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Assessment Manager

Yarranlea Solar Farm Project

Review of Agricultural Issues

and

Buffer and Pasture Vegetation

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Summary

This report has identified a number of impacts on agriculture associated with this project. Most of these impacts can be mitigated during the detailed design phases and a number of recommendations are provided in this report on some of those matters including the design of fencing and the management of overland flow.

The report also identifies that rural land use in the form of mainly grazing will continue around the physical infrastructure of the proposed solar farm. This grazing will replace the current dryland cropping uses and is consistent with grazing forms of use on contiguous areas not impacted by the project. Just under 50 ha which will not be used for solar farm activities can continue as dryland cropping.

The report has also identified that at the end of the project life time, all physical infrastructure can be removed. Given that underground utilities are installed below normal cultivation depths, and that above ground poles and structures are not concreted in, the rehabilitation process need not involve major rehabilitation actions. The only exception to this will be 0.39 ha of a substation and it is recommended that rehabilitation of this small area back to a condition consistent with adjoining rural use area soil conditions will be required.

The report also recommends that the detailed design stage of the project include the preparation of a relatively simple weed, pest, soil erosion and pasture management plan.

The report has recommended that a mix of sub tropical improved grasses be planted across the development area and over sown as needed by winter active forage. A legume component of the grazed pasture is not recommended as the same herbicides needed to control broad leaf weeds in the grazed pastures will also kill legumes. Broad leaf weeds are of primary concern within both grazed and cultivation areas it is important that they be effectively controlled.

The report also recommends that species selection for the buffer plantings be tied to the two main soil/landscape positions. In the areas of strongly self mulching heavy clays in the lower lying northern areas associated with the overland flow paths, a combination of blue gum and apple species (which originally existed in the area) under planted with tea tree and bottle brushes is recommended. In the remainder of the site, a mix of species derived from the original Brigalow Belah scrub is recommended given that care is taken to ensure that seed be sourced from the local area. It is also noted that many of the understorey species have shorter life cycles than the upper storey species. As an adjunct to a program of subsequent infill planting, it is recommended that coppicing be encouraged for a proportion of Brigalow, Belah, Wilga and Eucalyptus plantings to provide the mid storey fill in the middle and later years of the project as the original mid storey species reach the end of their life cycle.

1 Introduction

This report reviews the implications for agricultural land use and the most appropriate vegetation strategy for the buffer areas of the proposed Yarranlea Solar Farm at Pittsworth.

The review is based on the following reports and information:

- The Yarranlea Solar Project Overview Staging Plan dated 19th August 2016 – referred to in this report as the Plan
- The Typical Landscape Plan dated 19th August 2016 – referred to in this report as the Vegetation Plan
- The Morrison Geotechnic Preliminary Broadscale Geotechnical Report dates September 2016– referred to in this report as the Geotech Report
- CSIRO soil survey report[1] (CSIRO 1959) and the QDPI[2] report (1975) covering the soils of the area
- The Land Audit 2015 Land Use Mapping (QLUMP), the Priority Agricultural Area and Agricultural Land Class A/B mapping available from the Globe portal of QDNRM

The site was inspected on the 19th October 2016 by the author of this report.

2 Over view of Project Site

2.1 The Project Plan

The project site is north east of the junction with Watson Road (an undeveloped road that is not trafficable after rain and which also forms the eastern boundary of the project site) and Yarranlea Road which is a sealed road. The corner of Watson and Yarranlea Roads contains an existing substation on a separate parcel of land.

Yarranlea – Muralaggan Road (a formed and maintained road) traverses east west through the project site. It is proposed that this road will separate Stage 1 (of 100 ha of 40 MW generation capacity) from Stages 2, 3 and 4 (each of 50 ha and 20 MW capacity). Utility connections between the stages is to be a combination of overhead and underground lines.

Apart from small areas of Brigalow softwood non remnant vegetation, the greater majority of the 250 ha of proposed development is used for dryland cropping and associated on farm infrastructure uses such as headlands and soil erosion management works.

Table 1 summarises key elements of the project plan.

Of the 203 ha of land, pre development use comprises a small area for dwelling and farm shed uses and the majority of the remaining 202 ha is used for dryland winter and summer cropping.

Post development land use will involve a similar area of built infrastructure associated with agricultural uses in the form of a new farm lay down and shed area. Areas excised from any rural uses will include <0.39 ha of a substation and an estimated 3.4 ha of vegetated buffer. Areas containing the solar panels will be used for grazing, whilst 49 ha will be retained for agricultural uses and will not have solar panels installed.

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[1] CSIRO (1959 Thompson and Beckman, Soils of the Toowoomba area. Series 28 1:100,000 scale – available from Qld Globe in scanned form

[2] Vandersee QDPI/DLU (1974) Tech Bull 7 Land Inventory Eastern Darling Downs.

Table 1 Predevelopment land uses and development land uses (areas rounded to nearest whole ha)

Lot 2	Current Use	Proposed Use	Proposed rural use during development
Lot 2 RP7475 and 3347 A341649 and Lot 2 RP 18249 Total area = approx. 102 ha	Dryland winter and summer cereal, pulse and forage cropping. Small area of existing softwood vegetation	Stage 1 100 ha of solar farm, 0.39 ha of substation and 5m wide vegetated buffer to external boundaries.	Once developed all areas other than buffers and substation will be have improved pasture established and will be used for grazing.
Lot 2 A3925 of area 199 ha	Dryland winter and summer cereal, pulse and forage cropping including drainage overland flow path that crosses Yarranlea Road and smaller over land flow path that crosses Watson Road. Area also includes a farm house and small shed.	Stages 2, 3 and 4 of 150 ha and a residual area of 49 ha to be retained for agricultural use – inclusive of a farm shed/laydown area.	

2.2 Adjoining Land Uses

Adjoining land uses as of the time of inspection and as indicated in the Queensland Land Use Mapping Project (QLUMP) are as follows:

- All of the project site including where the dwelling is located and the small vegetated area is mapped as dryland cropping (ALUM Code 3.3.0)
- The area to the south west of the Stage 1 (opposite side of Yarranlea Road) is mapped as Production from relatively natural environments grazing of native vegetation (ALUM Code 2.1.0) and in fact is dominated by grazing with highly disturbed Brigalow Belah forest
- The area to the west and north west (opposite side of Yarranlea Road) is mapped as irrigated cropping - cotton (ALUM Code 4.3.6) and in fact is a mix of dryland cropping and irrigated cropping based around an overland flow/ring tank scheme associated with the drainage line that passes through the north western corner of Stage 4.
- Dryland cropping dominates the northern and south eastern boundary of project site whilst grazing dominates the north eastern boundary.

3 Soils and Land Suitability

Whilst parts of the Eastern Darling Downs have been subjected to recent assessments of soils and land suitability, the project site does not fall into one of those areas. The only available assessments date back to the 1959 work of CSIRO and the 1974 work of QDPI.

In the case of this project site, the CSIRO work however provides a reasonable assessment of the soils and the work of Vandersee quite correctly classifies the soils as suited for dryland cropping. A short summary of the soils is given below:

- The area below approximately the 415 m contour line is an alluvial plain dominated by Waco soils – a deep black Vertosol (cracking clay) commonly highly fertile. These strongly self mulching soils supported mostly blue gum (E. tereticornis) and apple (Angophera spp) woodlands prior to cropping development. Diagnostic features of these soils is their deep self mulching surfaces, high water holding capacity and absence of sand or gravel. The Geotech report does show gravels and cobbles present below 2.5m – an indication of the alluvial plain origin. These soils are well suited to cropping.
- The area above the Waco soils form the majority of the site. CSIRO called these soils Cecilvale - a grey of dark grey cracking clay with trace amounts of small rounded gravel in the profile and a thin veneer of sand and silt at the surface. Areas of this soil are extensive throughout the Oakey area and are often associated with poplar box (E.populnea) woodlands. They are often saline at depth and commonly strongly alkaline. They are formed from sediments derived from Walloon Coal measures. In this area however, Brigalow Belah scrubs dominated these landscape positions and the soils are self mulching dark cracking clays. The Geotech report identifies gravels of a non basaltic origin in these profiles. After CSIRO named and described these soils, the Kupunn soils were described in similar land scape positions as being associated with the Brigalow scrubs. The soils on the project site appear to be Kupunn soils and are suited to dryland cropping.

The project site has been mapped as containing Agricultural Land Classes A and B under the Land Audit and this aligns with the Darling Downs Priority Agricultural Area designation.

4 Impacts of the proposed development on agriculture

The types of impacts normally associated with developments are summarised in Table 2 along with mitigation strategies. None of the impacts represent a permanent alienation of the land from rural use. Rural use in the form of grazing will continue during the life of the project.

The impacts can be divided into three broad categories:

<u>Impacts that can be mitigated or which are unlikely to occur during the lifetime of the project</u>. Impacts associated with pest and weed management as well as dust and spray drift fall into this category. It is recommended that a pest and weed management strategy be prepared as part of a detailed buffer and vegetation management plan. These will not be complex documents.

Because the project area will be planted to permanent pasture, there will be no broad hectare cultivation or agro chemical application techniques used that are the main sources of such impacts and the amount of chemical spray used will be far less than in commercial cropping. Insecticides as opposed to herbicides will not be needed to manage the pasture area.

<u>Impacts that can be mitigated at the start of the project in the detailed design stage</u>. These impacts are primarily associated with overland flow and erosion control. During the project lifetime, the use of permanent pasture as opposed to annual cultivation will reduce erosion risks and runoff. The pasture in the project area will use more water than the current annual crops use, the velocity of run off will decrease and the discharge curve for runoff will be 'flattened'. Despite this, the currently installed runoff management system is in need of maintenance and the overland flow paths which are currently cropped over will need to be improved and rehabilitated.

The design of the security fence and vegetation buffer will also need attention.

Specifically:

- flap debris gates that will pass overland flow will need to be installed over the full width of overland flow paths
- elsewhere, the mesh fencing should not extend to the ground level except around the substation
- the buffer vegetation should have species selected that have minimal biomass from ground level to approximately 100 cm so that debris does not accumulate in the overland flow path. There may be a need to prune buffer areas to achieve this outcome.

<u>Impacts that will extend for the project life at which stage they can be eliminated</u>. These impacts are due to the infrastructure that will be built on site and which can or will be removed and the site rehabilitated at the end of the project. Minimising these end of life impacts is a matter for detailed design under a rehabilitation plan.

Irrespective of species selection, the vegetated buffers can be removed at the end of the project life using standard vegetation clearing techniques. However, the use of native species endemic to this area may provide wildlife and other benefits that would endure beyond project closure and removal may not be mandated except as part of any landholder agreement.

Any underground infrastructure installed at the start of the project should be installed at > 100cm below land surface to the top of any bedding material and terminated at that depth at end of project life. This means that there will be no excavation except at termination points required to reinstate agricultural land use as all installed underground infrastructure is below land cultivation depth. The excavated soil material is to be reinstated so that subsoil material (material >300 mm deep) is not placed on the infilled land surface at the start of the project[3].

The solar panels and powerline infrastructure will be removed at the end of project life. The poles will not be concreted in at the start and can therefore be removed without significant land disturbance at the end of project life. The less than 0.39 ha of substation can also be removed at project end. An appropriate condition would be that all impacts are remediated by returning the site to the same soil conditions as in the adjoining grazed area which has not been disturbed.

[3] This type of condition is based on the EA conditions commonly used for lower diameter CSG pipelines that traverse cropping land

Table 2 Impact types and mitigation

Impact Type	Description of Possible Impacts	Mitigation
Weeds and Pest	Within development area acts as a source of both declared and undeclared weeks and pests as well as reservoirs for diseases	Areas not directly used for the development are to be maintained in either dryland cropping or improved pasture state. They are not to be left fallow and a pest and weed management plan is to be developed and updated.
Overland Flow and Erosion	Existing erosion control structures are not maintained, increasing sediment export to adjoining land and overland flow paths capacity is reduced by infrastructure (such as buffers and fencing)	An erosion control plan for existing structure is to be developed and implemented. Buffer and fence designs where they cross flow paths are to be designed so as not to impede the design depth and velocity of the water ways. Section 5 of this report describes the buffer vegetation mixes. Mix A (a blue gum dominant mix) is recommended for areas that include the overland flow path. In overall terms the runoff from the development is unlikely to be greater than current run off patterns from dryland cropping. Soil water use from winter and summer active pastures and permanent vegetation on the buffers will be greater than from crop land and soil vegetation cover will be greater and perennial
Alienation and Fragmentation	The development permanently alienates the area from agricultural use and the alienated area fragments agricultural holdings	The proposal does not involve subdivision or an RoL which would increase permanent fragmentation. The proposed use has a defined life time at which time infrastructure will be removed and does not cause permanent alienation Grazing forms of agriculture land use will be conducted in the development area during the project– contiguous areas are already used for grazing. The landscaping infrastructure can be removed at the end of project life and returned to a rural use using already existing rural land use techniques. The substation infrastructure is a small area of 0.39 ha and could be demolished

Impact Type	Description of Possible Impacts	Mitigation
		and rehabilitated at the end of project life The solar panel infrastructure and any associated pole and overhead infrastructure is to be based around driven poles not concrete inserts. The above ground component will be pulled up at end of life and not excavated. Any underground infrastructure is to be installed at > 100cm below land surface to the top of any bedding material and terminated at that depth at end of project life. This means that there will be no excavation except at termination points required to reinstate agricultural land use and all installed material is below land cultivation depth. The excavated soil material is to be reinstated so that subsoil material (material >300 mm deep) is not placed on the infilled land surface.
Dust and Spray Drift	Activities conducted in the development area may increase drift hazards	It is likely that herbicides to control weeds and manage the buffer areas will be used. The weed and pest management plan will provide detail, however, the broad hectare wide boom and aerial spraying techniques common on adjoining properties will not be used even though a similar range of chemicals for the control of narrow and broadleaf weeds will be used. As the project area will be planted to pasture, there will be less dust generated than from dryland cropping.

5 Buffer and Pasture

The keys to successful buffer and pasture vegetation outcomes are:

- timing and sequencing of planting
- species selection

5.1 Timing and Sequencing of planting

Given the species groupings discussed below, the most appropriate window in time to plant either buffer or pasture is in Spring early Summer when both soil and night time temperatures are rising and there is no risk of late frosts.

5.1.1 Buffer Strips

For buffer strips a planting window of late October to April is most suited. Planting later than April when day length is shortening may result in poor growth vigour until the next Spring with a consequent need for greater infill planting and more extensive winter management. Conversely the earlier planting may require post plant watering if there is a dry start to the planting window.

5.1.2 Pastures

Most sub-tropical pasture species will not vigorously establish whilst soil temperatures in the near soil surface are not consistently rising and not above 18 to 20 degrees centigrade. Typically this requires a planting window of mid December to late February with treated and coated seed planted into a moist soil profile. If this window is not available because of project timing, a dense cover crop of millet (for a summer planting) or forage oats, can be zero till planted and either grazed out or slashed and killed with a knock down herbicide (such as Glycophosphate) and the treated pasture seed mix zero till planted into the next available planting window.

5.2 Species selection

The species selection approach needs to be driven by pragmatism in that suited and adapted species that will persist are the key requirements.

5.2.1 Buffer Strips

A number of exotics will establish in the soils of this area, however unless they are able to persist when their roots penetrate the deep subsoil where strongly alkaline pH's and poor internal drainage as well as higher soil salinity levels are encountered, they will not persist and thrive beyond the first few years. It is common for failed plantings of exotics or native species not endemic to an area to be diagnosed as pest and disease caused, when more often than not the plantings are weakened by unsuited soil conditions that pre dispose the variety to disease.

Over time most planted buffer strips do decline in functionality if not intensively managed. This is particularly common where only a few similar form and shape species is selected (particularly where eucalypts are used).

The major types of medium to long term problems which relate back to species selection and on going management are:

- decline of the mid storey component once full upper canopy cover (which happens earlier than full height) is established (typically years 6 to 12). The end result is that the density and screening value of the mid storey declines after the first decade.
- Die back of all components after the first 5 to 15 years. Some dieback associated with disease and pests is common – particularly in near monoculture eucalypt plantings and with

mid storey species that have a short life cycle. In some situations the commencement of die back in the upper storey may coincide with mid storey end of life stages.

Table 3 contains a list of species that were once or still are associated with the soils of the area. The table identifies soil areas where the species mix is most appropriate. This species selection is aimed at minimising the 'die back' effect by basing the selection on species associated with the soils of the site.

Apart from normal pest and weed management practises, the key management tool recommended in Table 3 is that of coppicing. Coppicing is a process where a selected number of dominant central upper stems are removed when fully canopy closure has occurred but before full height has been reached (and mid storey die back has started). Eucalypts, Brigalow and Belah are species which are renowned for their multiple stem regrowth/suckering from cut stump coppicing. This process infills the loss of mid storey buffer capacity whilst also allowing dominant overall height to managed.

Table 3 Buffer Strip vegetation mixes

	Mix A	**Mix B**
Soils	Areas of Waco soil – heavy clay strongly self mulching black clays.	Areas of Kupunn/Cecilvale soils – lighter cracking clay soils – originally Brigalow scrub soils
Location	Northern end of Stages 2, 3 and 4 and eastern boundary of Stage 2 north of and including the overland flow path. Along the western edge areas norther of the 415 m contour.	All other areas
Upper storey component for >10 m final height (20% of overall mix)	Blue Gum (E. tereticornis- Select and use genotypes developed for fast growth in agro forestry applications) and Apple (Angophora spp). Blue Gum commonly available as advanced tube stock – 100% of upper storey mix.	Brigalow and Belah (Acacia harpophylla and Casuarina cristata) – select or collect seed from local area as this is critically important as there is a wide range in genotypes. These should dominate the mix. The rest should be selected from Leichardt Bean (Cassia brewsteri) and poplar box (E populnea).
Lower storey component for <10m height component	There were no mid storey species in the original community. Black Tea Tree (Melaleuca bracteata) is adapted to these conditions and will coppice to infill the storey once established. Some fast growing varieties of bottle Brush (Callistomen spp) could be included.	A wide range of local species could be used. These include, false sandal wood (Eremophilla mitchelli) and sally wattle (Acacia salicina) neither of which will persist once the upper storey cover is complete. Wilga (Geijera parviflora) will persist and will strongly coppice and effectively replace loses.
Grass layer mix	Use pasture mixes – they will be shaded out after the first few years when a litter layer is developed. The 60 cms around the buffer plants should be kept grass free in the first year	Use pasture mixes – they will be shaded out after the first few years when a litter layer is developed. The 60 cms around the buffer plants should be kept grass free in the first year

	Mix A	Mix B
Comment Upper Storey	The Apple tree component will die back after the first 5 to 10 years, however canopy lateral cover from the blue gum may compensate. If Blue Gum is planted at a heavy rate, some trees can be coppiced to provide lower and mid storey cover	Losses of up to 30% can be anticipated with Belah. Both Poplar Box and Brigalow will coppice and contribute to lower storey cover if some of the established stands are cut at below chest height.
Comment on the Lower Storey	Coppicing of upper storey species will be critical to lower storey buffer function after full upper storey canopy cover is established.	Heavy planting rates at greater than required final density is recommended to compensate for early loses.

5.2.2 Pasture Species Pasture species that provide good ground cover in the first season and which will persist under grazing are required. Most native grasses are slow to establish and they will be out competed by weed species on these fertilised cultivated lands. As a result, improved pasture species are recommended. Table 4 lists the advantages and disadvantages of various species.

Legumes are not recommended for the following reasons – the primary weeds of improved grazed pastures are broad leaf weeds. All broadleaf herbicides will kill improved pasture legumes. A preferred strategy is to use nitrogen fertiliser programs to maintain soil fertility and vigour of plant growth.

A mix of Bisset bluegrass and Rhodes grass is recommended with a small component of Purple Pidgeon grass in the initial planting.

All seed should be coated (and therefore able to be zero tilled planted) and treated with ant repellent

Table 4 Recommended Pasture Species

Species	Benefits	Disbenefits
Creeping Bluegrass (Botriochloa insculpta) – Bissett variety	Well adapted to these soils and is widely used in soil conservation works. Moderately palatable and responds well to fertiliser and slashing. Highly recommended	Like all bluegrasses it can be slow to establish, but once established it will persist.
Floren Bluegrass (Dichanthium aristatum)	As above, but of lower palatability and thus resistant to heavy grazing. Recommended and would perform best on the Waco soils	Genotype related to Angleton grass which is regarded by some as a weed. Not recommended if Creeping blue is able to be established.
Purple Pidgeon grass (Setaria incrassate)	In mixed plantings often does not persist after the first few years – a useful pioneer species if included at a low seeding rate in the initial planting. Will become less	A strong tussock type grass that will be rank if not heavily grazed or slashed.

Species	Benefits	Disbenefits
	dominant as soil N levels decline	
Rhodes grass (Chloris spp)	A large number of varieties exist. Normally a "shotgun" mix of cold tolerant varieties with varieties that have large leaf production (as opposed to stem material) is recommended. Will initially out compete the blue grasses which are slower to establish. Responds strongly to fertility.	Because of higher palatability, these grasses are often grazed out by stock allowing the blue grasses to become dominant over time. Seed purity is critical – there are a number of Chloris species that are regarded as important weeds of cultivation (such as feather top rhodes.)

All of the recommended sub-tropical grasses are winter dormant hence growth after the first frosts will be minimal. If the grassed areas are either slashed or heavily grazed, winter active temperate grasses such as rye or forage oats could be sod seeded with minimal damage to the sub-tropical pasture.

5.3 Species availability and Cost

All of the pasture seed are commonly available. The Darling Downs has become the centre for grass seed production in recent decades and seed should be sourced from local suppliers. All seed used should be pelleted and treated.

Tree and shrub species may not be as readily available as grass seed. Typically tubed stock for significant bulk orders can be purchased and planted in prepared land in under 3 weeks from order if stock is available. However, if the tube stock have to be generated from seed, it will typically take 6 to 12 weeks to planting allowing for a hardening stage. If the closure of the planting window is say mid April, then orders for tube stock should be placed by November of the previous year and preferably much earlier.

If available ex stock tubed stock will have a cost of between \$3 to \$5/ tube. Costs will be higher if the supplier has to source seed from field collections.