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Report

Viewbank Solar Farm Surface Water Assessment

ERM

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15 June 2020

Alicia Burnett
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Dear Alicia

Viewbank Solar Farm Surface Water Assessment

The proposed solar farm located at the Viewbank property on McCague Road Girgarre East was investigated to assess the current surface water flood risk at the site.

A site inspection was conducted, including an interview with the landowner, and with a course 2d TUFLOW model, a good understanding of the flood risk was developed. The investigation confirmed that the existing Land Subject to Inundation (LSIO) and Floodway Overlay (FO) controls in the Planning Scheme are likely to be overestimated as they were based on survey from the 1950s, and the topography of the site is quite different.

The proposed solar farm layout was overlayed over the flood mapping results and it was observed that the majority of the panels are placed in areas not subject to inundation. Only two areas of solar panels had shallow inundation, and it is recommended the panels in these areas be designed to have the lowest panel edge set above the 1% AEP flood level (approximately 300 mm above ground).

The following additional recommendations are made:

- The flood risk across the majority of the site is minimal and there are further areas of the site that could be occupied by solar panels.
- The areas currently occupied by major irrigation channels could remain as they are for future agricultural activities beyond the life of the Solar Farm.
- It is recommended that the best practice stormwater management principles described in this report be considered along with other relevant EPA guidelines such as the Environmental Guidelines for Major Construction Sites (EPA, 1996), which considers stormwater and erosion management. Sediment control is important at all stages of design construction and operation.

Please do not hesitate to contact Ben Tate or myself for further discussion if you have any questions.

Yours sincerely

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Senior Engineer

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1 INTRODUCTION

The proposed solar farm at the Viewbank property on McCague Road in Girgarre East is to be located on land previously used primarily for irrigated cropping. The land is currently encumbered by Land Subject to Inundation (LSIO) and Floodway Overlay (FO) in the Planning Scheme. This triggered the need to investigate the surface water flood risk on the site to assess the sites suitability for a solar farm.

The aim of this report is to assess the current surface water flood risk of the site and propose any potential mitigation options to reduce the risk, and to determine the sites suitability for a solar farm with respect to flood risk.

1.1 Background

The site is situated in an irrigation district to the north-west of Waranga Basin (Figure 1-1). The area is generally quite flat and is intersected by various irrigation channels and local depressions which influence floodplain inundation.

The property has a Land Subject to Inundation Overlay (LSIO) and a Floodway Overlay (FO) designated under the Greater Shepparton Planning Scheme, Figure 1-1. The figure indicates that there has been a history of flooding on the site justifying the advice from Goulburn Broken CMA that a flood investigation is required as part of this development application. The hydrology for the site is difficult, because the LSIO indicates that flooding of the area may be a result of both local rainfall storm events and possibly spills from Waranga Basin.

The site is covered by the LSIO and FO where they extended across from Poole Road to McEwen Road to the north of the Midland Hwy.

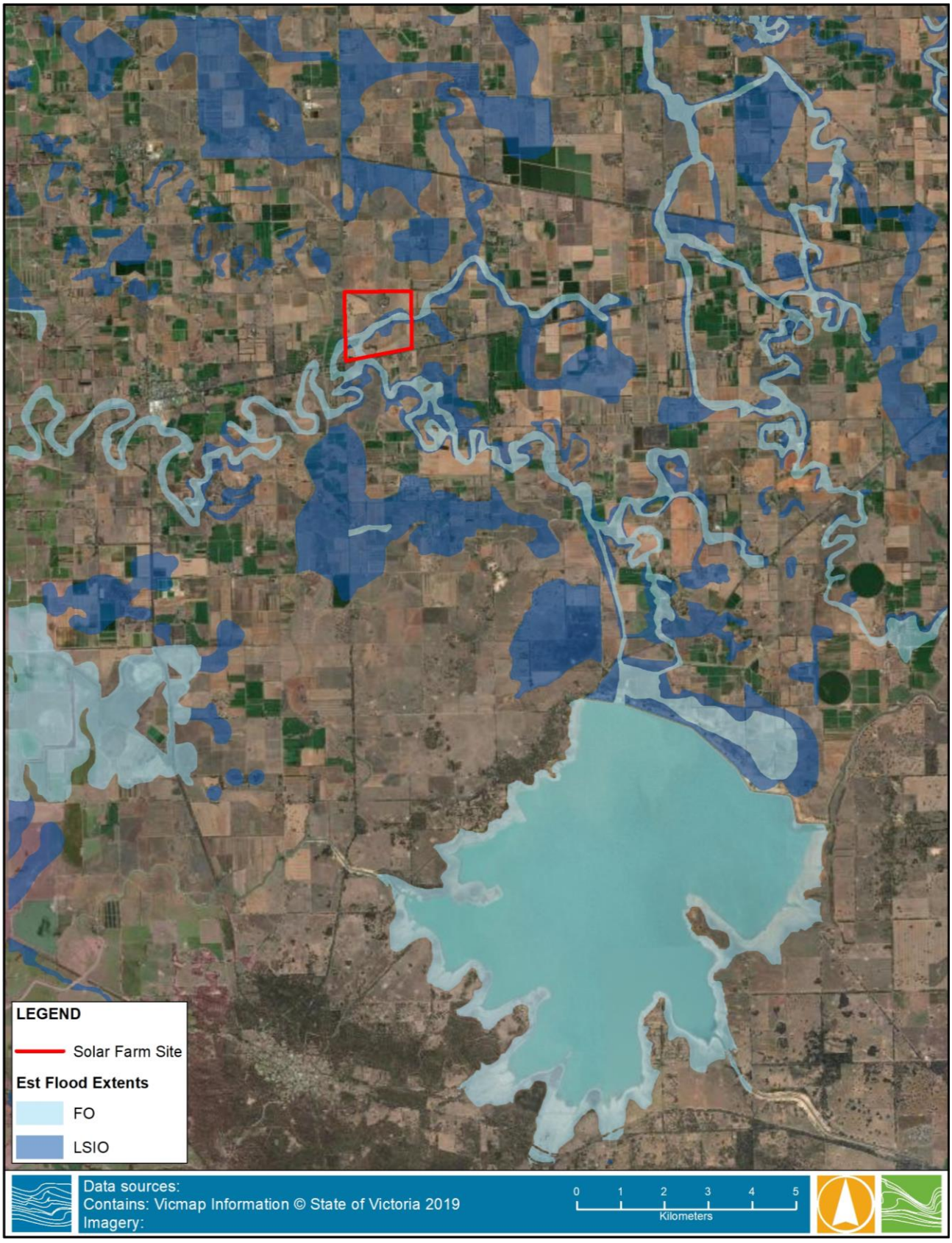

Figure 1-1 Current LSIO and FO around the site

2 METHODOLOGY

The surface water assessment was conducted using the following methods:

- The available satellite Digital Elevation Model (DEM) and a detailed survey data were available for the assessment. The survey data was used to confirm the contours of the site.
- Review of available satellite DEM, aerial imagery, and previous reporting.
- Site inspection to review the topography of the site and the upstream drainage catchment.
- Develop a course hydraulic model to compare the estimated flood extent to LSIO and FO.
- Using available information and site inspection, the flood overlays were reviewed to identify if the current FO and LSIO planning overlays are reasonable, or if there is an argument that they could be relaxed.
- Discussion with Goulburn Broken CMA regarding flood risk of the site.
- Develop recommendations for flood mitigation, site drainage and best practice stormwater management, raising any issues and opportunities with the site from a flood risk perspective.
- Prepare a brief report discussing the findings of the surface water flood risk assessment.

3 RESULTS

3.1.1 Existing Flooding

The current LSIO and FO extents were developed from a coarse mapping based on a storm event in the 1950s, aerial imagery and very old coarse topography. The flooding represented by the overlays crosses a significant irrigation channel with raised banks to the east of the site, meaning the overlays may no longer be accurate. Drainage structures within the site could also impact on the flow of surface water across the site. These were investigated in a site inspection and consultation with the landowner.

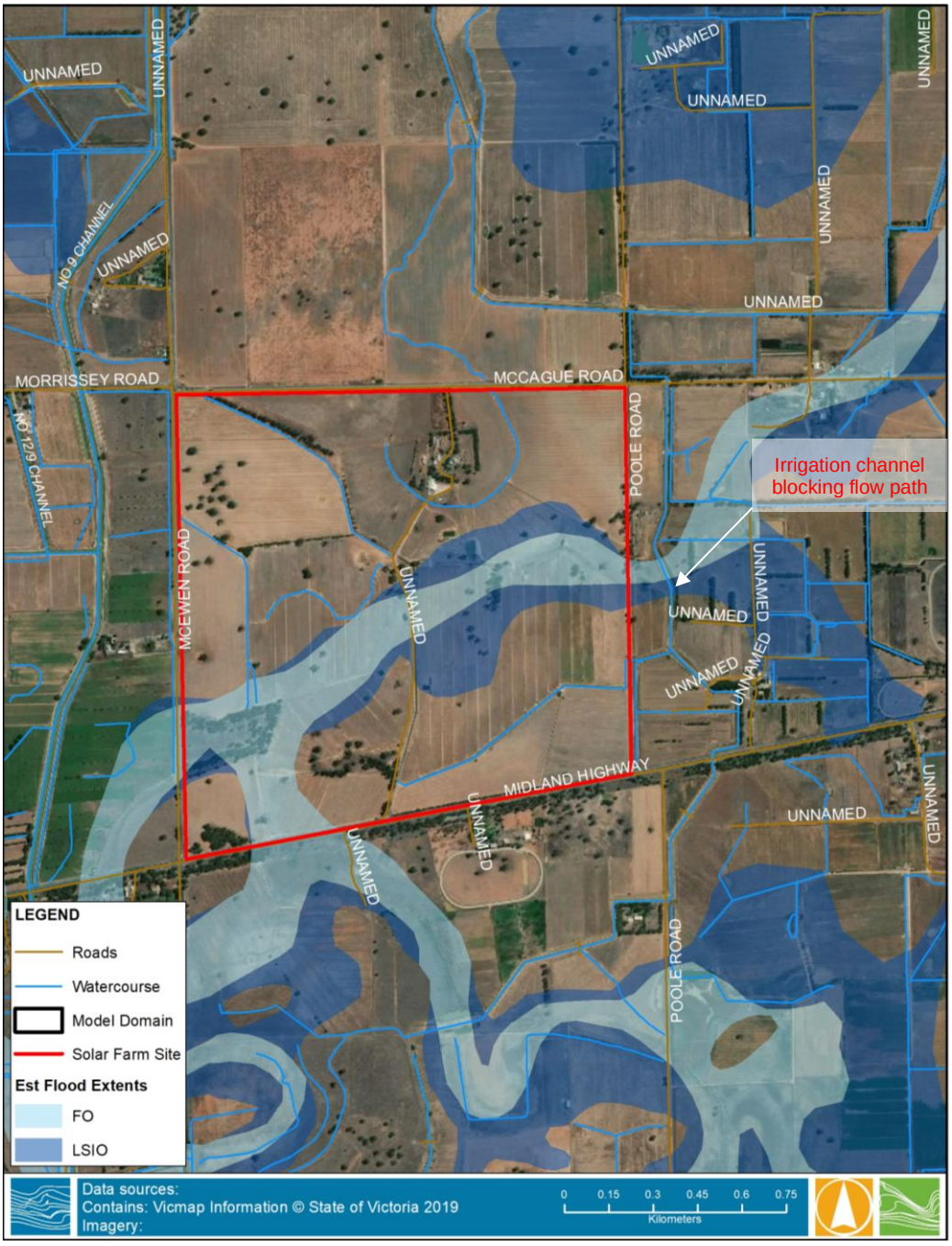

Figure 3-1 LSIO and FO at the site and immediate neighbouring properties

3.2 Site Inspection

A site inspection was conducted on the 3rd December 2019 to assess the existing drainage structures and to assess the current extents of the LSIO and FO to see if they are appropriate or could be overestimating the flood risk. The visit included a meeting with the landowner and discussed the purpose of the key surface water drainage and water supply channels across the site. The visit focused on the areas overlayed by the LSIO and FO, with the outcomes discussed below.

3.2.1 Study Site

The study site is shown in Figure 3-2, showing the current LSIO and FO and several photo points. Through the site inspection, the irrigation channel at the east of Poole Road was confirmed to exist (Figure 3-3 to Figure 3-5). It was also confirmed that the overland flows from the eastern side of this channel cannot cross the channel and flow west due to the high channel banks that acts as levees to the overland flow. This suggests that the LSIO and FO extents in this area should be significantly reduced as the external catchment to the east will not contribute flows across this land. The low depression which grades east to west will fill with local surface water drainage runoff.

Rapid rainfall-on-grid hydraulic modelling in Section 3.4 provides a more accurate representation of the possible flood extent in this area.

Within the site, the existing dwelling is located at the contour level of 120 m AHD at the top of the hill as shown in Figure 3-2. Drainage and irrigation channels exist across the southern side of the hill slope (shown in Figure 3-6 and Figure 3-7. A natural wetland also exists in the south-west corner of the site (Figure 3-8).

At the wetland, the water can discharge to the western neighbouring properties through a culvert crossing under McEwen Road. The extents of the LSIO and FO were estimated onsite to be limited to the extent of the wetland following contour level of 107.00 m AHD. This also extends south to Midland Hwy. The wetland is also likely to receive inflows from runoff to the south of Midland Hwy with the current LSIO/FO indicating that the highway may be overtopped. The area on the southern side is indeed low, and looks as though it would receive overland runoff, but there was no evidence suggesting if it would or would not overtop the highway.

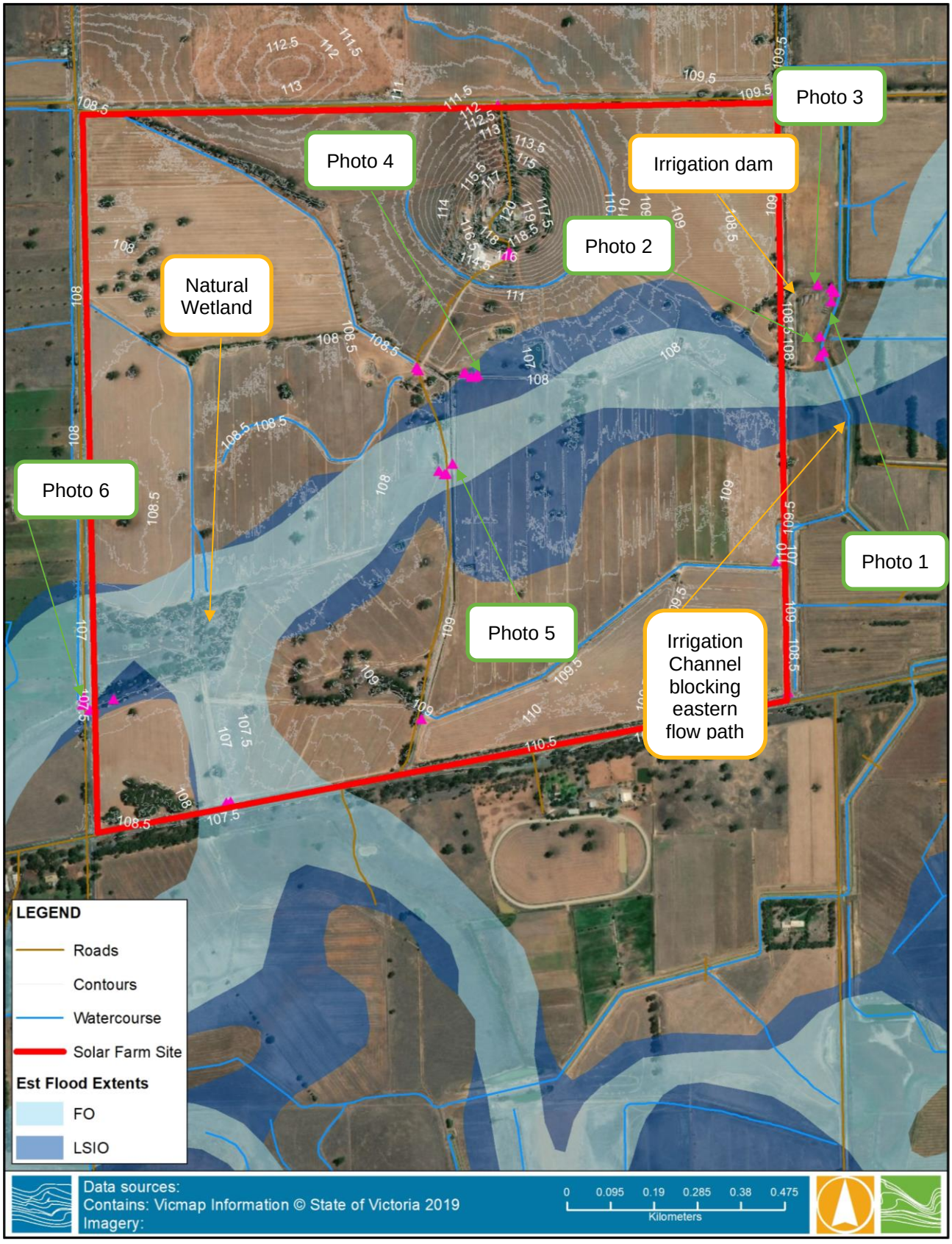

Figure 3-2 Study site with LSIO/FO and Photo Points

Figure 3-3 Photo 1, on top of the irrigation channel bank facing south

Figure 3-4 Photo 2, on top of the irrigation channel bank facing east

Figure 3-5 Photo 3, irrigation dam, facing west

Figure 3-6 Photo 4, drainage channel within the site

Figure 3-7 Photo 5, irrigation channel within the site

Figure 3-8 Photo 6, natural wetland

3.3 Current Drainage Works

During the site visit, we witnessed work being completed on nearby depressions, upgrading culverts along a flow path between Midland Hwy and McGrath Road. According to the landowner, this work aims at ensuring that the watercourses and local depressions have the capacity to convey flows to reduce inundation throughout the district, and this will include the culvert on McEwan Road which drains the wetland in the south-west corner of the site. This will help reduce the level of water ponding in the wetland on the site, thus reducing the flood extent in the south-west corner of the site.

3.4 Course TUFLOW Model

A course 2d TUFLOW model was developed to estimate the likely flood depths across the study area. The rain-on-grid approach was used to apply rainfall data across the full model area, representing a local storm falling on the site. The model area is shown in Figure 3-9. The model domain extends south down to the Waranga Basin, west of Stanhope, east near Byrneside and north to Kyabram South. The domain has not covered the entire contributing catchment that may contribute flows toward the site, but as discussed earlier the irrigation channel to the east of the site blocks the local overland runoff from continuing on to the site.

The 20 m Geoscience Australia satellite DEM was used along with the site survey to build the model topography. The 20 m DEM was modified to match the survey data in the area of overlap. No drainage structures were included such as pipes or culverts. The model was run for the 1% Annual Exceedance Probability (AEP), 72 hr storm event and Australian Rainfall and Runoff rainfall temporal pattern 2. This long duration storm event was adopted as the inundation extents are most likely impacted more by high volume, long duration storms.

Although the model has limitations due to the coarse topography dataset used for the external catchment, the information developed is sufficient and fit for purpose to provide a comparison to the existing LSIO and FO layers and to assess the likely flood risk for the site.

3.4.1 Model Results

The extent of the flood depth produced from the model result is presented in Figure 3-10. It covers mainly the watercourses and the natural wetland. The flood depths in wetlands, dams, drainage and irrigation channels reach levels above 0.5 m as expected. However, over the general area, the surface water runoff depths are low.

When comparing to the existing LSIO and FO as shown in Figure 3-11, the modelled flood extent is much smaller than the extents indicated by the LSIO and FO. There are no major continuous flow paths as depicted by the current LSIO and FO extents, instead water appears to concentrate in low depressions and drainage areas.

When comparing the modelled flood extent to the site layout of solar panels (Figure 3-12) the following findings were noted:

- The solar panels have been largely proposed in areas where there is no flooding.
- Solar panels have been proposed for two areas where the flood depth is less than 300 mm, as marked in Figure 3-12 (Area 1 and Area 2). The lower edge of the solar panels should be designed to be above the 1% AEP flood level, so approximately 300 mm above ground.
- The solar panels could be extended into areas where there is shallow flooding.

The site can be safely accessed through McCague Road and Poole Road.

Figure 3-9 TUFLOW Model Domain

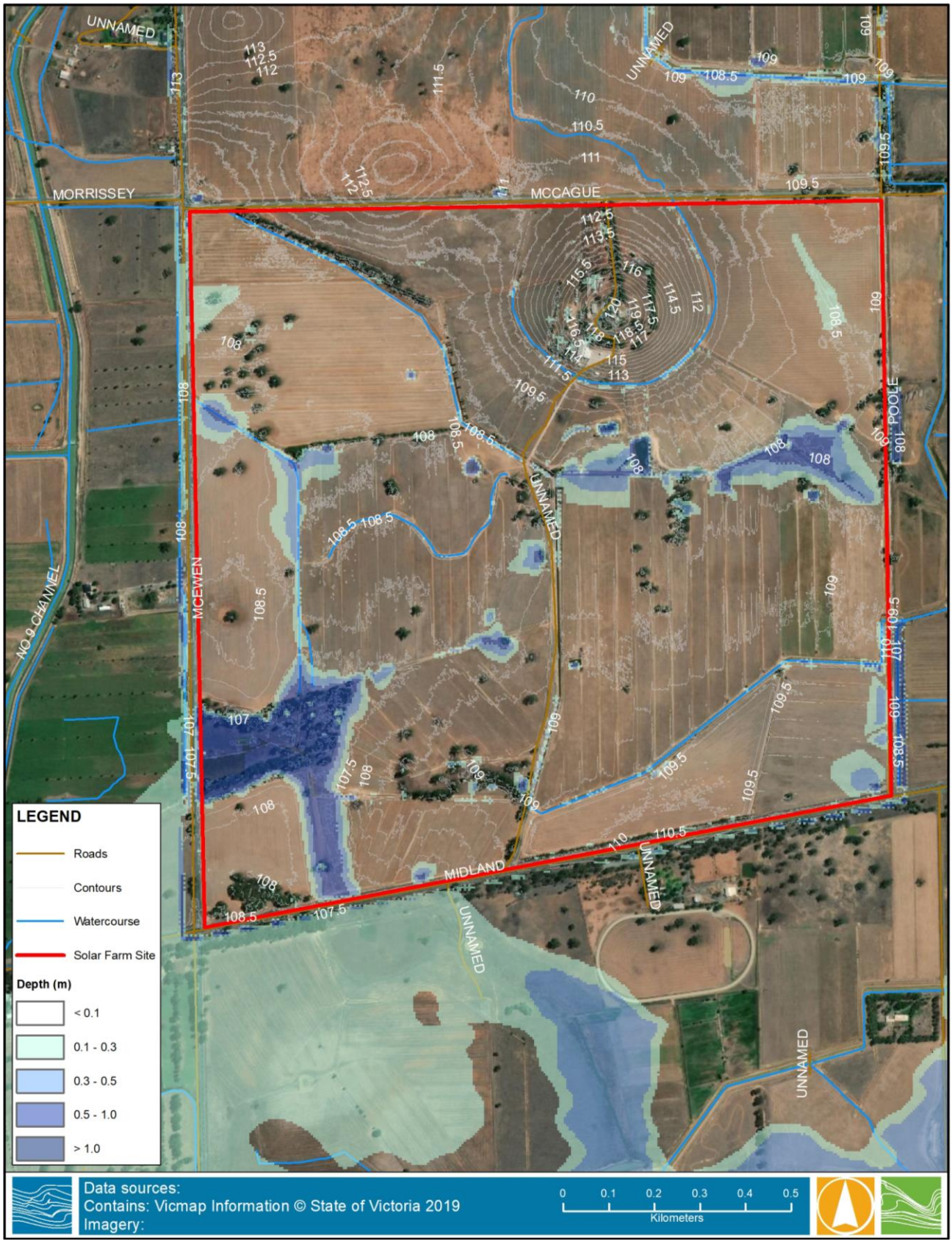

Figure 3-10 Modelled 1% AEP flood depths from local storm event

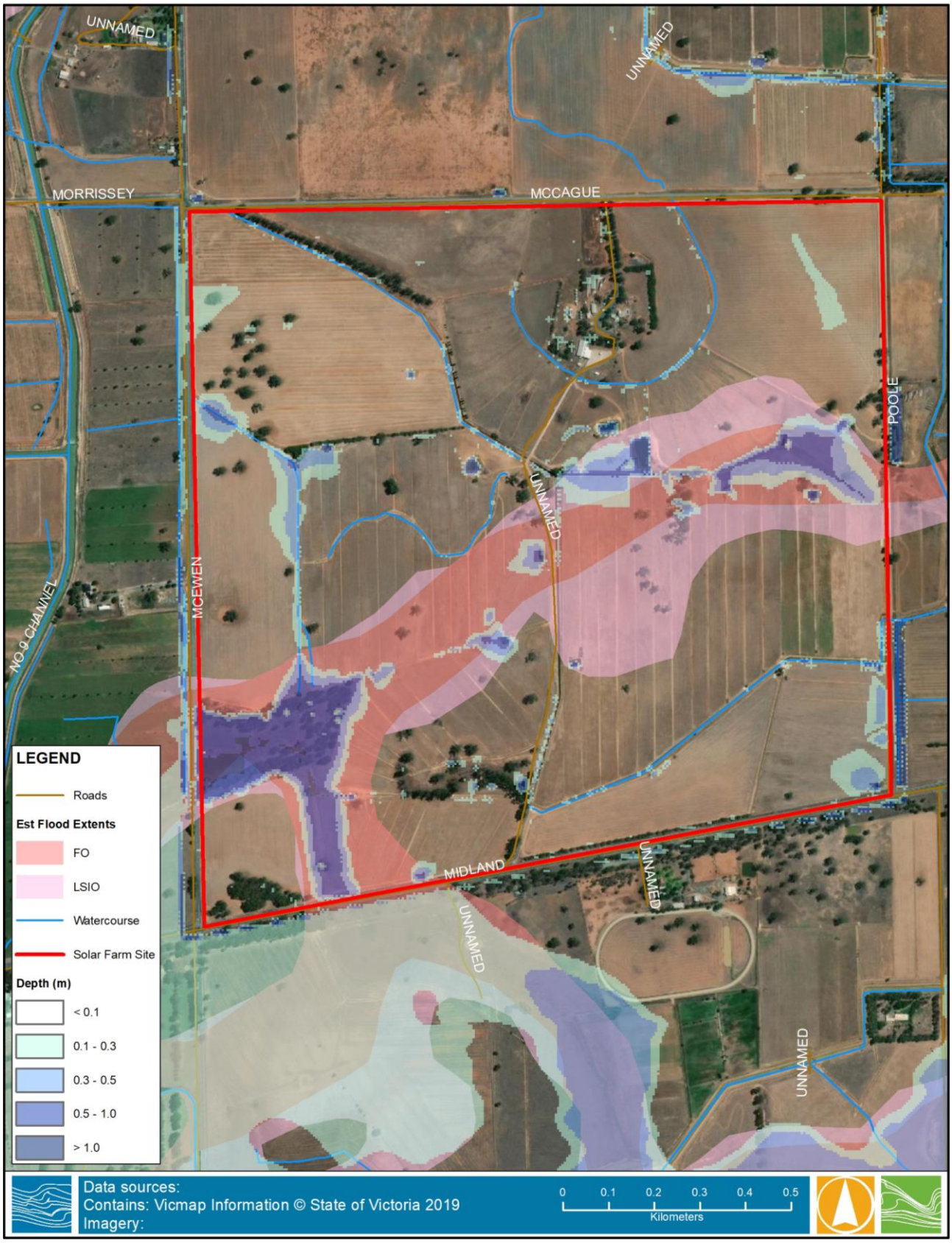

Figure 3-11 Modelled flood extent compared to LSIO and FO extents

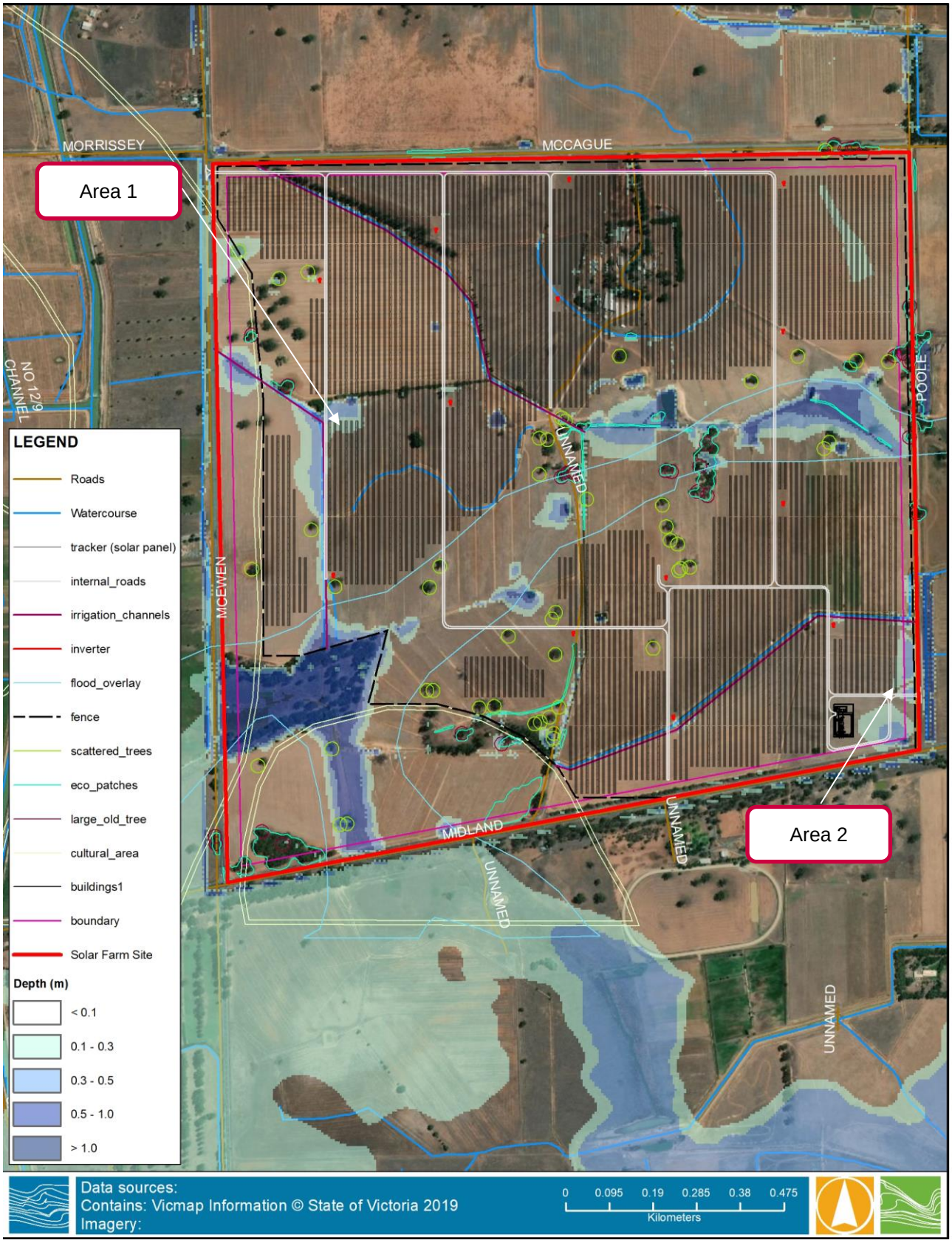

Figure 3-12 Modelled flooding at the site

4 SITE STORMWATER MANAGEMENT

4.1.1 Water Quality Measures

Stormwater management is an important consideration on solar farm sites as the addition of panels across large areas has the potential to increase erosion and runoff if not treated properly. There will be a shadow under each of the panels where rainfall will not fall directly on the ground, runoff from the uphill panel will be able to flow across the ground and under the downhill panel, as such solar panels do not effectively increase the fraction impervious in the same way road pavement or the roof of a building do. If solar panels are not fixed and change direction to track the sun, the drip line of runoff from the panels will vary depending on the time of the day.

There has been a lot of discussion and some research into the impact of solar farms on stormwater runoff in the USA and the UK. Some of the research has included theoretical modelling, and some research has been focused on applied field-based work. The general consensus with this research is that solar panels will not have a significant impact on the hydrology of the site under the following conditions:

- Ensure that the soil profile has not been overly compacted due to heavy machinery during construction, if it has, mitigate the soil to increase infiltration rates.
- Encourage vegetation cover to establish and be maintained. Native grasses would be the preference, but when dealing with cleared farmland, improved pasture is likely to exist in the soils seed bank already.
- The site is established to encourage sheet flow across the surface rather than concentrated flows along narrow flow paths. This can be achieved through minor earthworks.
- The gap between each row of solar panels is greater than or equal to the width of the solar panel rows to allow the runoff from the upslope panel a buffer strip to spread across the surface and allow vegetation growth.
- If the slope of the land is greater than 5%, provide an energy dissipator or contour that will hold the runoff up and allow it to spread across the downslope evenly. This break in slope should be provided downhill of each dripline from the upslope panel. This site is generally relatively flat, and this will not be required across most of the site, with the exception of possibly the hillslope to the south of the existing dwelling. This can be achieved under the existing condition of the site with extension to the existing earthen bunds. A series of small earthen bunds running across the contour of the hillslope to slow the runoff down and make it pool behind the lower bund and spread laterally across the contour before spilling down the slope to the next bund. These measures are expected to be able to be incorporated within the proposed layout plan
- Along any concentrated drainage paths, encourage vegetation along the drainage paths. Native vegetation such as grasses and sedges that tolerate frequent inundation would be preferred. These vegetated drainage paths should not be designed to trap and concentrate large flows, but to provide a filter for sediment control. They therefore do not require a large channel capacity; they are really to ensure water does not exit the property carrying elevated sediment loads. Note that works on a designated waterway would require a Works on Waterway permit from Goulburn Broken CMA. To Water Technology's knowledge, there are no designated waterways on the site.

If the site layout can meet the general stormwater management principles proposed above, then there should be no adverse impacts of the solar farm on the hydrology of the catchment or the sediment loading of the runoff from the catchment.

5 SUMMARY

The proposed solar farm at the Viewbank property on McCague Road in Girgarre East was investigated to determine the flood risk across the site. Findings from a site inspection and 2D flood modelling suggest that the flood risk of the site is less than that indicated by the current LSIO and FO flood extents in the Planning Scheme.

The drainage line south of the existing dwelling is currently proposed to have solar panels across it, it is suggested that the lowest portion of this drainage pathway have a vegetated buffer strip to aid in surface water runoff treatment. So in this section a minimum buffer distance from the drainage line could be adopted (suggest 30 m either side of the drainage line), with areas with flood depths greater than 500 mm from the rapid flood mapping also kept clear of solar panels.

The proposed solar panel layout is generally outside of the areas of inundation with the exception of two areas subject to shallow inundation less than 300 mm. It is recommended that the lowest edge of the solar panels in these areas be designed to be 300 mm above ground (above the 1% AEP flood level).

If the design of the solar farm allows, the current water supply channels could also be left intact so the land could be returned to irrigated agriculture when the life of the solar farm is finished.

A more detailed design of the drainage design should be completed during the detailed design phase of the solar farm, and consideration given to some of the steeper slopes on the site (particularly south of the existing dwelling), where some check banks may be required to control runoff from the panels and down the steeper slopes, in order to prevent hillslope erosion.

It is recommended that the best practice stormwater management principles described in this report be considered along with other relevant EPA guidelines such as the Environmental Guidelines for Major Construction Sites (EPA, 1996), which considers stormwater and erosion management. Sediment control is important at all stages of design construction and operation. The stormwater measures proposed to be implemented in this report would facilitate the project having no adverse impacts on the hydrology of the catchment and the sediment loading in runoff from the site.

This site appears to have a low flood risk across most of the site, and Water Technology sees no reason why this site could not be used as a solar farm for surface water flood risk reasons.

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