AGRICULTURAL IMPACTS

of the

INSTALLATION OF SOLAR PANELS AND CONSTRUCTION OF

the

BARNAWARTHA SOLAR FARM AND BATTERY STORAGE

For

Aurecon Group

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Table of Contents

1. Introduction

1.1 Project Brief

Ag-Challenge Consulting has been instructed by Aurecon Group on behalf of ARP Australian Solar Pty Ltd to investigate the agricultural impacts of a proposed solar farm on approximately 120 hectares of farmland at Barnawartha, northern Victoria. The investigation is to describe the existing agricultural use in both a local and regional context and to consider the impact of the solar development on the existing uses of the land, identify any potential impacts on adjacent properties and determine whether the proposal is likely to have any adverse impacts on surrounding land uses.

The subject 120 hectares of farmland, detailed in Table 1, is within three separate titles and two separate parcels abutting either side of Hermitage Road, Barnawartha.

Table 1. Title specifications of subject area.

Address of the Subject Land	Parcel	Total Approx. Parcel Area (ha)	Proposed Approx. Solar Farm Area (ha)
49 Hermitage Rd, Barnawartha	Lot 1 Section 24\PP2076	60	56
Murray Valley Highway, Barnawartha	Part Lot 2 Section 22\PP2076 Part Lot 3 Section22\PP2076	65 65 130 combined	32 32 64 combined

Figure 1. Aerial of the land parcels. Striped zones indicate parcel area not leased for solar farm, red stars denote described soil augers.

1.2 Experience and Capability of Ag-Challenge Consulting

Ag-Challenge Consulting is an agricultural consultancy company servicing the dairy, beef, and potato industries as well as other high rainfall and irrigated agriculture industries of Southern and Northern Victoria. The company is based at Warragul and the principals of the company have been providing independent farm consultancy advice since 1988 from this location. There are five active consultants within the company that service approximately 200 individual farmer clients with consultancy services from Ag-Challenge Consulting, as well as industry associations, financial institutions, and government. The company is active in vocational training, running focus farms and discussion groups and undertaking farm design work. The recycled water industry is a significant user of Ag-Challenge Consulting for the design and monitoring of recycled water projects. The renewable energy industry has collectively been a significant client of Ag-Challenge Consulting, using the company services for site selection and design, liaison with adjacent farm businesses and assistance in satisfying the provisions of planning schemes.

2. Regional Context

2.1 Planning Provisions

All parcels are part of the Farming Zone of the Shire of Indigo Planning Scheme and subject to the provisions of that zone. There is an Environmental Significance Overlay (ESO) overlay of the land and the properties are subject to Schedule 3 (ESO3) which seeks to protect the catchment of the Black Dog Creek waterway. The Farming Zone is denoted as such by the acronym FZ on the Planning Scheme Map. The purpose of the Farming Zone[1] is:

- *To implement the Municipal Planning Strategy and the Planning Policy Framework.*
- *To provide for the use of land for agriculture.*
- *To encourage the retention of productive agricultural land.*
- *To ensure that non-agricultural uses, including dwellings, do not adversely affect the use of land for agriculture.*
- *To encourage the retention of employment and population to support rural communities.*
- *To encourage use and development of land based on comprehensive and sustainable land management practices and infrastructure provision.*
- *To provide for the use and development of land for the specific purposes identified in a schedule to this zone.*

A planning permit is required for the development and use of a Renewable Energy Facility within the Farming Zone, and the Planning Scheme states that a condition of approval is that the facility must meet the provisions of Clause 53.13 of the Planning Scheme. Among other provisions, Clause 53.13 states that the applicant must undertake a site and context analysis including a description of the site and surrounding area. This assessment of agricultural impacts forms part of the response to the provisions of Clause 53.13.

The Solar Energy Facilities Design and Development Guideline (August 2019) specifies a number of factors that need to be considered during the site selection and decision making process in order that agricultural production is not unduly detrimentally affected. These factors include:

- Protecting strategically important agricultural and primary production land from incompatible land use.
- Protecting productive agricultural land that is of strategic significance to a local area or in a regional context.
- Avoiding the loss of productive agricultural land without considering the impact of the loss on the agricultural sector and its consequential effect on other sectors.

The agricultural values of the land will be assessed in accordance with these guidelines, including an assessment of the agricultural significance of the land and the location of agriculturally significant land within the shire and the region.

[1] Victorian Planning Provisions – DELWP – http://planning-schemes.delwp.vic.gov.au/schemes/vpps/35_07.pdf.

2.2 Climate

The climate of the Barnawartha area is defined by moderate annual rainfall and hot summers. The region experiences hot summers with an average daily maximum temperature of 31 °C. Thunderstorms during summer are not uncommon and lead to an increased risk of fire and floods. Winters are mild, with frosts a common occurrence[2]. The average annual rainfall of the Hume region is 500 mm;[2] whilst the mean rainfall for Barnawartha is ~646 mm per annum[3]. Since 1950 the annual average temperature in this area has been increased by as much as 1.2 °C and annual rainfall decreased by as much 200 mm[2]. The climate of the area is conducive to broadacre cropping together with low intensity grazing for sheep and cattle.

2.3 Regional Land Form

The land is located within the Benalla Land System as described by Ockenden and O'Meara (1980)[4]. The Benalla Land System has been formed from outwash and flood deposits from the north flowing rivers in this section of the Murray Darling Basin. The King, Broken and Ovens rivers emerge from the Victorian highlands as fast flowing streams and rapidly slow as they enter this extensive broad and nearly flat landform. Over many hundreds of centuries these streams have deposited sediments across the broad plain. The deposits are extensive and often very deep, and the flood plain is characterized by numerous terraces at different levels, prior streams, existing flood plains, swamps and billabongs. The landforms and their associated soils in an adjacent section of the Benalla Land System were described in some detail by Rundle and Rowe (1974)[5].

Rundle and Rowe describe four separate land types (land systems) within the Benalla Plain which are all low lying and lacking in topographical relief. They are the Benalla System, the Samaria System, the Warrenbayne – Tatong System and the Mokoan System. They differ in soils and drainage as well as minor differences in climate. The Benalla system likely encompasses all the land which is the subject of this impact study and is described with *topography [of] simple and low relief. It consists mainly of a broad plain, the Benalla plain, at about 150 m elevation but also includes gently sloping outwash fans from small hilly catchments adjacent to the plains, and the terraces associated with the trunk streams…. The whole system consists of alluvium of various ages, most of it directly associated with the stream systems, but some having soils with some reddish gradational soils on low sandy ridges…. [The system] occupies 250 square kilometres.*[5]

The Benalla Land System has limited versatility for agriculture due to frequent winter waterlogging and being at the higher rainfall threshold of cereal-crop water requirements[5].

[2] Climate-Ready Victoria, Hume – Victorian State Government - https://www.climatechange.vic.gov.au/__data/assets/pdf_file/0022/60745/Hume.pdf.

[3] Barnawartha mean annual rainfall calculated as average of Rutherglen and Wodonga mean rainfall.

[4] Ockenden P.L. and O'Meara M (1980) Land Capability Study in the Shire of Chiltern, Folio Report, Soil Conservation Authority Victoria.

[5] Rowe and Rundle (1974) A Study of the Land in the Catchment of the Broken River, TC 9, Soil Conservation Authority Victoria.

2.4 Regional Land Use

The intensity and type of agricultural production varies across the Benalla Plain. Grazing on both improved and unimproved pasture is common in the southern areas, where low hills and outwash slopes are interspersed with broad flood plains and old river terraces. There is some substantial viticulture in the southern areas where soils are suitable. The northern parts of the Benalla Plain can be conveniently separated from a land use perspective into eastern and western areas. The western area has well drained soils and is a highly productive agricultural region. In this area intensive agriculture is based around Shepparton. Fruit crops, vegetable crops, dairying and fodder production for intensive animal industries are all undertaken using irrigation water from the Goulburn system. The eastern area does not possess the same extensive areas of well drained soils and plant growth is often restricted in winter due to waterlogging. The eastern area is used for more extensive forms of agriculture such as grazing of beef and sheep cattle and some broadacre cropping. These properties are located within this eastern area.

3 Site Characteristics

3.1 Description of the Land

This land is located within an old alluvial plain landscape. The Murray River is located approximately 1.6 km north of the subject properties. Surface water drains towards the Murray Valley Highway where stormwater drains divert runoff towards the Murray River. However the topography is very subdued and the landscape is slow to drain after prolonged rainfall.

The underlying geology is alluvial deposits, derived as both alluvium and hillwash material from sources upstream in the catchments of the Kiewa, the Ovens rivers, and the upper Catchment of the Murray River. There may be prior streams embedded within the strata.

3.2 Soils

The soils of the properties were assessed by Tony Pitt and Jayden Voorzaat of Ag-Challenge Consulting during the site visit on October 22, 2021. Full soil profile descriptions can be found in Appendix I. Soils on eastern side of Hermitage Road can be described as brown texture contrast or gradational soils with weak crumbed surface soils increasing in structure at depth. These soils have good internal permeability. Gravel sized particles occur sporadically in the surface A horizons and become common at depth.
Soil profiles on the western side of Hermitage Road are brown to yellowish brown gradational soils. Surface A horizons here have a notable sand fraction present in the texture such that surface textures are sandy loams. In the subsoil B horizons, gravels become common, and structure becomes stronger. These soils are considered to have good internal permeability.

These soils have a reasonable diversity of potential uses. The B2 horizon of all the profiles examined was moderately permeable and would not be a significant restriction to the vertical movement of water in the soil profile. The soils on the western side of Hermitage Road are moderately well drained. The current land use reflects this with broadacre cropping present

including a lucerne crop. The eastern property is less well drained with the presence of partially degraded pastures and no recent evidence of broad acre cropping.

3.3 Native Vegetation and Riparian Zone

There are scattered remnants of the former open woodland vegetation that would have once dominated this landscape. The remnants are sporadically scattered throughout the properties but there are also a number of trees scattered on property margins. There are slightly denser stands in the northeast corner of the west title and southeast corner of the east property.

The remnant vegetation on the eastern property consists of both Red Gum (*Eucalyptus camaldulensis*), Grey Box (*E. microcarpa*) and some Yellow Box (*E. leucoxylon*). Western property remnant vegetation appeared to be mostly Red Gums.

Coinciding with the good ability for these soils to drain, there was no evidence during the site inspection of uncontained water ponding. Surface run-off is currently captured in farm dams or makes its way to the Murray River via rough water courses and drainage channels.

3.4 Water Supply

Within the boundaries of the combined land parcels are six dams. The eastern title has two farm dams built on an ill-defined watercourse and there are four dams located on the western title. All dams are well sited to collect surface water runoff from surplus rainfall. All stock water appears to be sourced from surface runoff into these six farm dams. Livestock grazing on these properties has been successfully undertaken for many years and water security for stock water appears to be adequate. All farm dams are too small for viable irrigation of broadacre crops.

3.5 Current Land Use

The property on the eastern side of Hermitage Road (49 Hermitage Rd, Barnawartha Lot 1 Section 24\PP2076) is used for the breeding and fattening of beef cattle. The current pasture is ryegrass dominant together with subterranean clover, soft and great brome, barley grass, sorrel, fog grass, wild oats, cocksfoot, prairie grass, paspalum and minor populations of capeweed and mallow.

The property on the western side of Hermitage Road (Lot 2 and Lot 3 Section 22\PP2076) is used for mixed farming. Current crops of cereals, oilseeds and lucerne are present or recently harvested, together with grazing of cattle on ryegrass dominant pastures. The landowner has also indicated sheep have previously been grazed on the property. The pastures are perennial ryegrass dominant with Italian ryegrass, barley grass, great brome and soft brome present. Minor populations of capeweed and mallow were observed.

4 Land Capability and Agricultural Production Potential Assessment

4.1 Agricultural Land Capability Classification

Land Capability Rating systems for a series of land uses, including agricultural land use were developed by Rowe, Howe and Alley[6]. The Land Capability Rating system for low rainfall grazing use (Table 2) is slightly below the mean annual Barnawartha rainfall. The rating system however remains relevant and has been applied to the combined land parcel. A Land capability rating of 2 has been determined in Table 2 using the highest determined value method for a range of potentially limiting parameters.

The Land Capability rating for cropping (

Table 3) is based on the production of annual horticultural crops rather than grain and oilseed crops, but it is nevertheless considered to be a relevant assessment for this site. The combined land parcel is determined to have a Land Capability rating of 3 with the limiting attribute being 15-20% gravel present within soil profiles (Appendix I).

A Land Capability rating of 1 or 2 means that the land is suitable for these uses and the hazards associated with such use are low to very low. It means that this is a sustainable form of land for grazing. A Land Capability rating of 3 indicates that there is a minor land degradation hazard associated with this use, which can usually be corrected with appropriate prudent management.

Table 2. Land Capability for Grazing in low rainfall areas (500 mm to 625 mm per annum)[6].

	Land Capability Class[6]				
Land Feature	**1**	**2**	**3**	**4**	**5**
Slope	Less than 10%	10% to 20%	20% to 30%	30% to 45%	More than 45%
Aspect	E. SE	S, SW, NE	N, NW, W		
Soil Group (Northcote)	Gradational soils, Um soils	Duplex soils with A horizon of 25 to 40 cm thickness	Other duplex soils; Ur & Ug soils	Uc soils	
Average soil depth	More than 1.0 m	0.6 m to 1.0 m	0.3 m to 0.6 m	0.15m to 0.3 m	Less than 0.15 m
Surface rock	Less than 2%	2% to 15%	15% to 25%	25% to 40%	More than 40%
Nominal DSE/ha rating	More than 5	3.5 to 5	2 to 3.5	0.5 to 2	Less than 0.5

[6] Rowe, Howe and Alley, 1981, *Guidelines for Land Capability Assessment in Victoria*, Soil Conservation Authority.

Table 3. Land Capability Rating for Intensive Cropping[6].

LAND FEATURES AFFECTING USE	CAPABIITY CLASS[6]				
	1	2	3	4	5
SOIL STRUCTURE:					
Gradient:	0 - 4%	4% to 8%	8% to 15%	15% to 20%	More than 20%
Apedal – weak					
Moderate, S.G.	0 - 8%	8% to 15%	15% to 20%	20% to 35%	More than 25%
Strong	0-15%	15% to 20%	20% to 35%	35% to 50%	More than 50%
FLOODING RETURN PERIOD	More than 20 years	20 years to 10 years	10 years to 5 years	5 years to 1 year	Several times per year
SOIL DRAINAGE CLASS	Well drained, Moderately well drained	Excessively well drained	Imperfectly drained	Poorly drained	Very poorly drained
ROOTING DEPTH	More than 50 cm	50 cm to 30 cm	30 cm to 20 cm	20 cm to 15 cm	Less than 15 cm
TEXTURE OF A HORIZON	L, SL, CL	SCL, LS, S	C	-	-
AGGREGATE STABILITY OF A HORIZON	1 (stable)	2	3	4.5 (dispersing)	
GRAVELS & STONES	Less than 4%	4% to 10%	10% to 20%	20% to 30%	More than 30%
BOULDERS AND ROCK OUTCROP	Less than 0.01%	0.01% to 0.05%	0.05% to 1%	1% to 10%	More than 10%

4.2 Land Quality & Strategically Important Agricultural Land

Agricultural land may be considered to be high value and strategically important due to a combination of features such as high quality or niche soils, good rainfall, access to irrigation, resilience to climate change, existing infrastructure investment and/or its special role within a specific industry. None of this land fits within these criteria. In particular, the soils are not high quality or niche soils, the rainfall is only moderate and quite variable from year to year, and there is no specific farm or public infrastructure which makes the land inherently productive or special from an agricultural perspective.

The agricultural attributes of land that identify whether a particular parcel may be strategically important land or strategically significant are presented in Table 4, together with an assessment of how the subject land performs with respect to these attributes. The combined parcel of land can be described as good quality land for grazing and for broad acre cropping, but it has no special values. The combined parcel land is not significant agricultural land, in that it is not unique, not highly productive, not highly versatile for a multiple range of uses, and not located within an irrigation district. It is currently part of the expansive land resource that supports the grazing and broad acre cropping districts of the Benalla Land System.

The combined parcel of land is productive farmland. The proposed change of land use to solar energy production will mean that much of the current agricultural productivity will be lost in favour of the alternative use for energy production. The loss of agricultural productivity can be partially mitigated with the introduction of sheep grazing underneath the solar panels. Whilst the main land use will become solar energy production, agricultural productivity would then be reduced, rather than lost.

Table 4. Assessment of the agricultural values of the Combined parcel land. Attribute groups adapted from Solar Energy Facilities – Design and Development Guideline (2019).

Attribute Group	Assessment Criteria	Project Land Assessment	Comments
Soils and Landscape	Inherent Soil Quality Niche Soil Inherent Soil Versatility	Good quality soils No Moderate versatility	These soils are moderately well drained and of low fertility. They have fair water holding capacity and are moderately stable, but not highly productive.
Water and Climate	Access to modern irrigation infrastructure	No access	Subject land is entirely dependent on natural rainfall. Annual rainfall of the area (Hume region) is 500 mm and considered low. Annual rainfall of the subject area is 646 mm[7].
Impact of fragmentation	Impact on local and regional productivity	Low	The impact on local and regional productivity is estimated to be a loss of around 0.02% of beef production and 0.06% of cropping production. Loss of productivity is mitigated if sheep are grazed beneath solar panels.
Impact of change of land use	Recent reform to update and modernize production or create industry clusters	No	No recent changes to these properties or within the general area.
Specific planning protection for agricultural values	Land set aside or defined for agricultural use and development in a planning scheme or other strategic document	No	The land has no special protection for agricultural values outside of the schedule to the farming zone (FZ) and environmental significance overlay (ESO) of which it is subject to schedule three (ESO3).
Government Investment	Government investment to support productivity from the site or the area	No	There is no specific government investment relevant to the agricultural use of this property or this area.
Co-location of solar energy facility with agriculture	Opportunity to co-locate the solar energy facility with agricultural production to diversify farm income without reducing productivity	Yes	It is the intention of both title land holders to graze sheep on pastures underneath and around installed solar panels.

[7] Barnawartha mean annual rainfall calculated as average of Rutherglen and Wodonga mean rainfall.

4.3 Agricultural Productivity

The property on the eastern side of Hermitage Road is currently stocked at a conservative level and managed with large paddocks and open gates. The stocking rate is fairly low and only roughly indicative of the potential productivity. With improved pastures and appropriate inputs of fertilizer and management, but with no change to farm infrastructure, the potential carrying capacity has been estimated to be around 12 DSE[8]/ha.

The property on the western side of Hermitage Road would have a similar carrying capacity. The combined carrying capacity of the 120 hectares in its current state is estimated to be a total of 1440 DSE.

The net returns from agricultural industries are cyclical and beef production is currently experiencing very high prices. History would indicate that these prices are likely to decline in the medium term, although there is considerable speculation and uncertainty as to when this will occur. A production gross margin for beef weaners from a vealer mother herd has been prepared based on current (December 2021) prices and is presented in Table 5. It shows a production unit based on the combined titles of 120 hectares and with a carrying capacity of around 12 DSE per hectare. Further details of the carrying capacity and livestock reconciliation are in Appendix II. The projected gross margin from this assessment is $126,000.

[8] DSE or dry sheep equivalent is a measure of stock fodder requirements and is defined as the amount of feed required to maintain the bodyweight of a 2 year old 50 kg merino wether.

Table 5. Indicative Gross Margin for First Cross Weaner Mothers on 56 Hectares.

Cull cow price	3.5	$/kg		
Weaner sale weight	300	kg		
Weaner sale price	5.5	$/kg		
Cull cow sale weight	550	Kg		
Income	**Per ha**	**Unit**	**Price/unit**	**Cash Income**
			$/unit	**$**
Sale of Weaners	90	head	5.50	148500
Sale of Cull Cows	14	head	3.50	26950
Sale of Cull Bull	1	head	2100.00	2100
Total Income				**177550**
Expenditure	**Quantity**	**Units**	**Price**	**Cash Costs**
			$/unit	**$**
Purchase of Heifers	15	head	1800.00	27000
Purchase of Bulls	1	head	5000.00	5000
Cartage costs	16	from point of purchase	25.00	400
Cartage costs	95	to point of sale	25.00	2375
Saleyard fees	95	head	8.00	760
Agents commission	4.5	percentage of sale revenue	0.045	7990
Fodder conservation	120	Rolls of hay	26.000	3120
Fertiliser (Pasture Booster)	0.3	tonne/ha	750.00	225
Fertiliser (urea)	0.16	tonne/ha	650.00	104
Drenches and vaccines	214	head	10.00	4280
Total Costs				**51254**
Gross Margin				**126296**
Gross Margin/DSE				**36**
Gross Margin/ha				**1055**

Both properties are suitable for cropping and the western property is currently part of a cropping enterprise which includes lucerne, oilseeds and cereals. In North East Victoria, canola yields for 2019/20 averaged 1.3 t/ha and wheat yields averaged 2.4 t/ha (ABS data). Cropping gross margins from dryland cropping are highly dependant on seasonal conditions, and also vary significantly depending on current prices. At the time of writing, Canola prices were at very high levels of $900 per tonne but this is expected to ease as harvest gets fully underway. Feed wheat prices were quoted at $320/tonne.

Table 6. Indicative Gross Margins for Canola and Feed Wheat crops.

	Range of yields and prices	Gross margin $/ha	Enterprise gross margin from 64 hectares
Canola	At $500/tonne, 1.1 tonne/ha	Loss ($92/ha)	-$5,888
	At $650/tonne, 1.4 tonnes/ha	$251/ha	$16,064
	At $800/tonne, 1.7 tonnes/ha	$682/ha	$43,648
Feed grade wheat	At $240/tonne, 2.2 tonnes per ha	$197/ha	$12,608
	At $290/tonne, 3.0 tonnes/ha	$472/ha	$30,208
	At $310/tonne, 3.5 tonnes/ha	$541/ha	$34,624

The analysis above shows that based on the assumptions above, and particularly assuming a level of management that achieves 12 DSE/ha, the higher income from this land is currently from the grazing of beef cattle herd of vealer mothers. The estimated gross margin from the combined 120 hectares is around $126,000.

5 Potential Impacts of The Solar Farm development for Agriculture

5.1 Livestock, Crop Production and the Solar Farm

The proposed concept design of the solar arrays together with utility areas, areas to be retained with existing native vegetation, areas planted to shelter belts and other proposed uses are provided in Figure 2. Detailed design is yet to be resolved. The design proposes a significant area of land for development of approximately 231,000 solar panels (each panel 1.5 x 1 m). On both titles, current land owners are assumed to continue grazing pastures underneath solar panels with sheep.

The installation of the solar panels will see physical changes to the farm. Existing internal fencing will mostly be removed. Multiple dams are to be filled in to create extra space for the installation of the solar panels, although a large dam will be retained on the eastern title and an area for water storage exceeding 45,000 litres will be constructed on the western title for firefighting purposes and for reticulation to defined watering points as stock are anticipated to be grazed beneath the panels.

It is anticipated that sheep will be able to graze beneath and in between the solar panels. The carrying capacity of the properties will be lower than the current capacity. The reduced carrying capacity is a result of the restriction on plant growth due to the presence of the solar panels. Solar panels are installed for the purpose of capturing sunlight and converting it to power. This competes directly with photosynthesis of grasses and other plants, which is the process by which plants convert sunlight into energy for the purpose of growth. With solar panels installed above pastures, there will be a reduction in the quantity of light which gets through, reducing the potential growth of the plants.

Figure 2. Barnawartha Solar Farm Proposed Solar Development.

There is also an impact on soil moisture as affected by rainfall. The solar panels will not reduce the amount of rain but will change where the moisture will accumulate. Instead of rain falling evenly over land, around half of the incident rainfall will fall on the panels, generating runoff which will be directed onto the area of land just below the panels. The uneven spread in rainfall may further reduce the growth of pasture overall, although it is likely to also stimulate plant growth in the area where rainfall is directed.

Should stock be used to control grass sward length on the farm, sheep would be preferable to cattle as they would be less likely to damage solar panel infrastructure. The current farm infrastructure will need to be updated to do so; stock water reticulation system improvements would be desirable, subdivisional fencing will need to be sheep proof, and existing stock handing infrastructure will need to be modified to hold sheep.

Whilst the carrying capacity of the farm will be reduced, after removal of facility infrastructure at termination of the solar energy project, it is assumed the land may be returned to agricultural purposes with similar productivity to current farming systems.

5.2 Weeds

Weeds as a result of the development of the solar farm are likely to be largely dependent on the management of the pastures after the solar farm has been established. It is probable that weeds will establish in disturbed soils from the installation of powerlines and solar panels. It is unlikely that the solar panels will directly cause a weed problem, though weeds may invade pastured areas due to soil disturbance involved during panel installation. Weeds will grow in and around pastures as is the case on the farm in its present state. A weed management plan will be required to minimise the growth of weeds.

5.3 Impact of Solar Farm on Neighbouring Farms.

There is no clearly identifiable impact from the installation of solar panels on any of the surrounding farming businesses. The removal of 120 hectares from grazing and cropping use should not result in any discernible negative impacts on other grazing businesses in the immediate area. It should not unduly affect market competition. It should not affect the ability of the adjacent farms to operate efficiently. It should not affect productivity of any of the adjacent properties.

5.4 The Agricultural Amenity of the Region.

The Australian Bureau of Statistics (ABS) compiles and publishes agricultural commodity data for nine separate agricultural regions in Victoria, referred to as Statistical Areas Level 4. The subject land for this impact analysis all lies within the Hume Region. ABS 2019/20 data for the Hume Region identifies a significant and stable beef industry with around 580,000 head. The regional beef herd is complemented by 1,400,000 head of sheep and also by cull animals from the dairy industry, giving a gross value of beef and sheep meat production from the region of around $780 million. Crop production for the region is dominated by wheat (31,000 ha) and canola (7,900 ha) while another 55,282ha is used each year for fodder production (principally pasture based hay production).

The proposed solar development will potentially remove around 56 hectares of grazing land from beef production (although it is intended to still be partially used for sheep) and 64 hectares from mixed farming that includes crop production and grazing. On current carrying capacity estimates (Appendix II), this would be a loss of grazing area of just 0.02% for the regional grazing herd. This is a very small proportion of the available grazing land and it is the opinion of the writers that such a change in land use would have no discernible effect on beef supply or market competition. The loss of available land for cropping equates to 0.06% of the cropping land within the region. Again, this should have no discernible effect on supply or competition within the region.

The loss of this land for grazing of cattle should not affect the ability of the adjacent farms to operate efficiently. The adjacent farms appear to have unrelated production systems. It should not affect productivity of any of the adjacent properties.

If all the land were at a productive optimum, the estimated gross margin from a vealer mother beef herd for this land is around $1,050 per hectare per annum. At current market beef prices,

the total gross margin for one parcel of land could be as high as $63,000, however beef prices are quite volatile, and premiums may drop. This is not sufficient farm income to support one labour unit. It is likely that other income sources would be required for any of the grazing enterprises to remain as an economically viable entity.

While farm income would be reduced from agricultural usefulness of the land, this loss of income is offset by the income from the renewable energy facility. Similarly, loss of agricultural employment is fully offset by the employment of operation and maintenance staff to manage the renewable energy facility. There would be additional employment of contractors during the construction phase.

5.5 Cumulative Effect of Solar farms on Agriculture in the Region.

Ag-Challenge Consulting are aware of seven solar farms near the subject site that have been approved for construction and operation. The electricity generation capacities range from 70 MW to 250 MW and the development footprints from 30 hectares to 600 hectares. Six of these are located within the Rural City of Benalla, and one within the Rural City of Wangaratta. The Winton Solar Farm and the Glenrowan West Solar Farm are currently under construction and expected to be operational by early 2021.

Table 7. Solar Farms in Proximity to West Mokoan Solar Farm

	Distance from Project	**Generation Capacity**	**Development Footprint**
Barnawartha Solar Farm		60 MW	120 hectares
Winton Solar Farm	11 kilometres south-east	85 MW	250 hectares
Mokoan Solar Farm	10 kilometres south-east	15 MW	30 hectares
Glenrowan West Solar Farm	14 kilometres south-east	125 MW	320 hectares
Glenrowan Solar Farm	16 kilometres south-east	140 MW	245 hectares
Goorambat Solar Farm	8 kilometres north	70 MW	130 hectares
Goorambat East Solar Farm	8.5 kilometres north	250 MW	600 hectares
Kennedys Creek Solar Farm	5.2 kilometres south	125 MW	290 hectares

6 Environmental Risks

6.1 Soil Erosion

The design and management of the surface runoff requires special consideration. In the first instance, water runoff from the panels may result in degradation of the soil below the panels where the water falls. The panel will tend to concentrate runoff as both an impact and an increased flow into a relatively small area. The degree of concentration will depend on the size of the panels, with smaller panels providing a lower level of risk than larger panels. These soils are not considered to be excessively prone to impact damage or dispersion. However, it would be prudent to maintain good pasture cover or consider placing crushed rock below each panel where water falls to absorb the impact energy of the rain splash, and also to help disperse the runoff across the soil surface rather than allowing concentrated flows within a

small area. With impact damage minimized, it will also be prudent to introduce measures that will retard surface runoff and increase infiltration. The total area of panels is substantial and the runoff from storm events will be concentrated by hard surfaces. The surface runoff needs to be dispersed and retarded as far as is practically possible around the property so that no higher storm runoff occurs within any natural or manmade waterway.

While the design of the project needs to consider soil erosion risks and mitigate against this appropriately, it would also be prudent to incorporate a soil loss and land degradation review into the monitoring program. Other measures to prevent soil loss can be introduced if the design needs modification. An annual review for the first five years of operation would be appropriate.

6.2 Wildfire

The location of the site within a climate with hot and dry summers gives it an inherent risk of fire damage. Bush fires are a common occurrence during Australian summers and occur more easily in dry areas where fuel (dry plant matter) for a fire is readily available. Summer thunderstorms are also common within the Hume region which increases the risk of bushfires.

The key to fire management is to manage fuel loads, so that if fire does occur it is of low intensity and controllable. It will be important to consider how this is done and a number of options are available. One option is to graze under the panels with sheep, ensuring that the sheep are unable to damage the panels as part of the initial design. This may mean preserving or improving some of the existing farm infrastructure so that stock water can be reticulated around the farm. Another option in the event sheep cannot graze under panels would be to use chemical weed control to suppress vegetation within and around the panel areas. A third option would be to mulch the soil with rock or some other substances that will suppress or severely limit plant growth beneath the panels. The increased electrical infrastructure may result in higher risk of ignition, but the fuel load management is critical to how a fire once started, is controlled.

It is anticipated that general bushfire management measures will be addressed in the project's detailed Environmental Management Plan. The Bushfire Management Plan will be prepared in consultation with the Country Fire Authority (CFA) to ensure that appropriate fire risk assessments are undertaken and measures are implemented during development and operation, to minimise the risk to life and property from fire.

6 Conclusions and Summary

- The subject land comprises an area of approximately 120 hectares of agricultural land on Hermitage Road, Barnawartha in three separate parcels. The land is currently utilised for grazing and cropping.
- There are no inherently unique features about the subject land that distinguish it from neighbouring farms in the area.
- The climate of the area is notable for dry and hot summers, summer thunderstorms, moderately low annual rainfall, and significant frost incidence in winter.
- Much of the native vegetation within the two properties has been removed over the years. Some mature Eucalypts remain sporadically scattered throughout the parcels and their boundaries.
- The landform is a flat plain and is part of the extensive landscape of the Benalla Plain.
- The soil types present are noted for moderate permeability and good drainage.
- The land is neither highly productive nor highly versatile. It is not considered to be significant land or strategically important land from an agricultural perspective.
- The development of a solar energy facility on the combined property will alter the nature of the farms. Grazing with cattle may no longer be possible. Cropping will no longer be practical. With appropriate design of the panels and improvement of stock water availability, sheep may be able to graze the land. The carrying capacity of the farm will be reduced.
- After removal of facility infrastructure at termination of the solar energy project, it is assumed the land may be returned to agricultural purposes with similar productivity to current farming systems.
- There are no perceived detrimental impacts of the development of the solar energy facility to the surrounding farm businesses. The impacts to the agricultural amenity of the Region are not significant.
- The concentration of runoff from the panels onto the soil surface may initiate soil erosion. Consideration needs to be given to minimizing this risk in the design stage.
- Heightened wildfire risk will occur if attention is not given to how fuel loads on the farm are managed. Fuel load management needs to be considered as part of the project design.

Appendix I – Soil Profile Descriptions

Soil Profile 1

Site: Southwest of Eastern Property.

Depth (cm)	Horizon	Description
0 – 6	A1	Dark Brown 7.5 YR 3/2 **Loam** Weak crumby Clear *transition to:*
6 – 45	A2	Brown 10 YR 4/3 **Gravelly Loam** Weak crumby Abrupt *transition to:*
45+	B1	Light Olive Green 2.5 YR 5/4 **Gravelly Light Clay** 15% gravel Moderate to strong structure, angular blocky Well drained Hole termination at 100 cm. No auger refusal.

Good drainage, currently perennial ryegrass dominant pasture.

Soil Profile 2

Site: Northeast of Eastern Property.

Depth (cm)	Horizon	Description
0 – 20	A1	Brown 10 YR 4/3 **Clay Loam** Weak crumby Abrupt *transition to:*
20 – 40	A2	Dark Greyish Brown 10 YR 4/2 **Light Clay** Weak crumby Abrupt *transition to:*
40 – 50	B1	Brown 10 YR 5/3 **Light Clay** 20% gravel (ironstone precipitate) Gradual transition to:
50+	B2	Strong Brown 7.5 YR 4/6 **Light Clay** Moderate to strong structure, angular blocky Yellow brown mottling Hole termination at 100 cm. No auger refusal.

Good drainage, currently perennial ryegrass dominant pasture.

Soil Profile 3

Site: Central of Western Property.

Depth (cm)	Horizon	Description
0 – 12	A1	Dark Yellowish Brown 10 YR 3/4 **Sandy Loam** Blocky weak structure Abrupt *transition to:*
12 – 41	A2	Brown 10 YR 4/3 **Light Sandy Loam** Weak blocky structure Clear *transition to:*
41 – 90	B1	Brown 10 YR 5/3 **Clay Loam** Moderate blocky structure becoming strong with depth Gradual transition to:
90+	B2	Yellowish Brown 10 YR 5/4 **Gravelly Light Clay** Yellow, brown and orange mottles Hole termination at 100 cm. No auger refusal.

Well drained, currently pasture with cereal crops in surrounding paddocks.

Soil Profile 4

Site: Northeast of Western Property.

Depth (cm)	Horizon	Description
0 – 7	A1	Brown 10 YR 4/3 **Sandy Loam** Moderate structure, blocky Clear *transition to:*
7 – 22	A21	Brown 10 YR 5/3 **Loam** Moderate structure, blocky Gradual *transition to:*
22 - 52	A22	Yellowish Brown 10 YR 5/4 **Loam** Moderate structure, blocky Diffuse transition to:
52+	B1	Dark Yellowish brown 10 YR 4/4 **Gravelly Clay Loam** Strong structure, blocky Hole termination at 100 cm. No auger refusal.

Well drained, currently lucerne crop.

Appendix II – Model for 90 Cow Weaner Breeding Enterprise

Opening			**Closing**	
Cows	90		Cows	90
Heifers (joined)	15		Heifers	15
Bulls	3		Bulls	3
Purchases			**Sales**	
Heifers	15		Weaners	90
Bulls	1		Bulls	1
Birth	90		Cull Cows	14
			Deaths and provisions	1
Total	**214**		**Total**	**214**

Annual Feed Requirements

Type of Stock	DES rating	Portion of the year		DSE
Cows (weaner mothers)	14	12	months	1260
Heifers	9	12	months	135
Bull	14	12	months	42
			Total DSE	1437
Area required at	**12**	**DSE/ha**	**120**	**hectares**

Area required	120	hectares
Purchase price, bulls	5000	$/head
Purchase price, heifers	1800	$/head
Weaner weights at sale	300	kg

Cull cow price	3.5	$/kg		
Weaner sale weight	300	kg		
Weaner sale price	5.5	$/kg		
Cull cow sale weight	550	Kg		
Income	**Per ha**	**Unit**	**Price/unit**	**Cash Income**
			$/unit	**$**
Sale of Weaners	90	head	5.50	148500
Sale of Cull Cows	14	head	3.50	26950
Sale of Cull Bull	1	head	2100.00	2100
Total Income				**177550**
Expenditure	**Quantity**	**Units**	**Price**	**Cash Costs**
			$/unit	**$**
Purchase of Heifers	15	head	1800.00	27000
Purchase of Bulls	1	head	5000.00	5000
Cartage costs	16	from point of purchase	25.00	400
Cartage costs	95	to point of sale	25.00	2375
Saleyard fees	95	head	8.00	760
Agents commission	4.5	percentage of sale revenue	0.045	7990
Fodder conservation	120	Rolls of hay	26.000	3120
Fertiliser (Pasture Booster)	0.3	tonne/ha	750.00	225
Fertiliser (urea)	0.16	tonne/ha	650.00	104
Drenches and vaccines	214	head	10.00	4280
Total Costs				**51254**
Gross Margin				**126296**
Gross Margin/DSE				**36**
Gross Margin/ha				**1055**