding in the local area from the Broken River, flood information available on the GBCMA website indicates that the site is subject to minimal flooding during the one per cent AEP storm event Waterway condition. The extent of flooding is indicated in **Appendix A**.

2.4 Water Quality

Water quality within the catchment varies considerably with good quality runoff from alpine regions. The clearing of native vegetation and the introduction of agriculture has resulted in increased nutrients in most waterways. Other factors contributing to poor water quality include turbidity, suspended sediments, biocides, acidity and temperature.

2.5 Waterway Condition

The changes in land use within the catchment have most likely increased volumetric runoff which can result in increased scour and erosion of waterways.

The GBCMA has indicated in preliminary advice to Neoen that there are two designated waterways on the site (see **Appendix B**). These designated waterways are ephemeral and aerial photography indicates there is no instream vegetation.

There are also several constructed farm drains or irrigation channels on the site, however these are not recognised by the CMA and do not require a permit to construct over.

There is also a pre-European wetland that covers a portion of the northern part of the site (see **Appendix A**). However aerial photography indicates the site is now fully used for agricultural purposes with no indication of remnant vegetation or water storage. Preliminary advice from GBCMA to Neoen notes that no designated wetland is present on the site (see **Appendix B**).

3.0 Feedback from the Goulburn Broken Catchment Management Authority

The GBCMA has been contacted by AECOM in preparing this report to provide flood advice relating to the site and provide criteria for future development. The primary development criteria are listed in the table below.

3.1 Development Setbacks

Information relating to required development setbacks from waterways has been obtained from the GBCMA's website and is provided below.

As outlined in the Figure 1 (below), buildings should be setback a minimum distance of 30 metres to allow for a 30-metre buffer from a designated waterway. This setback of 30 metres has been adopted for the inverters (an electrical converter that converts the output of the solar arrays into a current that can be fed into the electricity grid). A setback of 15 metres from the two designated waterways on the site has been adopted for the solar panels.

As described in Section 2.5, the GBCMA have provided preliminary advice to Neoen that no designated wetland is present on the site (see **Appendix B**). No setbacks from this pre-European wetland shown in **Appendix A** are therefore required.

The GBCMA will be a referral authority for the purposes of the planning permit application for the proposed solar farm, in accordance with the provisions of the Benalla Planning Scheme.

TABLE 12: Minimum Setbacks from Waterways and Storages

These are minimum setbacks in relation to the protection of water quality and aesthetic values only. There may be other reasons that exclude buildings near waterways, *ie* severe flooding.

(Taken as distance from the top of the bank, or high water mark if there is no bank, unless noted otherwise)

TYPE OF WATERWAY	SEPTIC TANKS[a]	BUILDINGS[b]	BUFFERS ALONG WATERWAYS[d]
Heritage River[1] **Example: Goulburn River**	100 metres	50 metres minimum	30 metres
Storage, natural lake or wetland. **Example: Lake Eildon, Lake Nagambie, Kinnaird's Wetland**	100 metres	*The greater of:* • 50m from Full Supply Level *or* • 300mm above the 100-year ARI flood level	30 metres
Domestic water supply[g] channel **Example: Aqueducts**	200 metres	50 metres minimum	30 metres
Domestic water supply[g] storage **Example: Violet Town**	300 metres	100 metres	30 metres
Waterway[e] in a special water supply[2] catchment area **Example: Delatite River**	100 metres	30 metres	30 metres
Any waterway[e] outside a special supply catchment and not a heritage river **Example: Broken Creek**	60 metres	30 metres	30 metres
G-MW Drain/ Community Surface Drain **Example: Deakin Main Drain, Ardmona Drain II**	100 metres	30 metres[f]	N/A
G-MW Irrigation Supply Channel **Example: Central Goulburn Channel No. 7**	60 metres	30 metres[f]	N/A

[a] Minimum requirement under Code of Practice Onsite Wastewater Management Publication No. 891.3 February 2013 and State Environment Protection Authority (Waters of Victoria)
[b] Includes dwellings, shed, tourist accommodation, and auxiliary structures, eg carports and decking.
[d] Minimum width of undisturbed vegetation along all waterways (Clause 4.02-1 of the SPPF- Victoria Planning Provisions)
[e] Section 3 of the *Water Act, 1989*
[f] G-MW recommendation
[g] Water used for human consumption
[1] *Heritage Rivers Act, 1992*
[2] *Catchment and Land Protection Act, 1994*

Figure 1 GBCMA Minimum Setbacks from Waterways and Storages

4.0 Surface Water Quality

4.1 Impacts of Existing Land Use

The properties identified for the proposed solar farm are currently used for agricultural activities and are predominantly cleared of native terrestrial and riparian vegetation and replaced with pastures. The removal of the original vegetation has likely resulted in increased runoff volumes and flow rates which can contribute to localised erosion and increased incision of some of the waterways.

These risks are exacerbated where stock and/or machinery reduce the effectiveness of vegetative cover or interact with surface water features (e.g. reduction in riparian vegetation, increased soil erosion in dry channels).

4.2 Impacts of Proposed Land Use

The proposed solar farm presents an opportunity to reduce the risks of surface water contamination from agricultural practices over the longer term. However, during construction and establishment, there is an increased risk of poorer quality water discharging from the site without proper sediment and erosion controls. The following section outlines the key surface water quality risks associated with the development of the solar farm on the site. A range of surface water quality risk management measures are outlined in section 5.4 of this report.

4.2.1 Ground Disturbance

The proposed construction activities are likely to remove some areas of existing grasses which creates the potential for increased erosion and sediment to be transported to nearby waterways. Clay material suspended in runoff is difficult to remove due to the small particle size and if not removed may cause pollution and sedimentation in the receiving waters.

These risks can be managed through a Construction Environmental Management Plan (CEMP) which incorporates best practice erosion and sediment control measures and pollution prevention strategies in accordance with EPA publication 480 "*Environmental Guidelines for Major Construction Sites*".

Typical mitigation strategies often include sediment control fences, timely reinstatement of excavations, best practice storage of materials and spoil, wet weather working restrictions, seasonal ground re-establishment, soil amelioration and efficient dust suppression. Sedimentation basins can also be considered if the above controls are not effective. Many of these measures should remain in place until vegetation across the site is fully re-established and the sources of potential contamination removed.

4.2.2 Runoff from Solar Arrays and associated Infrastructure

If local climate and soil conditions prevent the establishment of effective groundcover vegetation across the site, drips and runoff from the solar panels may increase the risk of localised soil erosion. These risks can be managed with small scale erosion control measures, such as aggregate filled drip lines constructed beneath the lowest part of the panels.

Similarly, runoff from any proposed buildings can also be managed through rainwater harvesting and infiltration, where ground conditions are deemed suitable.

4.2.3 Pollution Incidents

Construction activities carry an increased risk of pollution incidents. The causes of contamination include poor management of materials, exposed spoil storage, fuel spillages and litter. Good environmental practice for major construction projects should be addressed in the site's Surface Water Management Plan as part of the Environmental Management Framework.

4.2.4 Potential Cumulative Impacts

It is understood that a permit has been issued for a solar farm on a neighbouring property. It is not expected that there will be any significant accumulated impacts to water quality related to the neighbouring solar farm as runoff from both sites will predominantly continue to be intercepted by existing impervious surfaces and infiltrate into the ground. There is potential for some accumulated impacts associated with ground disturbance and potential spills, however these should be mitigated by implementing the suggested design and operational controls.

4.3 Recommendations for managing surface water quality

It is anticipated that the proposed solar farm will result in a reduced risk of surface water contamination once the site has been re-established after the construction phase. However, the construction activities, including early works and ground reinstatement, may present a significant risk of surface water contamination. The following recommendations aim to reduce these risks:

- Ensure construction activities are effectively managed by best practice pollution prevention strategies in accordance with EPA publications *480 Environmental Guidelines for Major Construction Sites and 275, Construction Techniques for Sediment Pollution Control.*
- Minimise the extent of disturbed areas and re-establish as soon as possible.
- Obtain the necessary works on waterways permit from the Goulburn Broken Catchment Management Authority.
- Minimise works in waterways and only work in waterways when dry and reinstate ground quickly following completion.
- Employ sediment control fences downstream of work areas.
- Construct sediment ponds to collect silty runoff and allow sediment to settle out prior to discharging. (consider the use of flocculants where appropriate).
- Construct bunds to collect and divert sediment laden runoff for treatment in the sedimentation ponds.
- Remediate soils quickly with topsoil (where compacted or leached), seed and over-seed during the correct season.
- Maintain all pollution control measures until the site is fully re-vegetated.
- Construct aggregate filled drip lines beneath solar panels where vegetation cover is deemed inadequate or where the panels are found to cause local soil erosion.
- Monitor and manage grazing activities to ensure soils are not exposed through over grazing or through the creation of trackways.
- Internal roads/tracks on the site should be designed to not significantly redirecting surface flow.
- Road drainage infrastructure such as grassed table drains should be designed to minimise flow velocities and prevent scour.

5.0 Flooding

5.1 Designated flood overlays

The site is not significantly affected by Land Subject to Inundation Overlays (LSIO), however there is a small section of the site along the western boundary that is impacted (indicated by a Rural Flood Overlay under the Benalla Planning Scheme). The extent of flooding during the one per cent AEP is indicated in **Appendix A**. There are two designated waterways on the site as shown in **Appendix A**.

A works on waterway permit will be obtained from the GBCMA prior to undertaking any construction activity on designated waterways.

5.2 Proposed land use

The proposed solar arrays will not significantly change the fraction of imperviousness for the total area of the site as runoff from the panels will flow overland where infiltration can occur. However, the construction activities and some of the proposed infrastructure may change the local drainage characteristics. The following section highlights some of these aspects for further consideration. Examples of mitigation measures for these are summarised in the conclusion of this report.

5.2.1 Internal Access Roads

Access roads risk impeding surface flows across the site which could cause local ponding or increase the duration of waterlogging for some parts of the site.

5.2.2 Substation Area

Like the site roads, areas required for sub stations may inhibit local flows and create areas of ponding and/or waterlogging. The choice of materials and surface grading for the substation platform may also concentrate or redirect local flows.

5.2.3 New Impervious Areas

New impervious areas of the site could generate increased runoff volumes and flow rates or reduce infiltration however the impact is expected to be minimal.

5.2.4 Solar Arrays

The solar arrays may increase the risk of flooding or change local flow characteristics if they are sited too close to the designated waterway, flood zones or overland flow paths. However, adhering to the CMA conditions of setbacks and elevation will benefit the project and provide greater flood immunity to sensitive infrastructure.

5.2.5 Potential Cumulative Impacts

The proposed solar farm on a neighbouring property is unlikely to result in any cumulative impacts relating to flooding as the development of either site will result in additional runoff as there is no net change to the existing pervious areas.

5.3 Understanding flood risks

Flood maps made available by the GBCMA identified several water features across the sites and indicate that they are not subject to flooding during the 1 in 100-year ARI event. The flood maps are available on the DELWP *VicPlan* website and provide an indication of flood level; however more specific flood information can be obtained from the GBCMA if required.

5.4 Recommendations for Managing Flood Risk

While there is not a significant risk of major flooding on the site, the layout and design of the solar farm should aim to limit changes to catchment surface flows or result in increased flood levels. Minor flooding from local catchment runoff will need to be considered in the design, particularly in relation to placement of the arrays and the design of access tracks.

The design considerations for the site should include the following:

- Set the solar panels (lowest edge at full tilt) and other critical infrastructure above the 1% AEP flood level with allowance for freeboard (600mm). GBCMA are likely to include this allowance even though the flood level is off the property.
- Design access roads on grade to allow minimise obstruction to surface flows and retain existing flow paths.
- Design culverts for waterway crossings to limit afflux and avoid increased water levels on neighbouring properties.
- Reinstate ditches or land drains that were disturbed during the works.
- Design the perimeter fence to allow through flow of surface water up to the 1% AEP flood level.
- Construct on site storage and conveyance structures if required (e.g. table drains to manage runoff from access roads, rainwater harvesting on the site buildings).
- Any existing impoundment or conveyance structures (e.g. irrigation storage ponds and channels) are assessed for their condition structural integrity and ongoing safety.

6.0 Conclusion

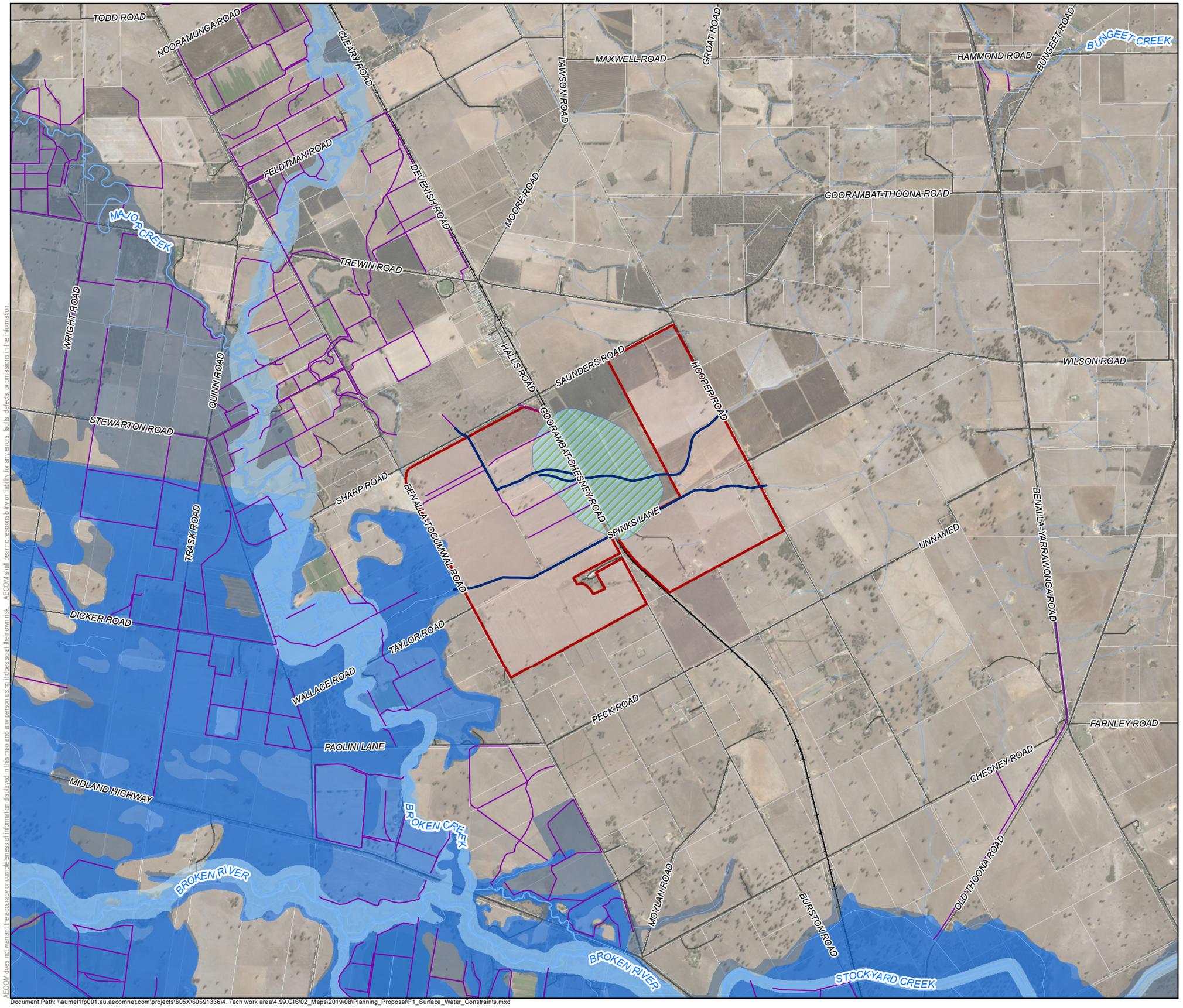
The investigation indicates the site is not at risk of major flooding based on flood maps available from the GBCMA. There are two designated waterways on the site and a permit will be required from the GBCMA to undertake works that impact the waterway.

The pre-European wetland that is mapped on the site is understood to not be a designated wetland from preliminary advice provided to Neoen by the GBCMA (see **Appendix B**). Aerial photography indicates the site is now fully used for agricultural purposes with no indication of remnant vegetation or water storage. No setbacks from this mapped wetland are therefore required.

It is not expected that the solar farm will have an impact on existing flood levels, water quality or waterway condition. The largest risk to the external surface water environment will be during the construction period however these can be managed using a Construction Environmental Management Plan that references established construction techniques and environmental controls.

Appendix A

Site Context and 1% AEP Flood Extents



NEOEN AECOM

Coordinate System: GDA 1994 MGA Zone 55

0 0.65 1.3

Kilometers

1:37,500 (when printed at A3)

Legend

- Site Investigation Area
- Roads
- Railway
- Cadastre
- Watercourses
- Designated Waterways
- Irrigation Channels and Drainage
- Current Wetlands
- Floodways
- Floodway or Rural Floodway Overlay
- 100 years ARI Flood Extent

Data Sources:
Locality, Railway, Drainage Line, Streets, Features © VICMAP - 2018

Disclaimer:
Victoria State Government - Environment, Land, Water and Planning © (VICMAP) 2018
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Goorambat East Solar Farm

SURFACE WATER CONSTRAINTS

PROJECT #:	60591336
CREATED BY:	JB
LAST MODIFIED:	brierej: 15/08/2019
VERSION:	1

Figure 1

A3 size

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Appendix B

Preliminary advice from GBCMA on designated waterways

Knight, David P

From: Tom O'Dwyer <tomod@gbcma.vic.gov.au>
Sent: Wednesday, 17 July 2019 11:07 AM
To: Kristina Yan
Cc: MAIL Statutory Planning; Russel Haque
Subject: RE: Goorambat Stewarton Solar Farm

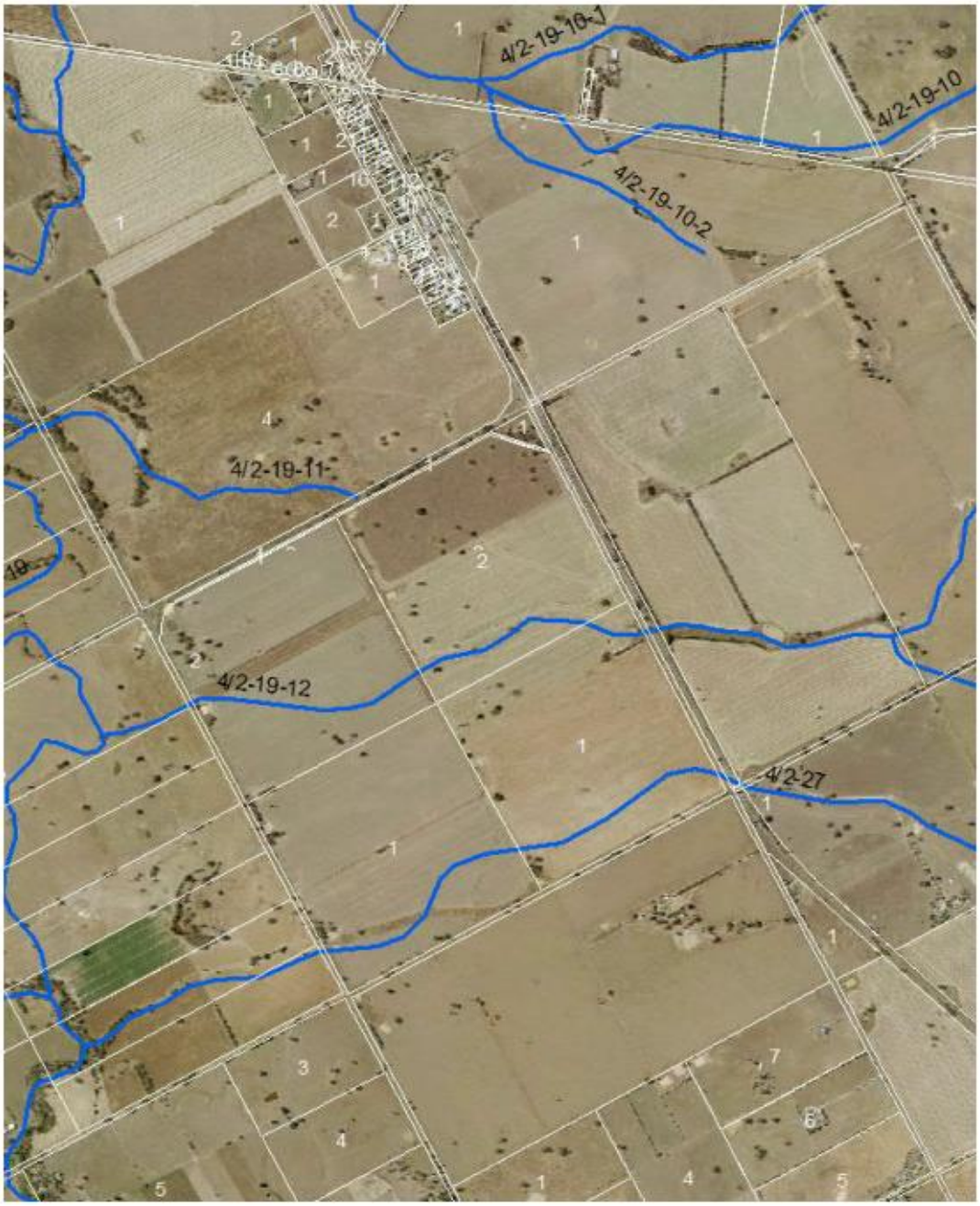
Hi Kirsten

As discussed, please refer below to the Eastern Front site. I have taken a screen grab from the GBCMA's GIS. The blue lines signify the presence of a designated waterway. Note the number...4/2-19-12. The NEWQ guidelines require buildings and works to be setback a minimum of 30 m from the top of the bank of a waterway as a starting point. If you need to cross the waterway you will be required to obtain a permit..eg under ground cabling, roads etc

In relation to a wetland, there appears to be nothing there.

Please refer to the GBCMA's website for further detail. https://www.gbcma.vic.gov.au/floodplain-planning/works-on-waterways

1



Sincerely

GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY

Tom O'Dwyer
Senior Waterway and Floodplain Engineer

P | 03 57974402

2

M | 0407366643

I acknowledge the Traditional Owners of the land on which we work.
I pay my respects to their Elders; past, present and emerging and our Indigenous staff.

From: Kristina Yan [mailto:kristina.yan@neoen.com]
Sent: Tuesday, 16 July 2019 9:52 AM
To: Tom O'Dwyer <tomod@gbcma.vic.gov.au>
Cc: MAIL Statutory Planning <planning@gbcma.vic.gov.au>
Subject: RE: Goorambat Stewarton Solar Farm

From: Kristina Yan
Sent: Tuesday, 16 July 2019 9:14 AM
To: 'Tom O'Dwyer' <tomod@gbcma.vic.gov.au>
Cc: planning@gbcma.vic.gov.au
Subject: RE: Goorambat Stewarton Solar Farm

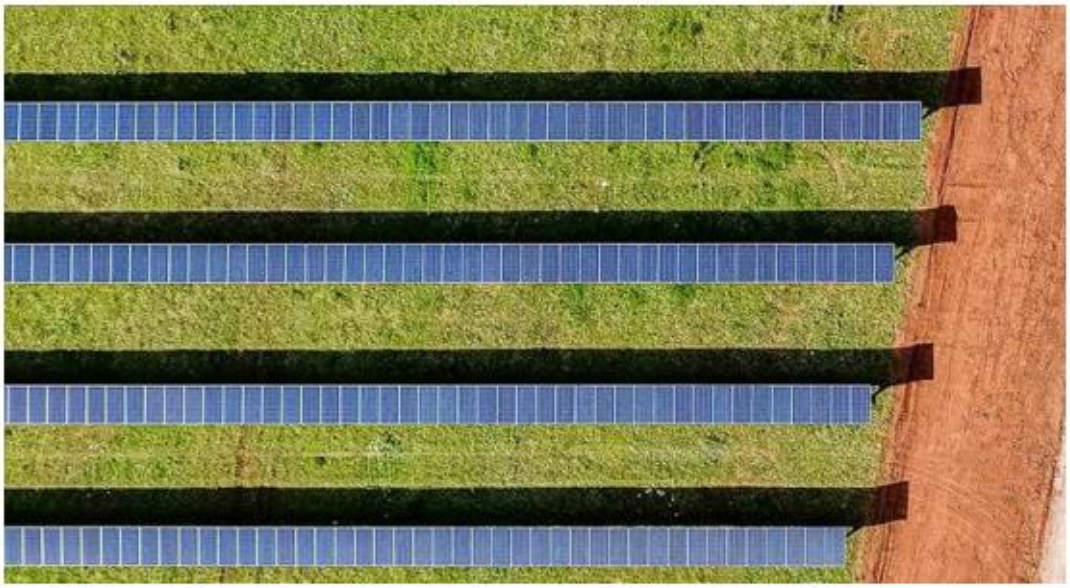
Hi Tom,

Thanks for the email. As we discussed late yesterday please find attached the development footprint on the full project. Sent below is a close up of the design near the collector station on the Eastern Front. Note that recent discussions with Council and DELWP have led to our decision to split up the project into two smaller projects and we will be redefining the development area and design shortly for GBCMA review prior to submission. Also attached is previous correspondence with GBCMA at an earlier stage in the project.

The question outstanding at the moment is the one around solar tracker installation within the watercourse buffer zone (30m) and within wetland layers. To help you understand what is meant by solar tracker installation see attached specifications and picture below.

Thanks
Kristina

3



From: Tom O'Dwyer <tomod@gbcma.vic.gov.au>
Sent: Monday, 15 July 2019 4:57 PM
To: Kristina Yan <kristina.yan@neoen.com>
Subject: FW: Goorambat Stewarton Solar Farm

Hi Kristina

I have been asked to assisting in answering your question below.

As I don't know the back ground concerning this project could you please provide me with a more detailed locality plan?

Sincerely

GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY

Tom O'Dwyer
Senior Waterway and Floodplain Engineer

P | 03 57974402
M | 0407366643

I acknowledge the Traditional Owners of the land on which we work.
I pay my respects to their Elders; past, present and emerging and our Indigenous staff.

From: Rachael Spokes <rachaels@gbcma.vic.gov.au>
Sent: Monday, 15 July 2019 8:54 AM
To: Russel Haque <russelh@gbcma.vic.gov.au>
Subject: Fwd: Goorambat Stewarton Solar Farm

4

Hello Russel,
Can you lease follow this up

Regards,
Rachael

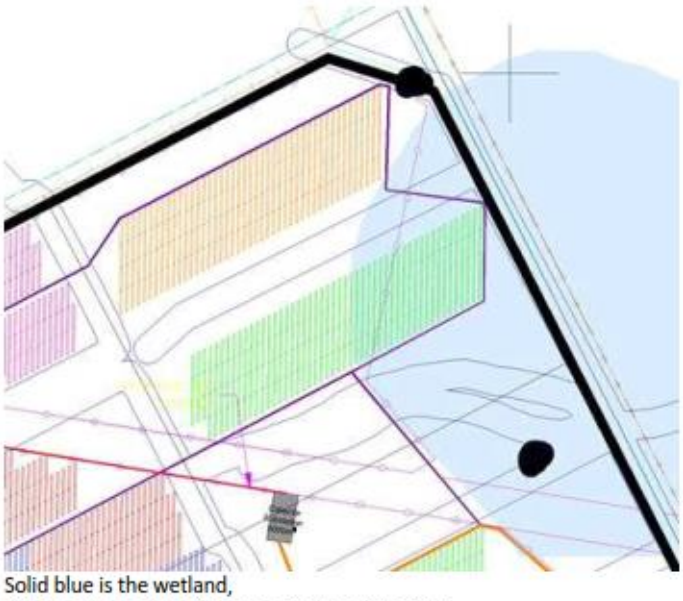
From: Kristina Yan <kristina.yan@neoen.com>
Sent: Friday, July 12, 2019 11:02:19 AM
To: Guy Tierney; Rachael Spokes
Subject: Goorambat Stewarton Solar Farm

Hi Guy and Rachael,

I wanted to thank you both for your help so far on the Goorambat Stewarton Solar Farm. Rachael it was great to have you at our pre-DA meeting with Council.

Could I ask you both to confirm a question we brought up at the meeting. It was mentioned that structures such as solar panel trackers which don't obstruct water flow could potentially be built into the 30m buffer zone otherwise given to watercourses. This is something we are looking into but our construction engineers need to first be comfortable with flood study results which are underway.

My question though is whether this type of construction applies to registered wetlands as well? Our construction engineers are much more comfortable constructing over these areas as they have been heavily modified by farming. A design could be formed where inverters are not constructed in this area but panels are. For example below. Would this be an option?



Solid blue is the wetland,
Green, orange, pick lines are solar panel trackers.
Outlined blue is watercourses

Thanks

Kristina Yan
Senior Project Developer

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