ATTACHMENTS

Infrastructure & Environmental Services Committee Meeting

9 August 2022

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19MPL0314

Government
of South Australia

The Hon Stephan Knoll MP
Member for Schubert

Ms Karen Redman
Mayor
Town of Gawler
PO Box 130
GAWLER SA 5118

Dear Mayor

Thank you for your letter regarding the Rural Areas Development Plan Amendment.

I acknowledge that in response to my letter dated 20 January 2019, Council has now released from confidence the Statement of Intent (SOI) and the 'Rural Land Use and Infrastructure Investigations Report 2' by Jensen Planning and Design (the Report). I also note that Council is proposing to undertake public consultation on the SOI and Report with a view to progressing a change to the land use policy framework over the next 12 months.

I am advised by the Department of Planning, Transport and Infrastructure that in addition to Council's proposed analysis of infrastructure needs and associated costs, comprehensive investigations are required to inform the strategic settings for the 1700 hectares of rural zoned land, noting that data which informed the Report also requires updating.

These required investigations are substantive and would need to include (but not be limited to) a comprehensive assessment of land demand and supply, land capability and viability and population demographics (to inform the direction for the best use of the land to achieve liveability and amenity), economic prosperity and social development, while managing:

- land use compatibility and land use interface issues
- landscape and heritage values
- natural resources, topography and drainage lines
- natural hazards including land liable to inundation and bushfire risk
- transport and connectivity
- broader impacts on residential growth and productive rural land use activities
- community services and facilities
- urban design.

Minister for Transport, Infrastructure and Local Government
Minister for Planning

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SOUTH AUSTRALIA

As you are aware, existing Development Plans will be replaced by the new Planning and Design Code by July 2020. Given this timeframe and the work required to ensure a successful transition, coupled with the significant investigations required and Council's proposed public consultation to inform the SOI, it is my view that Council's efforts would be best channelled toward having the matter properly considered as part of a proposed future amendment of the Planning and Design Code.

I trust this information is of assistance.

Yours sincerely

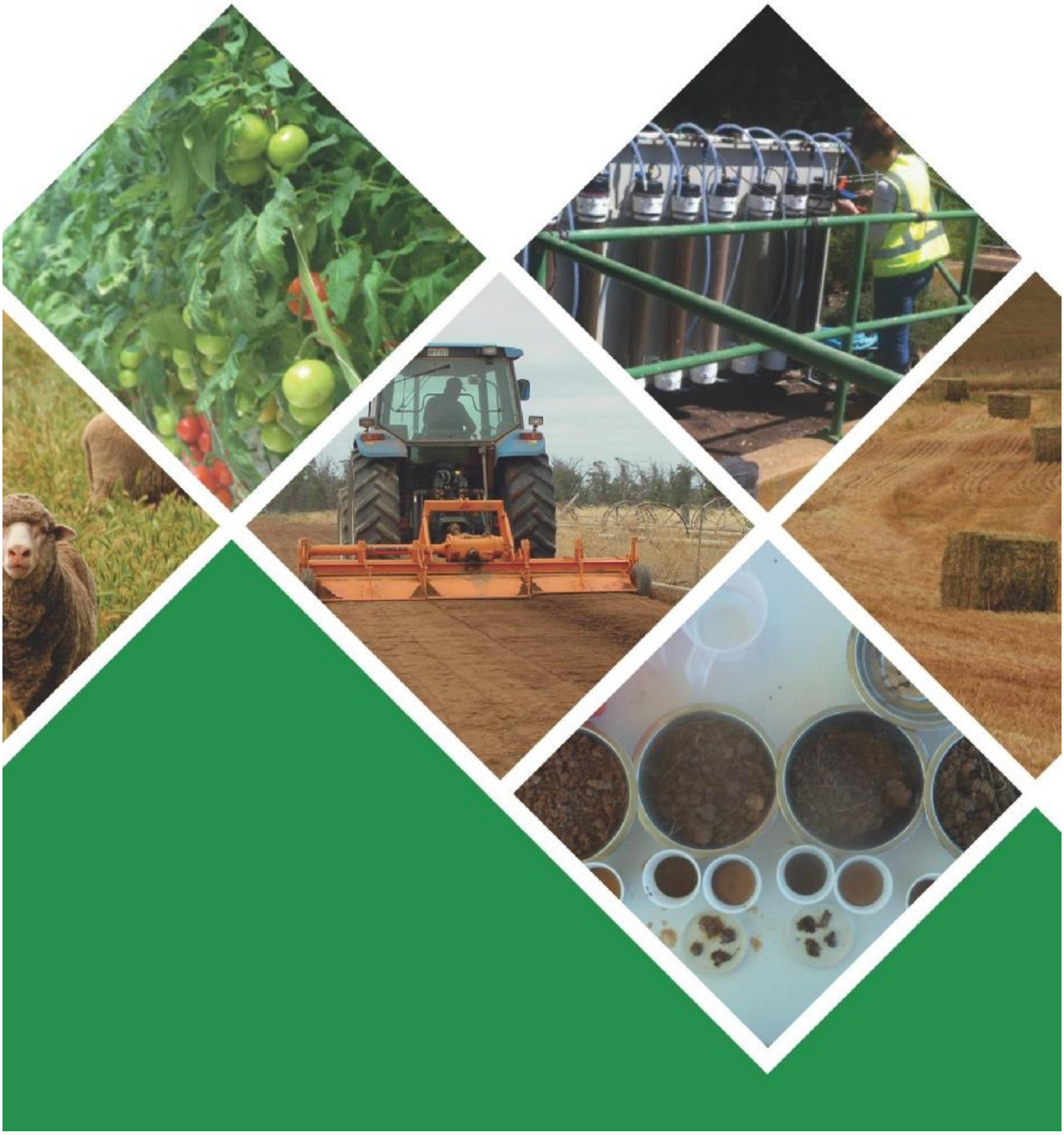
HON STEPHAN KNOLL MP
MINISTER FOR TRANSPORT, INFRASTRUCTURE AND LOCAL GOVERNMENT
MINISTER FOR PLANNING

4 / 6 /2019

arris
agricultural & environmental

Land Capability Assessment
Gawler Rural Zone

For: Town of Gawler



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Abbreviations

Abbreviation	Description
<	Less than
>	Greater than
%	Percentage
$	Dollars
$/ha	Dollars per hectare
t/ha	Tonnes per hectare
l/ha	Litres per hectare
Km/hr	Kilometres per hour
l/t	Litres per tonne
t	tonne
m	Meters
mm	Millimetres
m^2	Meters squared
dS/m	Deci-siemens per meter
mg/kg	Milligrams per kilogram
GL	Giga litres
HCL	Hydrochloric acid
PIRSA	Primary Industries and Resources SA
ha	Hectares

Executive Summary

A land capability assessment has been prepared for the "Gawler Rural Zone" which lies south and west of the town of Gawler. The original concept for this area was to maintain it as a green belt that would separate the Town of Gawler from urban development to the south. The allotment size in the Gawler Rural Zone has decreased due to subdivision and the Town of Gawler council now seeks to clarify if different primary production enterprises are still viable in terms of economic return, social and infrastructure aspects. Arris Pty Ltd has been engaged to asses primary production viability within the Gawler Rural Zone. The aims of the land capability assessment were to:

- Assess the capability and suitability of Rural Land within the Town of Gawler for primary production; and
- Assess the factors that impact the commercial viability of primary production within the Rural Zone.

There has been some confusion with regards to the term "Land Capability" and "Land Suitability". The terms are defined as follows:

- _Land Capability_ is the potential of land for use with specified management practices. Land is placed into capability classes from *least* limitations to *most* limitations. The South Australian Government Soil Mapping Program developed a 5-class system for land capability that uses soil and land attributes to determine land class for different crop types. This concept has been defined as "Land Use Potential". Class I land is least limiting and requires only standard land management practice, while Class 5 land has permanent limitations that preclude agriculture or horticulture. The Soil Mapping Program has made this data available on NatureMaps;
- _Land Suitability_ for a specific land use or crop type assesses *all* soil and land limitations *and other factors* such as climate, infrastructure, water availability and gross margins. There will be variations within these parameters and the final land suitability will depend on the risk a landholder is prepared to undertake to conduct a specified land use without causing environmental harm.

The South Australian Soil Mapping Program divided agricultural land into *7 land use potential categories,* namely: Field crops; Perennial horticulture; Annual horticulture; Irrigated pasture; Dryland pastures; Native fodder; Alternative crops (no land use limitation for hydroponic greenhouse production). The land use potential categories within the Gawler Rural Zone are *field crops, perennial and annual horticulture*. These land use potential categories have been assessed against each land system within the Gawler Rural Zone:

- _Land systems_ are mapped and defined as broad and readily recognisable landscape areas defined by particular and distinctive patterns of geology, topography, soils and vegetation within a limited climatic range. Each Land system comprises one or more Soil landscape units. The land systems within the Gawler Rural Zone are *Smithfield, Northern Adelaide Plains, Angle Vale, Gawler River and Yattalunga*;
- _Soil landscape map units_ are areas of land defined by recognisable topographic features, formed on specific geological materials (or sequences of materials) and with a limited number of soils occurring in known (estimated) proportions;

The results of *land use potential assessment* for *field crops, perennial and annual horticulture* are as follows:

- Field Crops overall have ***a moderately high (class 2) land use potential*** with the exception of the Yattalunga land system. The limitation for this category is based on allotment size and scale of production rather than limiting soil and land attributes;
- Perennial horticulture overall has ***a moderate (class 3) to moderately high (class 2) land use potential***. Production in the Gawler Rural Zone will require specialised land management.

The Northern Adelaide Plains will not support all perennial horticulture plantings due to high soil pH and soil carbonate content of the soil and the Yattalunga land system is not capable of supporting perennial horticulture due to slope and rock content of the soil;

- Annual horticulture overall has ***a moderate (class 3) to moderately high (class 2) land use potential***. Production in the Gawler Rural Zone will require industry standard and some specialised land management. Smithfield and Angle Vale land systems are preferred for annual horticulture based on government mapping. The Northern Adelaide Plains and Gawler River land systems will require more specialised land management. Yattalunga land system is not capable of supporting annual horticulture with severe limitations, including slope, shallow soil depth and high coarse fragment content.

In the Gawler Rural Zone land suitability for field crops and perennial and annual horticulture should consider allotment size. Data supplied by Gawler Council (September 2021) showed that 90% of land within the Gawler Rural Zone is less than or equal to 5 ha in size. *Gross margin analysis* for an allotment size of 1 ha and 5 ha for field crops, perennial and annual horticulture showed:

- **Field crops** are not-viable on a land size of 1 ha or 5ha. The benefit of field crops would be for small quantities of on-property hay and or ground cover and management of pest plants and weeds;
- **Perennial horticulture** is viable at 1 ha and 5 ha if the income was used to cover land costs such as rates, water and electricity at 1 ha scale, but at 5 ha scale there is scope for a modest *second income* from the property. Vines and Olives are suited to all land systems within the Gawler Rural Zone and would be the preferred option for perennial horticulture. Citrus such as Mandarins are marginally more profitable but are limited on some land systems such as the Northern Adelaide Plains due to presence of shallow soil carbonate and calcrete with high soil pH;
- **Annual horticulture** is viable at 1 ha and 5 ha scale when crops are grown either as low technology polyhouses or as in-ground crops and could provide a *sole income*. *All annual horticultural crops could provide an income from 5 ha* with gourmet tomato and capsicum providing the greatest potential income;
- **Native Food Crops** such as Bush Tomato, Native Lime (Desert Lime) and Quandong are suited to the soils and environment within the Gawler Rural Zone. Production at 1 ha to 5 ha is possible but the returns variable. To be successful produce should be sold at local niche markets.

The costings are based on average yields and exclude fix costs and assume a viable water supply for the production of all crops. The main restrictions to perennial or annual horticulture in the Gawler Rural Zone are:

- Water supply;
- Confirmation of zoning for perennial or annual horticulture;
- Transport routes;
- Noise.

Water supply is currently a major limitation to development of the Gawler Rural Zone for primary production. Reliable, quality and affordable water is required and recycled water maybe the main source. The State Government in-conjunction with Kellogg Root Brown Pty Ltd are developing the business case for use of recycled water for the Barossa Valley. An opportunity exists for the Town of Gawler to secure water from the "Barossa New Water" project as the pipeline routes have not been finalised. Perennial and annual horticulture are viable options based on gross margin analysis and would require the securing of water from the Barossa New Water project or an alternative reliable source.

Recycled water schemes such as Glenelg to Adelaide Parklands and the example of the Casey Fields development in the City of Casey near Melbourne, VIC, show the use of recycled water is feasible. The Town of Gawler could investigate the use of recycled water from its own council boundary for irrigation of residential homes, green spaces, golf courses and primary production.

The development of open recreational and sporting complexes in the Gawler Rural Zone as a "re-imagined green wedge" has been discussed within the Town of Gawler with the preparation of the "Town of Gawler Open Space, Sport & Recreation Plan 2025". Another issue affecting the Gawler Rural Zone is land speculation where larger allotments have been purchased with the aim of subdivision at a later date. This process has contributed to 90% of land within the Gawler Rural being less than 5 ha in size.

The successful development of the Gawler Rural Zone as primary production hub will also require coordination between government agencies. SA Water will need to be involved if recycled water from Bolivar Treatment Plant is acquired via the Barossa New Water project. PIRSA (Primary Industries Resources SA) and SARDI (SA Research Development Institute) will be involved with regard to crops, water requirements and land management guidance to growers. Individual not for profit grower organisations will also have an input into crop management. Finally there needs to be cooperation between adjacent Councils, particularly discussions on prospective recycled water pipelines routes for development of primary industries.

The recommendations from this study are:

- Soils in the Gawler Rural Zone are in general not limiting for primary production in the Gawler Rural Zone. Soil properties such as soil carbonate, soil pH, salinity, waterholding capacity and percentage of coarse fragments will impact all crop yields depending on crop tolerances. Matching crop to soil conditions and soil management will be required;
- Analysis of land size shows 90% of the area is composed of landholdings of 5 ha or less. The Gawler Rural Zone will therefore be suited to small intensive annual horticultural using low cost polyhouses with in-soil production or small-scale perennial horticulture;
- ***Water is the main limitation to primary production in the Gawler Rural Zone***. There is an opportunity to acquire water from the Barossa New Water project currently in the business case stage. Gawler Council could approach PIRSA and Kellogg Brown Root Pty Ltd with an expression of interest for water allocations and infrastructure for the Gawler Rural Zone. If unsuccessful the alternative approach would be development of a recycled water facility within the Gawler Council area to supply all domestic garden, green space and primary production needs;
- Based on the assumption of adequate water, there is the potential for the Gawler Rural Zone to produce niche horticultural enterprises with closeness to Adelaide Markets.

1 Introduction

There has been on-going debate within council and successive state governments about land use in the area referred to as the "Gawler Rural Zone" (Figure 1-1). This area lies between the council districts of Town of Gawler and the City of Playford (Ward 2) along Dalkeith Road. The original concept was to maintain a green belt separating the Town of Gawler from urban development from the south. The allotment size has decreased within this zone due to subdivision and the Town of Gawler council now seeks to clarify if different primary production enterprises are still viable in terms of economic return, social and infrastructure aspects. Arris Pty Ltd has been engaged to asses primary production viability within the Gawler Rural Zone.

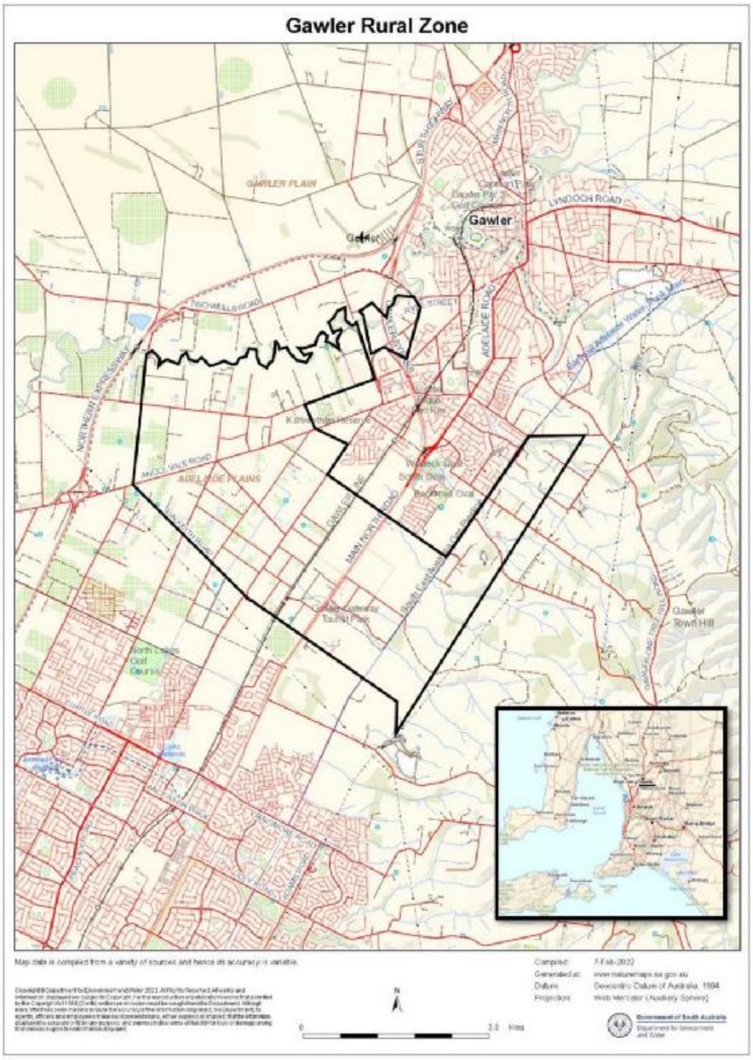


Figure 1-1 Location map showing Gawler Rural Zone

2 Aims

The aims of this Land Capability Assessment are clearly stated in the scope of works by the Town of Gawler, they are:

- Assess the capability and suitability of Rural Land within the Town of Gawler for primary production; and
- Assess the factors that impact the commercial viability of primary production within the Rural Zone.

3 Literature Review

Reports prepared for government agencies and councils in the Northern Adelaide Plains region by Jensen Planning and Design (Jensen 2013 and Jensen 2015) listed a number of priority areas for the Gawler Rural Zone which included: land tenure and zoning, development of infrastructure including power supply, gas, and freight routes; land values and return on investment from agricultural and horticultural enterprises; industry leadership, access to markets and training. These areas were considered necessary for development of the Gawler Rural Zone with regard to agriculture and horticultural enterprises.

A major issue for agricultural and horticultural development of the Gawler Rural Zone is access to water supply. The Northern Adelaide Plains Water stocktake (Goyder Institute 2016) listed five sources of water for the region that are currently used or could be improved, they are:

- recycled water currently supplied to the Virginia Pipeline scheme;
- groundwater extraction from Tertiary aquifers that is currently under-utilised;
- harvesting of water from natural watercourses and stormwater;
- Gawler River reuse scheme; and
- Water use efficiency improvements with existing irrigated developments.

More recently the State Government of SA has initiated a project titled “Barossa New Water” with the aim of introducing recycled water into the Barossa and Eden Valleys (PIRSA 2021). The project is in the Business Case stage and is run through several government agencies including: Department of Primary Industries and Regions (PIRSA); Department of Treasury and Finance, SA Water, Department for Environment and Water, and Infrastructure SA. Kellogg Brown and Root Pty Ltd (KBR) have been engaged to develop the detailed business case which will include potential investment options. Stakeholders include existing water customers, potential new primary producers and users, current infrastructure owners and industry stakeholders.

The pipeline route has not been confirmed at this stage and there is the potential that recycled water could be directed to the Gawler Rural Zone for use as irrigation water for agricultural or horticultural crops and or for use on open space land such as sporting facilities, golf courses and general open public land. Contracting of the water supply to users will affect the pipeline route which is currently not finalised.

In 2017 the Horticultural Coalition of South Australia (HCSA) prepared a report titled “South Australian Horticultural Blueprint”. It was reported that in 2015-16 the estimated farm gate value of produce from 45 different horticultural commodities was $920 million and over a 10-year period from 2005 to 2015 there has been an 85% increase in farmgate returns. The HCSA believes there are further opportunities with capital investment, new technology and export markets.

Based on this data and the findings of the Jensen reports (2013 and 2015), information provided by the HCSA and the business case for Barossa New Water being prepared by Kellogg Brown Root and PIRSA there is potential for the Gawler Rural Zone to contribute to this production if water, infrastructure and planning issues are resolved. Horticultural development of the Gawler Rural Zone is one possible option. Other options may include creation of "Green space" recreational zone and sporting complex or potentially allowing further subdivision of the Gawler Rural Zone.

The aims of the Land Capability Report (section 2.0) will be addressed as follows:

- Definitions of land capability and suitability assessments as used in South Australia will be defined to clarify the differences and purpose of these two land assessment procedures;
- Analysis of soils and landscapes within the Gawler Rural Zone based on existing publicly available data from the South Australia government soil mapping program;
- Determination of land size within the Gawler Rural Zone to determine the potential for agricultural or horticultural development;
- Gross margin analysis of agricultural and horticultural enterprises;
- Stakeholder consultation through multi-criteria analysis to determine government, landholder and other interested party views regards the Gawler Rural Zone; and
- Summary presentation of key findings and recommendations.

4 Definitions

4.1 General definition of Land Capability

Land Capability is the potential of land for use with specified management practices (Dent and Young 1981). The concept was first developed in the USA for farm planning (Klingebiel and Montgomery 1961). Land is placed into capability classes from least limitations (class I) to most limitations (class VIII).

Mapping in South Australia has used 8 class definitions for dryland agriculture and grazing regimes (Maschmedt 2002) (Table 4-1). Several notes accompany the use of the class definitions, these are:

- Class definitions are based on observation and experience and not experimental work;
- The classes are guidelines only and not rigid boundaries;
- The classification system is applicable throughout the agricultural districts of South Australia, but is not specific to individual paddocks, districts or regions;
- The definitions will need to be modified as technology increases;
- The lower limit for agricultural land in South Australia ranges from 160 mm to 180 mm, less rainfall is considered pastoral zone.

Table 4-1 Land Class Definitions

Class	Description
1	Land with no significant limitations which can be used for all types of agricultural production on a permanent basis.
2	Land with slight limitations, which can be used for most types of agricultural production on a permanent basis provided that careful planning and simple modifications to standard practices are applied. Simple modifications do not include capital expenditure on works or machinery, nor do they require the use of specialized technology. Some examples of simple modifications are; contour working, reduced tillage, use of tolerant varieties, additional fertilizer applications and so on. Slight productivity reductions occur where limitations cannot be overcome.
3	Land with moderate limitations, which can be used for most types of agricultural production on a permanent basis, provided that very careful planning and intensive management practices are applied. Intensive practices involve capital expenditure on works or equipment, and/or the use of specialized technology, and/or practices requiring significant

	time and inconvenience. Moderate productivity reductions occur where limitations cannot be overcome.
4	Land with a sufficiently high level of limitation that the growing of annual crops requires a high level of management skill or is characterized by low productivity. This land is used for improved pastures or, depending on the type of limitation, for perennial or occasional annual crops.
5	Land which has such a high level of limitation that its low productive potential and/or extreme management requirements limit its use. Improved pastures, or perennial horticulture (where erosion potential is the main limitation), are the principal land uses.
6	Land not traversable with standard equipment due to steep slopes or excessive rockiness. The land is mostly used for grazing of native pastures.
7	Land with extreme limitations which requires protection by perennial vegetation. Some limited grazing is possible but the primary aim of management is protection rather than productivity.
8	Land with no productive potential, but not requiring any specialized management for its protection. This land includes exposed rock, bare salt pans and land permanently inundated.

4.2 General definition of Land Suitability

Land suitability evaluation assesses land for specified uses. Examples may include: intensive rotational horticulture with vegetable crops; rainfed arable farming of Lucerne hay; turf farming.

Land suitability for a specified use has four levels of classification (Landon 1984). They are order and class (subclass and unit):

- Order – refers to suitable (S) or non-suitable (N) for specified use;
    - Suitable (S) refers to land on which sustained use from an enterprise does not impose unacceptable risks to the land resources or environment;
    - Non-suitable (N) refers to land that has qualities that preclude sustained use of the enterprise under consideration;
- Class
    - S1 – highly suitable – non significant limitations to a given land use
    - S2 – moderately suitable – limitations above that of S1 land that reduces productivity or benefit and increases inputs above that of S1 land
    - S3 – marginally suitable – limitations that reduces productivity or benefit and increases inputs to a level that only marginally justifies this land use
    - N1 – currently not-suitable – limitations that at the present time that are unable to be altered with current knowledge. Limitations preclude successful sustained use of the land for the desired use
    - N2 – permanently not-suitable – limitations severe and precludes use of the land in the desired manner.

5 Methodology

The general methodology adopted in this report is to determine if the soil, landscape and climate of the rural zone is capable of supporting varied commercial primary production. Publicly available gross margins will be used in-conjunction with property size and valuer generals land values to assess the economic viability of land within the rural zone.

Land suitability assessment will be based on publicly available soil landscape mapping and land use potential developed by PIRSA (Primary Industries Resources SA) mapping program. Land, soil and climate data will be used to assess the suitability of the five production types. Land characteristics assessed will include slope, aspect, flood risk and drainage patterns. The major soil types within the rural zone will be assessed with regard to their soil physical and chemical characteristics that limit or constrain agricultural and or horticultural production. Access to water including surface water, groundwater and reclaimed water will be assessed along with water quality and quantity.
Finally, gross margin analysis for the five primary production types will be assessed. The results may indicate land, soils and climate that are capable of supporting primary production but the financial returns or other factors such as access to markets and infrastructure may limit primary production.

6 South Australian Soil and Landscape mapping

6.1 Definitions

Mapping in South Australia uses a 5-class system which links *Soil Landscape Mapping* to *Land Use Potential* (Rowland *et al* 2016):

- *Land systems* are mapped and defined as broad and readily recognisable landscape areas defined by particular and distinctive patterns of geology, topography, soils and vegetation within a limited climatic range. Each Land system comprises one or more Soil landscape units;
- *Soil landscape map units* are areas of land defined by recognisable topographic features, formed on specific geological materials (or sequences of materials) and with a limited number of soils occurring in known (estimated) proportions;
- *Land Use Potential* is defined as the potential of soil and land to sustain a specific crop type. Land use potential in South Australia only deals with *soil and land attributes* that impact on a crop or land use. It does *not* include economics, climate, landscape, soil type, pest and disease incidence, water availability (for irrigated crops), social considerations and government regulations. As such land use potential *is not* land suitability but describes *land capability* for a specific use.

Mapping in South Australia uses 7 soil and land attribute groups, they are: topography; waterlogging; chemical barriers to crop root growth; soil depth and water storage; soil fertility; soil physical conditions; erosion potential (Table 6-1). Each group has several specific soil physical and chemical properties that relate to that group. For example, "soil physical conditions" has soil and land attributes: surface soil condition; surface texture; structure of subsoil; water repellence.

Soil and land attributes are used to *define* land use potential. Not all soil and land attributes (Table 6-1) will be applicable to each soil landscape and region under assessment. A land classification criteria table is prepared for each crop type and the soil and land attributes are assigned a limitation class from 1 to 5 (Table 6-2). *For example, the potential rootzone depth for Almonds* is defined as:

- Class 1 – > 80 cm - degree of limitation negligible (corresponds to land class 1, 2 Maschmedt 2002);
- Class 2 – 50 - 80 cm - degree of limitation slight (corresponds to land class 3, 4);
- Class 3 – 30 - 50 cm - degree of limitation moderate (corresponds to land class 5, 6);
- Class 4 – 20 - 30 cm - degree of limitation high (corresponds to land class 7);
- Class 5 – < 20 cm - degree of limitation severe (corresponds to land class 8).

This process is repeated for all relevant soil and land attributes and a list of limitations for the crop type is recorded and mapped.

The results of this type of land evaluation is shown in NatureMaps (http://data.environment.sa.gov.au/NatureMaps/Pages/default.aspx) with Land Use Potential Maps for different crop types. This data has been used to assess the Gawler Rural Zone.

Table 6-1 Soil and land attribute groups used to assess land use potential

Soil and land attribute groups (with code letter) #		*Soil and land attribute* and code ^ (used in *Land use potential* rules)	
Soil type	-	Soils (soil type)	-
Topography	T	Steepness (as indicated by Water erosion potential) *	6e, 7e
		Surface rockiness	r
		Exposure	y
		Flooding susceptibility	f
Waterlogging / salinity / drainage	W	Waterlogging susceptibility	w
		Depth to watertable	o
		Salinity - watertable induced	s
		Deep drainage	b
		Recharge potential	q
Chemical barriers to root growth	B	Alkalinity	i
		Salinity - non-watertable (dry saline land)	v
		Boron toxicity	tb
		Sodium toxicity (sodicity)	ts
		Aluminium toxicity	ta
		Acid sulfate soil potential	j
Soil depth / water storage	D	Available waterholding capacity	m
		Depth to hard rock	xr
		Depth to hardpan	xp
		Potential rootzone depth:	
		Sensitive perennial horticultural crops (e.g. cirtus, avocado)	da
		Intermediate sensitivity perennial horticultural crops (e.g. stone fruits, almonds, pome fruits)	db
		Hardy perennial horticultural crops (e.g. grape vines, olives)	dc
		Annual root crops (e.g. potatoes, carrots, onions)	dd
		Above ground annual horticultural crops (e.g. brassicas)	de
Soil fertility	F	Inherent fertility	n
		Acidity	h
		Surface carbonate	ka
		Subsoil carbonate	kb
Soil physical conditions	S	Physical condition of surface soil	c
		Surface texture	-
		Structure of subsoil	p
		Water repellence	u
Erosion potential	E	Water erosion potential *	2e-5e
		Wind erosion potential	a
		Scalding	z
		Gully erosion	g
		Mass movement (landslip)	l

Table 6-2 land use potential class definitions assigned to soil and land attributes

Land use potential class	Potential	Definition
Class 1	High	Land with high productive potential and requiring no more than standard management practices to sustain productivity.
Class 2	Moderately high	Land with moderately high productive potential and / or requiring specific, but widely accepted and used, management practices to sustain productivity.
Class 3	Moderate	Land with moderate productive potential and / or requiring specialized management practices to sustain productivity.
Class 4	Moderately low	Land with marginal productive potential and / or requiring very highly specialized management skills to sustain productivity.
Class 5	Low	Land with low productive potential and /or permanent limitations which effectively preclude its use.
Class X	Not applicable *	Urban, evaporation pans, quarry, water, rock, saline soil, reservoir, cliff, reef etc.

6.2 Soil and Landscape Data

Land System and Soil landscape data is publicly available via NatureMaps and Enviro Data SA. Soils of Southern SA (Hall *et al* 2008) details soil groups and type profile information for the agricultural regions of SA.

The land systems within the Gawler Rural Zone based on PIRSA mapping are Smithfield (SMI), Northern Adelaide Plains (NAP), Angle Vale (ANV), Gawler (GAW) and Yattalunga (YAT). Each land system contains a number of soil-landscape units (Figure 6-1). Note that NatureMaps does not adequately define on the maps the area of soil-landscape units due to scale, but the Land System Reports are used to identify the dominant soils and soil-landscapes units within each land system.

6.2.1 Smithfield SMI

This *land system* contains soils derived from alluvial clays from the ranges to the east and incorporates aeolian (wind-blown) carbonate. It is described as outwash fans with very gentle to gentle slopes from 2% to 10% with well-defined water courses.

Soil landscape units within the Smithfield land system are:

- JAB - very gently inclined fans with slopes of 2-4% (37.5% of area)
- JAC - gently inclined fans with slopes of 4-10% (58.8% of area)
- JAJ – eroded watercourses (3.7% of area)

The *main soils* across all landscapes are:

- Loam over red clay - D2 (E)
- Gradational red loam - C3 (E)
- Gradational red clay loam - C4/M2 (E)

6.2.2 Northern Adelaide Plains NAP

The *land system* contains flat to very gently undulating plains with slopes less than 1% adjacent to the Gawler River alluvial plain and north of Adelaide. Surface soils are sandy or loamy over clayey subsoils which contain carbonate and in places calcrete (wind-blown cemented carbonate) stony rises are present.

Soil landscape units within the Northern Adelaide Plains land system are:

- JoA – very gentle rises (11.2% of area)
    - main soil is sand over red sandy clay loam (G1a) which is very extensive (60 – 90% of landscape)

- JpA – flats and very gentle slopes (19% of area)
    - main soils are sand and sandy loam over hard red clay that maybe dispersive
    - D5, G1b, D3 – all are extensive (30 – 60% of landscape)
- JqA – flats (51.6% of area)
    - main soil is loamy sand over hard red clay which is very extensive (>90% of landscape)
- JrA – flats and depressions (11.9% of area)
    - main soil is sandy loam over hard red dispersive clay which is extensive (30 - 60% of landscape)
- JoA – JpA – JqA – JrA – represents sequence of decreasing soil depth and drainage capacity
- RKA – stony flats with a rubble calcrete layer within 100 cm (4.7% of landscape). Land is well drained and potentially productive but calcrete rubble abundance is variable
    - main soil in this landscape is gradational red loam over calcrete, which is very extensive (>90%) of the RKA landscape

The main soils across all soil-landscapes in the NAP are sandy or sandy loam over hard red clay that maybe dispersive and occurs on flats. Stony flats have calcrete within 100 cm. Includes D5, G1b, D3.

6.2.3 Angle Vale ANV

The *land system* represents the alluvial plains of the Gawler River with sandy, silty and clayey deposits from the Gawler River.

Soil landscape units within the Angle Vale land system are:

- JoA – very gentle rises above 10 m contour (7.8% of landscape)
    - main soil is sand over red sandy clay loam (G1a) which is very extensive (60 – 90% of landscape)
- JpA – flats and slopes above 10 m contour (48.3% of landscape)
    - main soil is loamy sand over hard red clay (D5) which is extensive (30 – 60%)
- JqA – flats above 10 m contour (11.7% of landscape)
    - main soil loamy sand over hard red clay (D5) which is very extensive (60 – 90%)
- JsA – flats near watercourses
    - main soil is hard silty clay loam over dispersive brown clay (F2) which is very extensive (60 – 90% of landscape)
- KTA – black flats near watercourses (10.7% 0f landscape)
    - main soil is black clay (M2/E10 which is dominate (>90% of landscape)

Soils are in general sand and loamy sand over hard red clay that maybe dispersive on flats above 10 m, with gentle rises of sand over loamy soil and black clay near watercourses (D3, D5, G1a, G1b).

6.2.4 Gawler River GAW

The *land system* represents a very gently inclined floodplain of the Gawler River and extends to Port Gawler. Slopes are less than 1% and soils are deep and well drained and mainly black loams and clays.

Soil landscape units within the Gawler River land system are:

- XMA – flats are black compared to red colour of surrounding landscapes. The dominant soils are:
    - Black gradational clay loam (M2/E1) which is 60 to 90% of the landscape. Black Dermosol is the dominant soil
    - Silty loam over dispersive brown clay (F2) which has limited extent 10-20%

6.2.5 Yattalunga YAT

The *land system* represents the west facing slopes of the Mt Lofty Ranges and is dissected by water courses and slopes are variable but less than 30%. Soils overlie rock and soil depth is variable.

Soil landscape units within the Yattalunga land system are:

- The dominant landscape covers 40.8% of the Yattalunga land system and the dominant soil landscapes are:
    - DCC - Undulating rises with relief to 40 m and slopes of 4-10%
    - DCD - Moderate slopes of 10-18%, up to 50 m high
    - DCI - Moderate slopes of 10-18%, up to 50 m high with some eroded watercourses

The dominant soils within these soil landscapes are: Shallow loam over red clay (D1a); Shallow stony loam (L1); Shallow gradational red loam (C2).

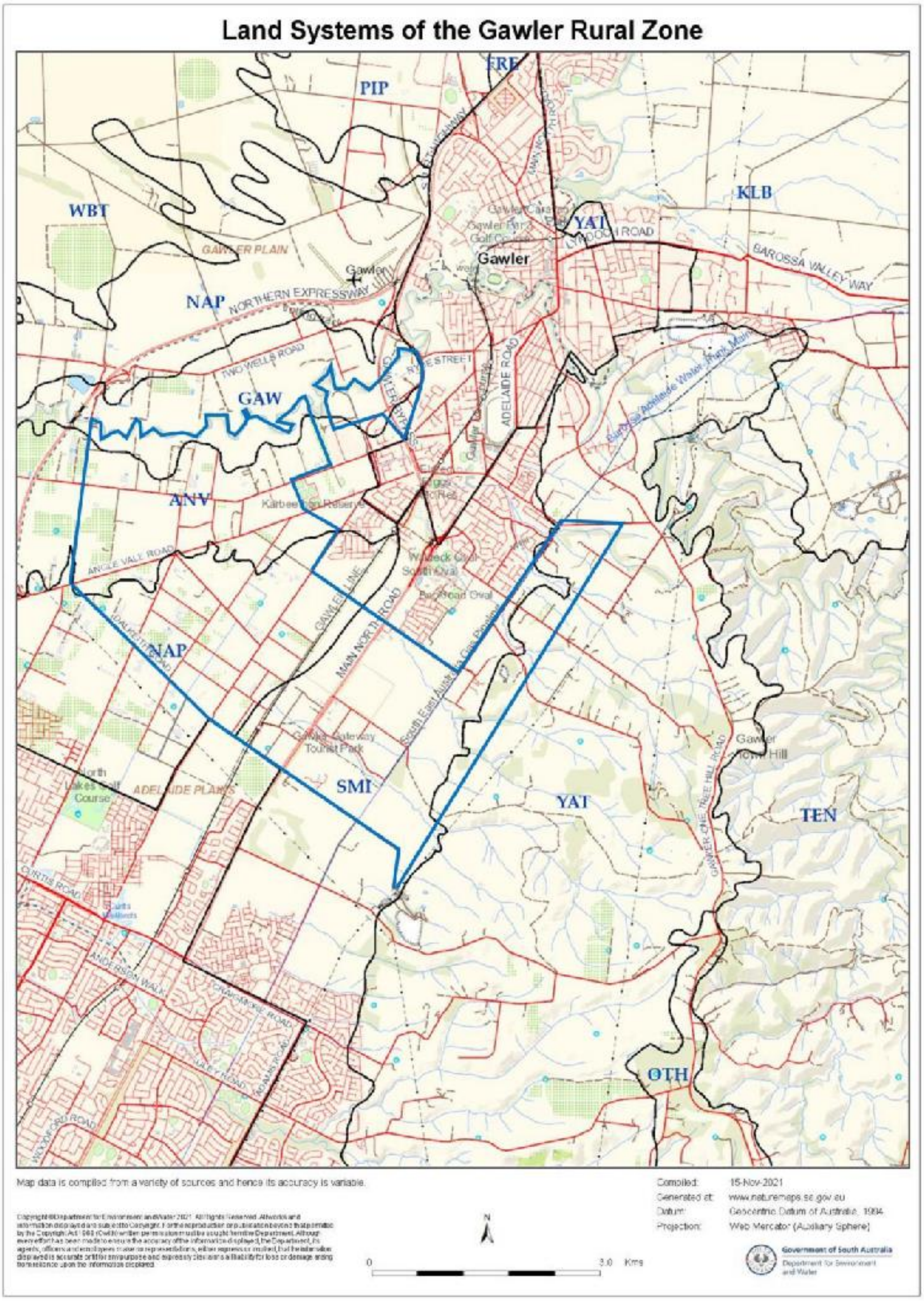


Figure 6-1 Land systems of the Gawler Rural Zone

6.3 Dominant soil types in the Gawler Rural Zone

The dominant soil types in the Gawler Rural Zone (Table 6.3) show several soil characteristics. Soil types are based on local South Australia soil classification shown in Hall *et al* (2002), they are:

- *Soil carbonate* is a characteristic feature of the subsoil. Calcium carbonate (Ca_2CO_3) is the common form of soil carbonate which may occur as hard nodules or in the fine earth fraction of the soil. If carbonate is present soil pH will be high usually greater than 8.5 soil pH units, consequently subsoils in the Gawler Rural Zone will usually have high soil pH. Subsoil carbonate is present in D and C soil types;
- *Texture contrast soils* dominant in the Gawler Rural Zone, that is soil types D, F and G. Texture contrast soils are those with a marked increase in clay content from the surface soils to the clay horizons in the subsoil;
- *Deep uniform or gradational soils* are present adjacent to the Gawler River as a dark coloured cracking clay soil such as M and E;
- *Soil on weathered rock with variable depth*. Soil on the western facing slopes of the Mt Lofty Ranges usually contain rock in the subsoil and soil depth is variable depending on the extent of rock weathering, soil type and slope. Soil type L.

Table 6-3 Dominant soil types in Gawler Rural Zone

Soil Group	Soil Type	Description
D soil group		
hard red-brown texture contrast soils with highly calcareous lower subsoils	D2	loamy over red clay
	D3	loam over poorly structured red clay
	D5	hard loamy sand over red clay
	D1a	loam over clay on rock
	Dominant features of D soil group	
	texture contrast between surface soil and subsoil	
	soil carbonate in the subsoil	
	alkaline to highly alkaline subsoil	
	hard surface soil	
C soil group		
gradational soils with highly calcareous lower subsoils	C2	gradational loam over rock
	C3	friable gradational clay loam
	C4	hard gradational clay loam
	Dominant features of C soil group	
	soil carbonate in the subsoil	
	alkaline to highly alkaline subsoil	
	well structured	
G soil group		
sand over clay soils (texture contrast)	G1a	sandy over sandy clay loam
	G1b	sandy over sandy clay loam
	Dominant features of G soil group	
	loose sandy topsoil	
	water repellent surface soils	
	wind erosion prone	
	poorly structured subsoil clay	
	potenial for seasonal waterlogging	
M soil group		
uniform or gradational soils	M2	gradational clay loam
	Dominant features of M soil group	
	friable well structured soils	
	more clayey, more productive	
	on creek flats but flooding is common	
E soil group		
cracking clay soils	E1	black cracking clay
	Dominant features of E soil group	
	self-mulching to massive surface soil clay	
	usually alkaline surface soils	
F soil group		
deep loamy texture contrast soil with brown or dark subsoil	F2	sandy loam over brown or dark clay
	Dominant features of F soil group	
	abrupt boundary between topsoil and subsoil	
	sandy loam to clay loam topsoil	
	poorly structured clay subsoil	
	waterlogging potential	
L soil group		
shallow soils on rock	L1	shallow soil on rock
	Dominant features of L soil group	
	weathered rock or hard rock at shallow depth	
	variable soil depth	
	grazing or pastures only when this soil is present	
	many areas not cleared for agriculture	

6.4 Land Capability Class

6.4.1 Methods – land capability class

South Australian government soil and landscape mapping has used ***Land Use Potential*** to classify land within each ***land system*** (Table 6-2). The classification has five classes with decreasing soil-land viability for sustained agricultural or horticulture use. *Class 1* is least limiting and requires no more than standard best practice land management, *Class 2* requires some more specific land management practices, *Class 3* requires specialised land management, *Class 4* requires highly specialised land management and *Class 5* has permanent limitations that preclude its use for sustained agriculture and horticulture. Soil and land attributes (Table 6-1) are used to assess capability.

Agricultural land has been divided into *7 land use potential categories* (Rowland *et al* 2016), they are:

1. Field crops
2. Perennial horticulture
3. Annual horticulture
4. Irrigated pasture
5. Dryland pastures
6. Native fodder
7. Alternative crops – no land use limitation for hydroponic greenhouse production

The most common land use categories in the Gawler Rural Zone are field crops, perennial and annual horticulture. The land use categories were assessed against each land system with a range of crops within each land use category. Native fodder has also been included as a potential niche option:

- *Field crops* were assessed using - wheat, barley, canola and field peas;
- *Perennial horticulture* was assessed using - almonds, grape vines, citrus and olives;
- *Annual horticulture* was assessed using - carrots, onions, potatoes and brassicas;
- *Native fodder* – was assessed using – bush tomato, native citrus and quandong.

Based on the ratings of each crop type an overall rating was determined for each of the 3 land use potential categories (field crops, perennial horticulture and annual horticulture) within the Gawler Rural Zone. Lack of reliable soil, climate and agronomic data is available for native food crops.

Other factors such as size of land parcels, water availability, transport access and gross margins will be used to assess land suitability (section 7).

6.4.2 Results – land capability class

6.4.2.1 Field Crops

Wheat, barley, canola and field peas were assessed against each land system within the Gawler Rural Zone. Based on the data supplied from NatureMaps and Enviro Date, the order of preferred crop type for field crops is: barley > canola > wheat > field peas.
Overall field crops have ***a moderately high land use potential*** with the exception of the Yattalunga land system. The classes are as follows:

- *Wheat - class 2*
- *Barley - class 1* – this crop has higher tolerance to soil salinity and alkaline subsoil conditions when compared to canola and wheat. Barley could be grown on some portions of Smithfield (SMIJAB), Angle Vale and Gawler land systems
- *Canola - class 2*
- *Field peas - class 2*

Based on Land Use Potential classification criteria for each soil and land attribute:

- ***Waterlogging –*** is the inundation of a soil and landscape with water for an extended period of time. It is measured by *permeability* which is the potential of the soil to transmit water and *drainage* which is the speed and extent of water removal from a site. Barley is more susceptible to waterlogging than wheat, canola and field peas. The length of time the soil profile can remain saturated following heavy rainfall before yield loss is less for barley;
- ***Plant available waterholding capacity –*** is the amount of water held in the soil from near saturation point (called field capacity) to when the soil is dry and the plant is unable to remove water from the soil (called permanent wilting point). Barley requires less plant available waterholding capacity than wheat, canola and field peas. Barley has a greater potential to utilise soil moisture provided the soil profile does not remain saturated for extended periods;
- ***Soil pH –*** is log scale from 1 to 14 that shows if a soil is acidic (1 to 5.5) neutral (6 to 8.5) or alkaline (greater than 8.5). Most soil nutrients are more available to plants in neutral soil conditions. Field peas more tolerant of soil acidity, however they are less tolerant of calcareous soils, which are common in Gawler Rural Zone particularly in the Northern Adelaide Plains land system;
- ***Soil Salinity –*** is the accumulation of water soluble salts such as sodium, potassium, calcium and magnesium which maybe present as chlorides, sulfates or carbonates. Salinity is measured as the electrical conductivity of a soil/water suspension. Field peas more susceptible to surface and subsoil salinity;
- ***Exchangeable sodium (Na) –*** If high, sodium attached to clay particles in the soil may result in dispersion or collapse of the soil leading to soil erosion. It is also toxic to plants at high levels. Field peas less tolerant of exchangeable Na. The order of tolerance to exchangeable Na is field peas < wheat < barley < canola;
- ***Coarse fragments –*** is gravel, cobbles or boulders greater than 2 mm in size. In high percentages they limit waterholding capacity of the soil and may limit plant root growth. Field peas less tolerant of surface coarse fragments.

The *Yattalunga land system* which represents the western facing slopes (4 to 10%) of the Mt Lofty Ranges has shallow depth to weathered rock, potential soil erosion and high percentage of coarse fragments (gravels, cobbles and boulders) and low waterholding capacity as some of the soil attribute limitations making it un-usable for field crops. Yattalunga land system is rated as Class 4 for land use potential for *all crops*.

The *Gawler land system* has well-structured deep loam and clay soils with high waterholding capacity and is Class 1 for barley, canola and wheat and also Class 2 for field peas. The main limitation of Gawler River land system is potential flooding in some years.

The legend for land use potential maps is shown in Table 6-4. Each code represents the area of land with moderate to high potential for a particular crop. For example, code Aa has > 60% of land with moderate to high potential for a crop and the most common class is high. These codes apply to all land use potential maps for field crops, perennial horticulture and annual horticulture.

Land system classification for field crops is shown in Table 6-5, with maps showing each land system and is classification for field crops in Table 6-6.

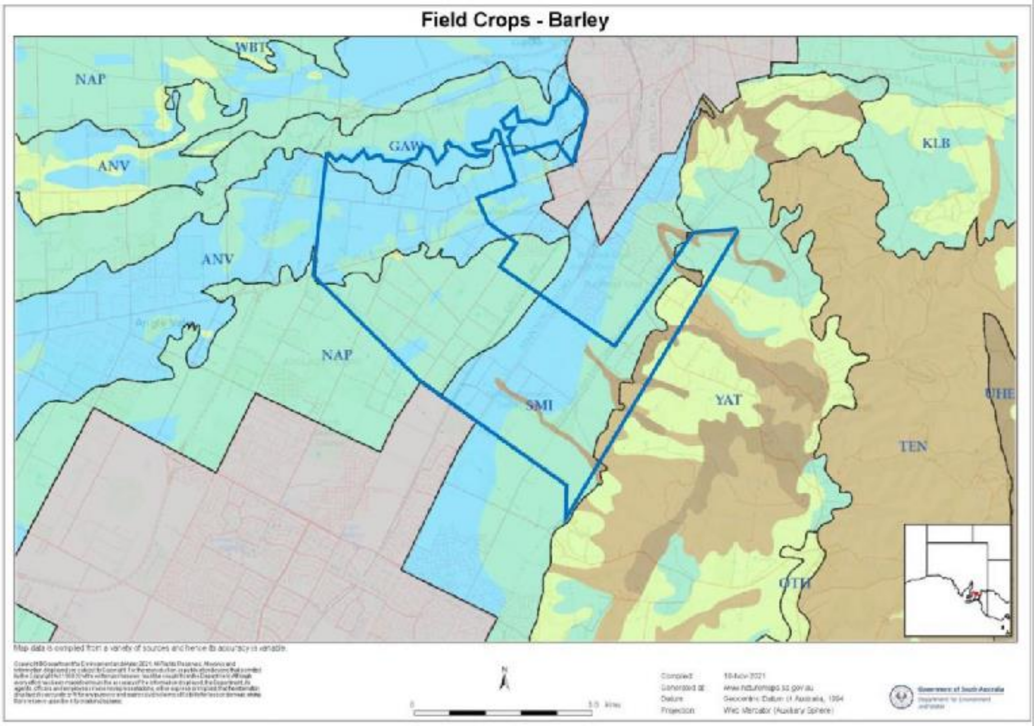
Table 6-4 Legend for land use potential maps for field crops, perrenial horticulture and annual horticulture

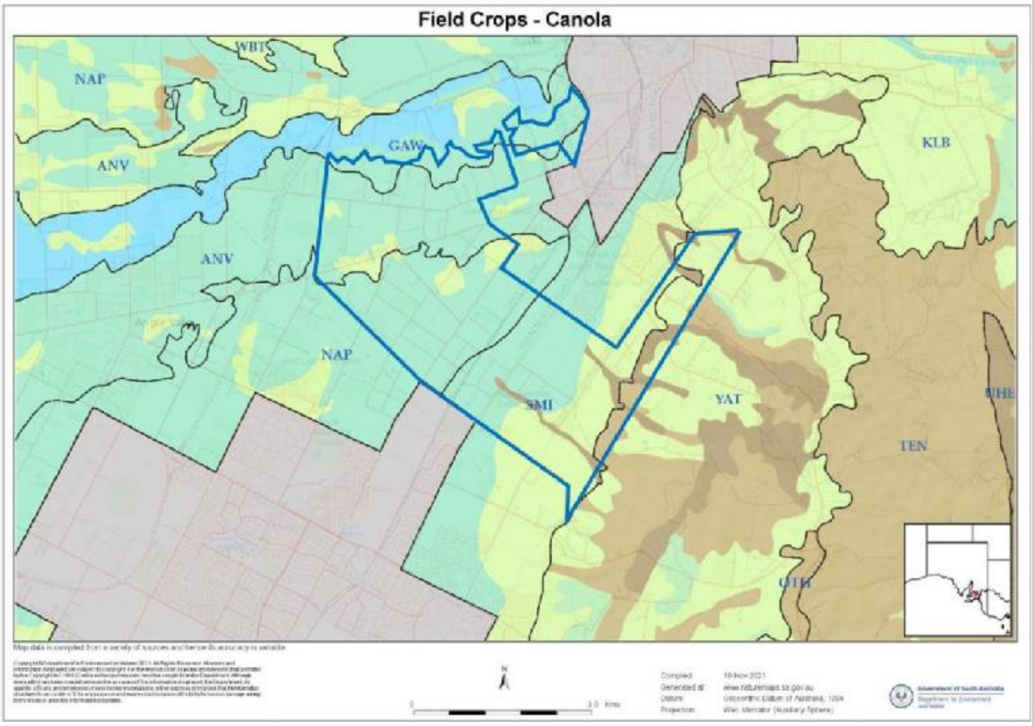
	% mod to high potential / most common class
	Aa: >60% mod to high / high
	Ab: >60% mod to high / mod high
	Ac: >60% mod to high / mod to high
	Ad: >60% mod to high / mod
	B: 30-60% mod to high / low to high
	C: 10-30% mod to high / mod low to low
	D: 1-10% mod to high / mod low to low
	Ea: <1% mod to high / mod low
	Eb: <1% mod to high / low
	X: Not applicable

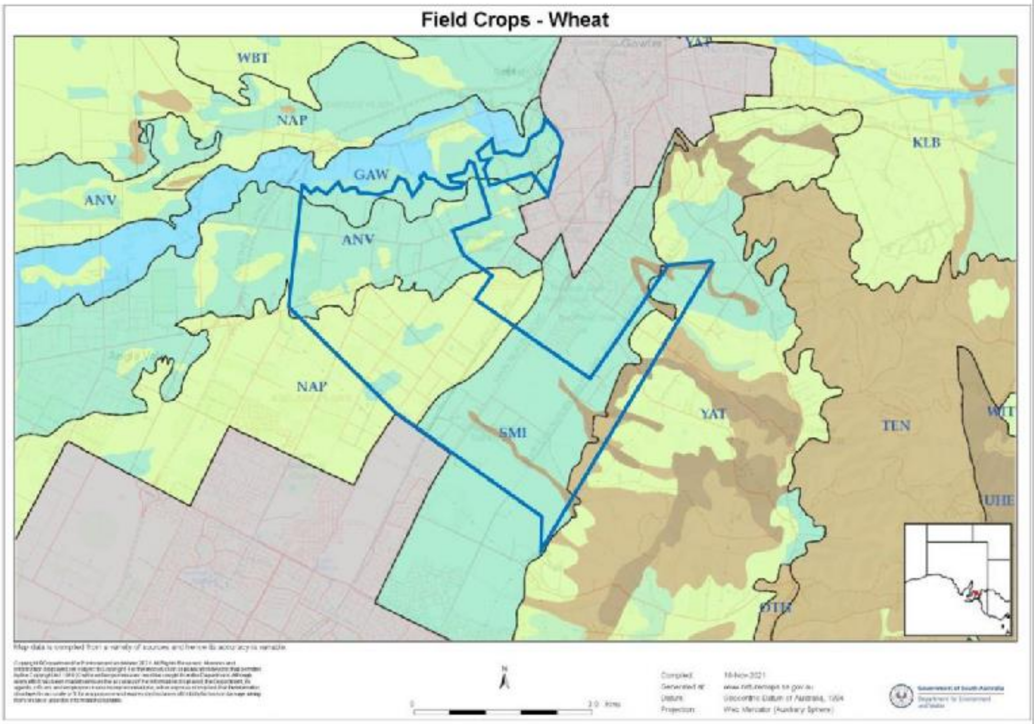
Table 6-5 Field crops land system classification

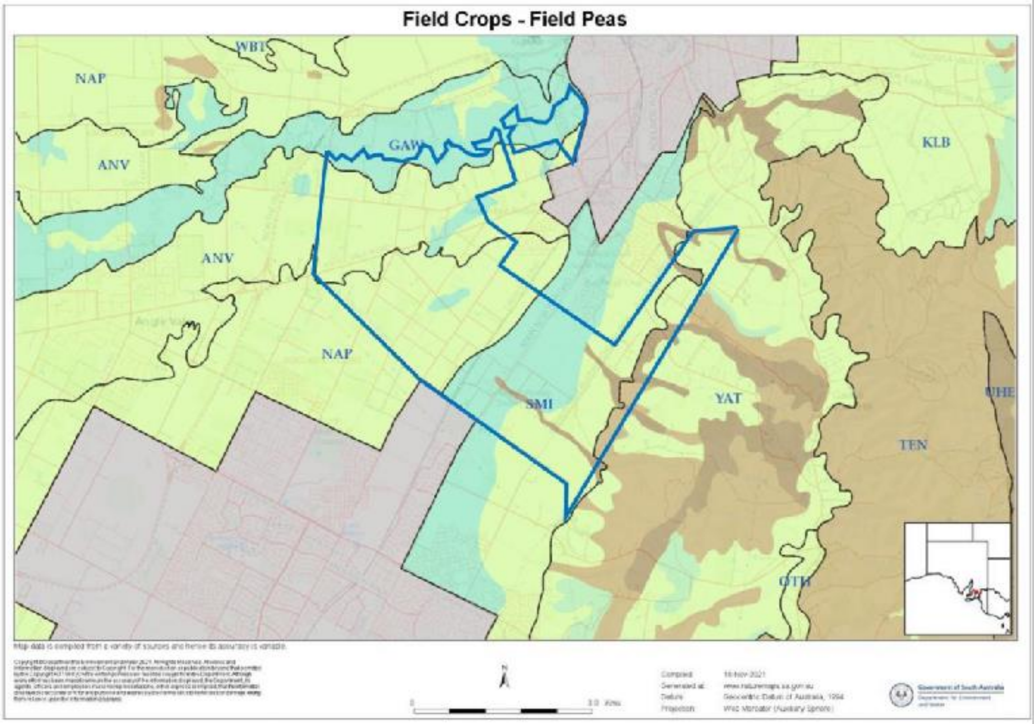
Land Use Category	Crop	Land System	Soil Landscape Unit	Class 1	Class 2	Class 3	Class 4	Class 5	Class NA	Class total %	Overall Class	Class Description
Field Crops	wheat	Smithfield	SMIJAB	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Northern Adelaide Plains	NAPJqA	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Angle Vale	ANVJpA	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Gawler River	GAWXJJ	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Gawler River	GAWXMA	100	0	0	0	0	0	100	1	high potential / > 60% high potential
		Yattalunga	YATAAI	0	0	0	100	0	0	100	4	moderately low potential / <1% mod to high
	barley	Smithfield	SMIJAB	100	0	0	0	0	0	100	1	high potential / > 60% moderately high potential
		Smithfield	SMIJAC	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Northern Adelaide Plains	NAPJoA	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Angle Vale	ANVJpA	100	0	0	0	0	0	100	1	high potential / > 60% high potential
		Gawler River	GAWXJJ	100	0	0	0	0	0	100	1	high potential / > 60% high potential
		Gawler River	GAWXMA	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Yattalunga	YATAAI	0	0	0	100	0	0	100	4	moderately low potential / <1% mod to high
	canola	Smithfield	SMIJAB	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Smithfield	SMIJAC	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Northern Adelaide Plains	NAPJqA	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Angle Vale	ANVJpA	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Gawler River	GAWXJJ	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Gawler River	GAWXMA	100	0	0	0	0	0	100	1	high potential / > 60% high potential
		Yattalunga	YATAAI	0	0	0	100	0	0	100	4	moderately low potential / <1% mod to high
	field peas	Smithfield	SMIJAB	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Smithfield	SMIJAC	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Northern Adelaide Plains	NAPJqA	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Angle Vale	ANVJpA	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Gawler River	GAWXMA	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Yattalunga	YATAAI	0	0	0	100	0	0	100	4	moderately low potential / <1% mod to high

Table 6-6 Land Use Potential maps for field crops for each land system






Field Crops - Wheat
WBT
NAP
GAW
ANV
ANV
NAP
SMI
YAT
KLB
TEN
WIT
UHE
OTH


Field Crops - Field Peas
WBT
NAP
ANV
GAW
ANV
NAP
SMI
YAT
KLB
TEN
UHE
OTH

6.4.2.2 Perennial Horticulture

Almonds, grape vines, citrus and olives were assessed against each land system within the Gawler Rural Zone. Based on the data supplied from NatureMaps and Enviro Date, the order of preferred crop type for perennial horticulture is: grape vines and olives > citrus > almonds.

Overall perennial horticulture has ***a moderate (class 3) to moderately high (class 2) land use potential***. Production in the Gawler Rural Zone will require specialised land management. The Northern Adelaide Plains will not support all perennial horticulture and Yattalunga land systems are not capable of supporting perennial horticulture. The classes are as follows:

- *Almonds – class 3 – 4 –* soil carbonate is a major limitation to almond root growth and the Northern Adelaide plains has soils with shallow soil carbonate;
- *Grape vines - class 2 –* vines are tolerant of soil carbonate;
- *Citrus – class 3 -* soil carbonate is a major limitation to citrus root growth and the Northern Adelaide plains has soils with shallow soil carbonate; and
- *Olives – class 2 –* olives are tolerant of soil carbonate.

Based on Land Use Potential classification criteria for each soil and land attribute:

- ***Soil Carbonate***. Grape vines and olives have the same tolerance to subsoil carbonate and plant roots will penetrate Soil Carbonate Layers (Wetherby and Oades 1975). Citrus and almonds need subsoil carbonate to be at least greater than 60 cm, while vines and olives will tolerate subsoil carbonate at 30 cm depth;
- ***Waterlogging***. Almonds and citrus have lower tolerance to waterlogging with any period greater than 1 to 3 weeks imposing a high limitation and greater than 3 weeks severe limitation on crop growth. Vines and Olives can tolerate high limitations at 3 to 6 weeks of inundation and severe limitations at greater than 6 weeks, which is double that of almonds and citrus;
- ***Soil pH***. Soil pH levels greater than 9.0 in the surface and subsoil imposes moderate to high risk in all crops (almonds, vines, citrus and olives). Soil pH less than 4.5 will have a moderate to high limitation on all crops.
- ***Salinity***. Where depth to impermeable clay is greater than 150 cm almonds and citrus have lower threshold salinity tolerance in the surface and subsoil compared to vines and olives. Salinity limitations will be high in almonds and citrus and moderate in vines and olives. All crops have lower tolerance to surface salinity compared to subsoil salinity. Finer plant feeder roots are located in the surface soil.
- ***Boron and Exchangeable Na.*** Boron greater than 15 mg/kg imposes moderate limitations when in almonds and citrus when it is present at 50 cm or greater, while in vines and olives it only imposes slight limitations. Exchangeable Na limitations are similar in all crops.

The *Yattalunga land system* ((western facing slopes (4 to 10%) of the Mt Lofty Ranges has shallow depth to weathered rock, potential soil erosion, high percentage of coarse fragments (gravels, cobbles and boulders)) and low waterholding capacity as some of the soil attribute limitations making it a severe limitation (Class 5) for almonds and moderate limitation (Class 3) for vines, citrus and olives.

The *Northern Adelaide Plains land system* has calcareous soils which have subsoil carbonate and some areas of stony rises of calcrete. Almonds and citrus are limited by soil carbonate as non-calcareous soil above Soil Carbonate Layers is shallow (< 30 cm).

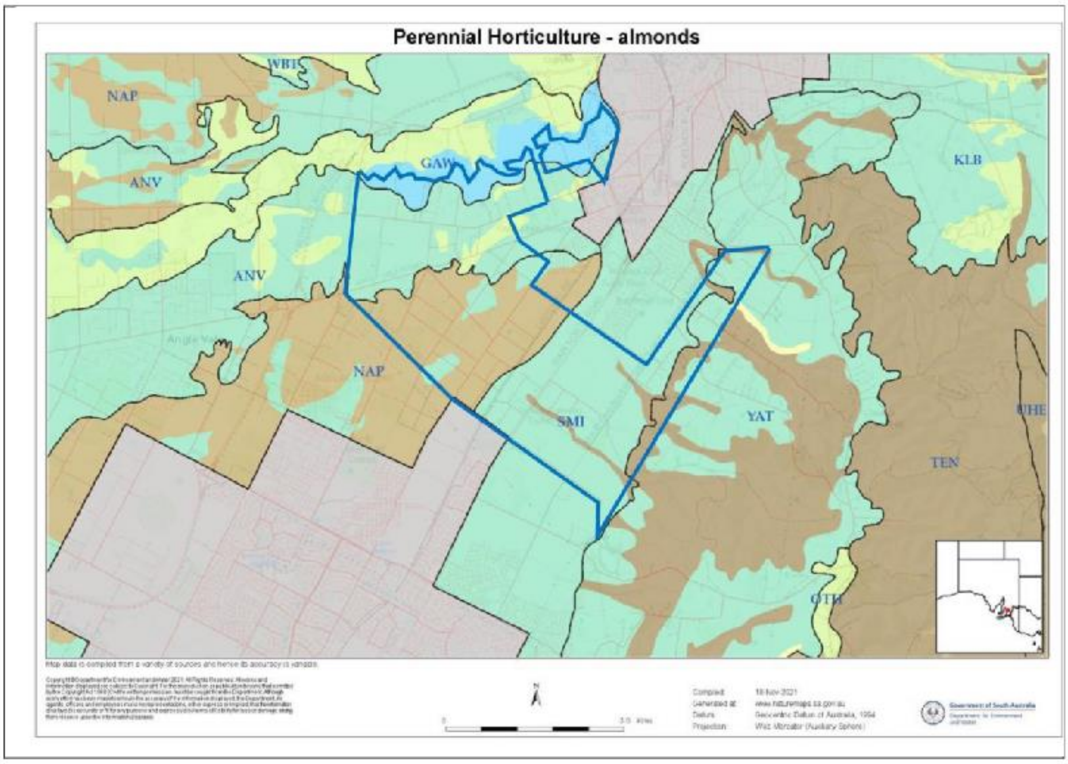
The *Gawler land system* has slight limitations (class 2) for vines and olives and moderate limitations (class 3) for almonds and citrus. Potential flooding and waterlogging will limit all crops.

Land system classification for perennial horticulture is shown in Tables 6-7, with maps showing each land system and its classification for perennial horticulture in Table 6-8.

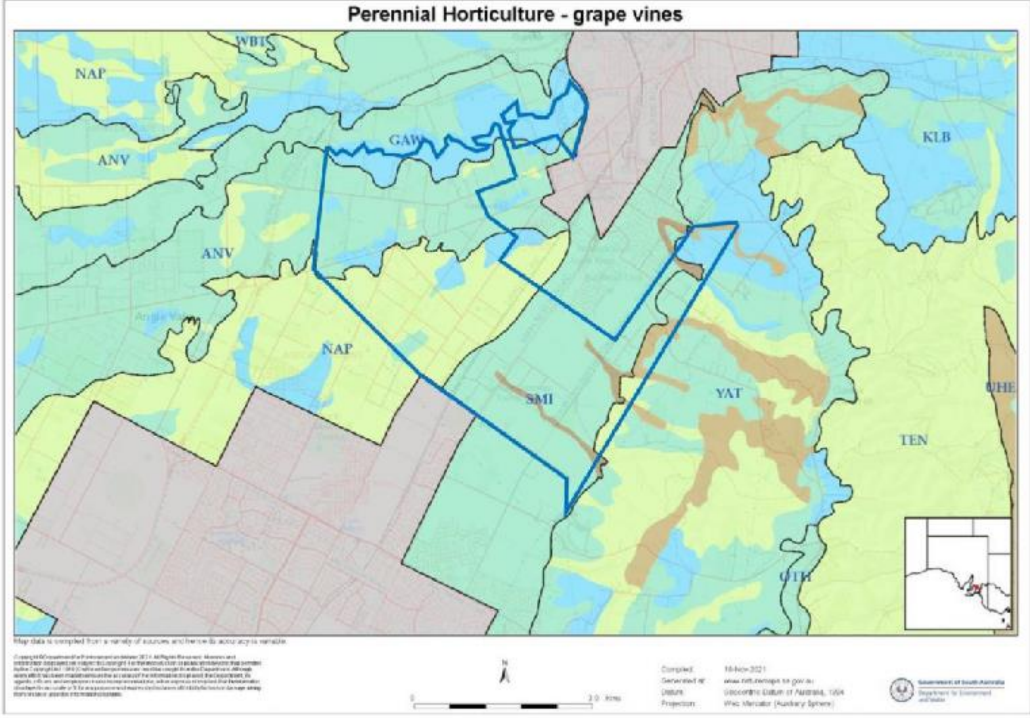
Table 6-7 Perennial Horticulture land system classification

Land Use Category	Crop	Land System	Soil Landscape Unit	Class 1	Class 2	Class 3	Class 4	Class 5	NA	total %	Overall Class	Class Description
Perennial Horticulture	almonds	Smithfield	SMIJAB	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Smithfield	SMIJAC	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Northern Adelaide Plains	NAPJqA	0	0	0	100	0	0	100	4	moderately low potential / <1% mod to high
		Angle Vale	ANVJpA	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Gawler River	GAWXMA	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Yattalunga	YATAAI	0	0	0	0	100	0	100	5	low potential / <1% mod to high
	vines	Smithfield	SMIJAB	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Smithfield	SMIJAC	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Northern Adelaide Plains	NAPJqA	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Angle Vale	ANVJpA	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Gawler River	GAWXMA	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Yattalunga	YATAAI	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
	citrus	Smithfield	SMIJAB	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Smithfield	SMIJAC	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Northern Adelaide Plains	NAPJqA	0	0	0	100	0	0	100	4	moderately low potential / <1% mod to high
		Angle Vale	ANVJpA	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Gawler River	GAWXMA	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Yattalunga	YATAAI	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
	olives	Smithfield	SMIJAB	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Smithfield	SMIJAC	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Northern Adelaide Plains	NAPJqA	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Angle Vale	ANVJpA	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Gawler River	GAWXMA	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Yattalunga	YATAAI	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high

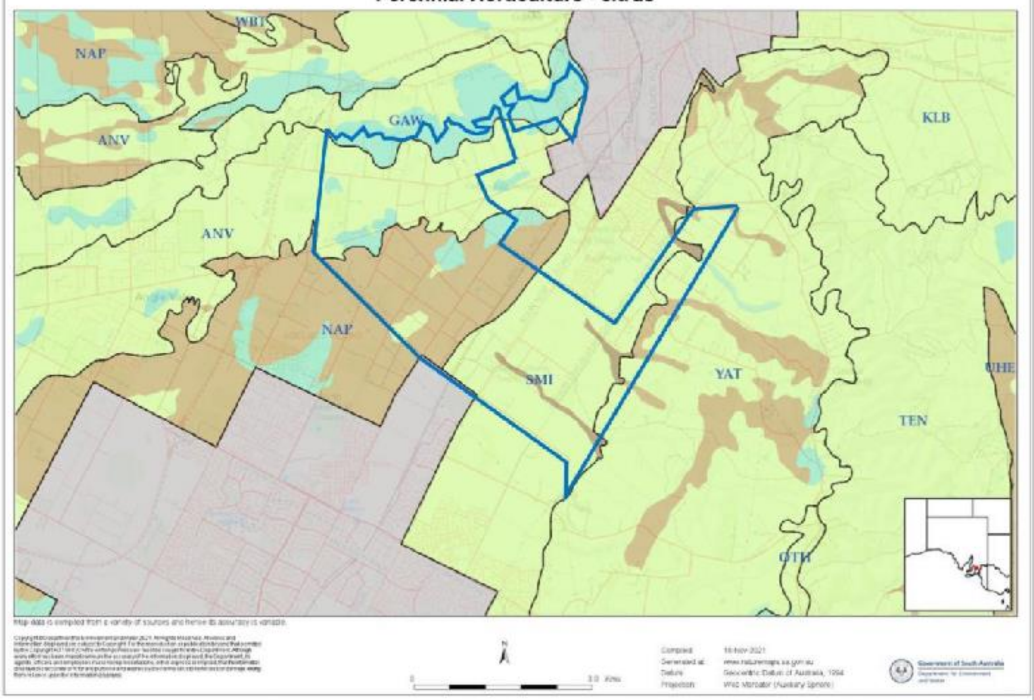
Table 6-8 Land Use Potential maps for Perrenial Horticulture

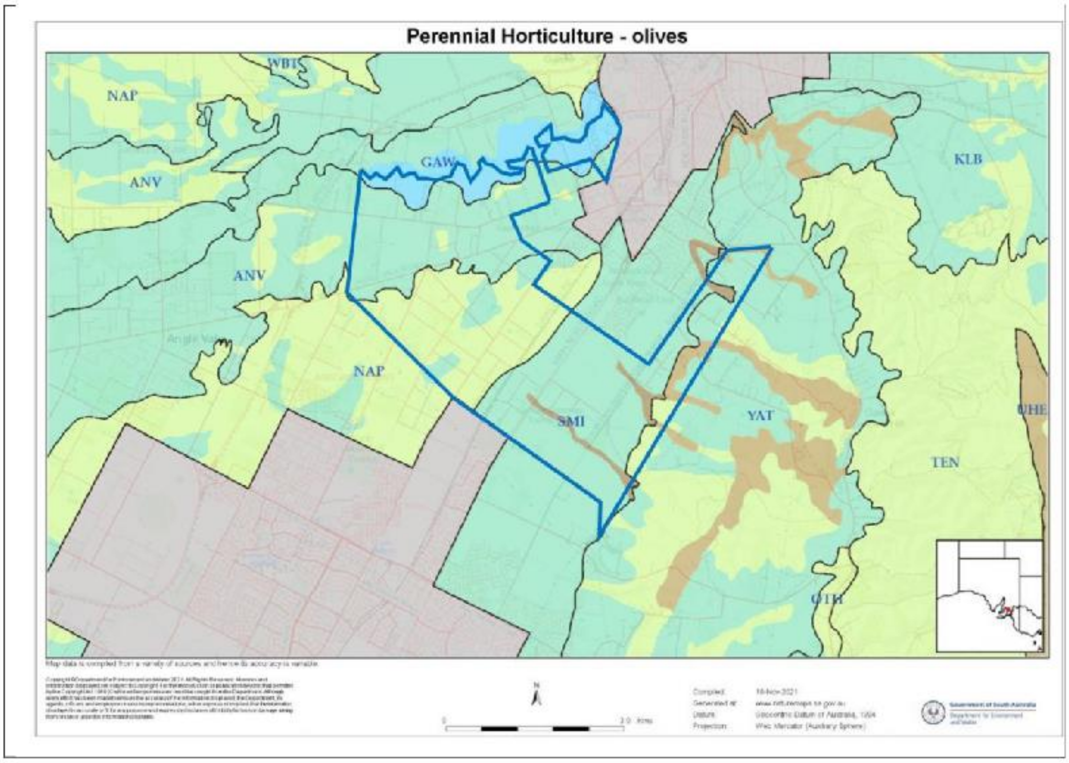


Perennial Horticulture - grape vines



Perennial Horticulture - citrus





6.4.2.3 Annual Horticulture

Carrots, onion, potato and brassica were assessed against each land system within the Gawler Rural Zone. Based on the data supplied from NatureMaps and Enviro Date, there is no preferred crop type for annual horticulture as all crops are similarly rated.

Overall annual horticulture has ***a moderate (class 3) to moderately high (class 2) land use potential***. Production in the Gawler Rural Zone will require industry standard and some specialised land management. Smithfield and Angle Vale land systems are preferred for annual horticulture based on government mapping. The Northern Adelaide Plains and Gawler River land systems will require more specialised land management. Yattalunga land system is not capable of supporting annual horticulture with severe limitations, including slope, shallow soil depth and high coarse fragment content. The land class for Smithfield, Angle Vale, Northern Adelaide Plains and Gawler River Land Systems are as follows:

- *Carrots – class 2 - 3;*
- *Onions - class 2 – 3;*
- *Potato – class 2- 3;*
- *Brassica – class 2 – 3.*

Based on Land Use Potential classification criteria for each soil and land attribute:

- ***Soil Carbonate***. Potatoes have deeper root systems than carrots, onions and brassicas and require greater than 60 cm of soil with only slight reaction to 1M HCL. Carrots, onions and brassicas require greater than 30 cm;
- ***Waterlogging***. Potatoes are not limited by waterlogging conditions, with high limitations only occurring after several months of inundation. Carrots, onions and brassicas will have high limitations due to inundation after 3 to 6 weeks. Gawler River land system would be capable of supporting potato production.

- ***Soil pH***. Soil pH levels less than 4.5 will be limiting to all annual crops (carrots, onions, potatoes and brassicas). Soil pH greater than 9.0 in the surface and subsoil imposes high to severe limitations in all crops (carrots, onions, potatoes and brassicas).
- ***Salinity***. If surface soil salinity is less than 4 dS/m and subsoil salinity less than 8 dS/m there will be negligible limitation on all annual horticultural crops if the depth to any impermeable clay is greater than 150 cm. If impermeable clay is shallow then tolerance levels will decrease to 2 dS/m in the surface and 4 dS/m in the subsoil.
- ***Boron and Exchangeable Na***. A Boron level greater than 15 mg/kg needs to be at a depth of 50 cm or greater for negligible limitations. Exchangeable Na greater than 25% needs to be at a depth of 50 cm or greater for negligible limitations.

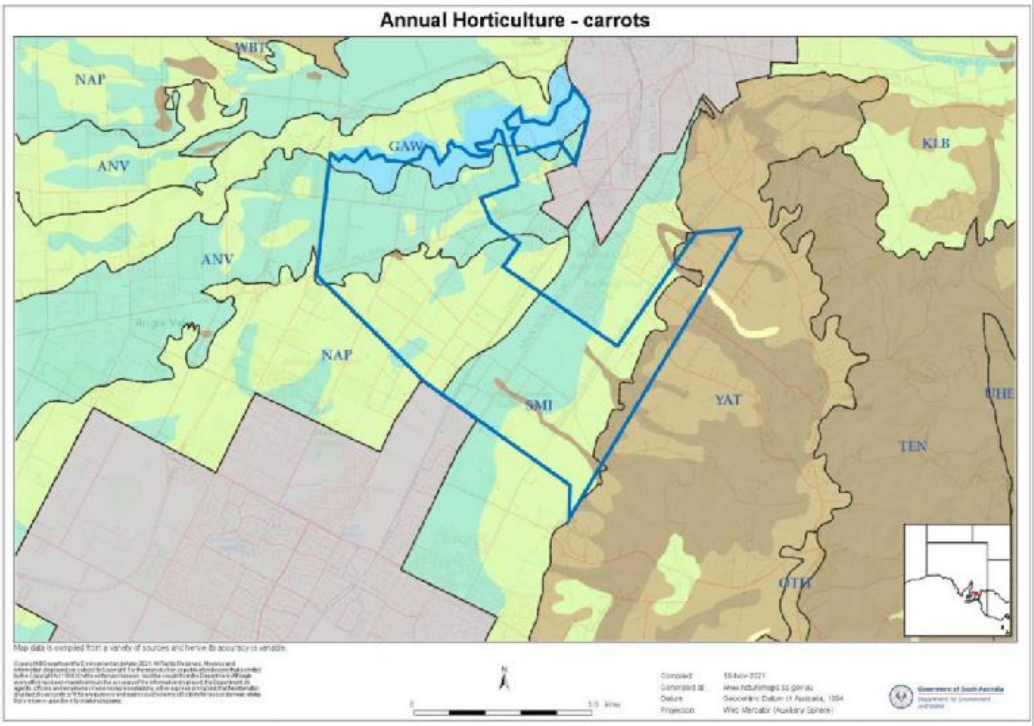
The *Yattalunga land system* ((western facing slopes (4 to 10%) of the Mt Lofty Ranges has shallow depth to weathered rock, potential soil erosion, high percentage of coarse fragments (gravels, cobbles and boulders)) and low waterholding capacity as some of the soil attribute limitations making it a high (class 4) or severe limitation (Class 5) for all annual crops.

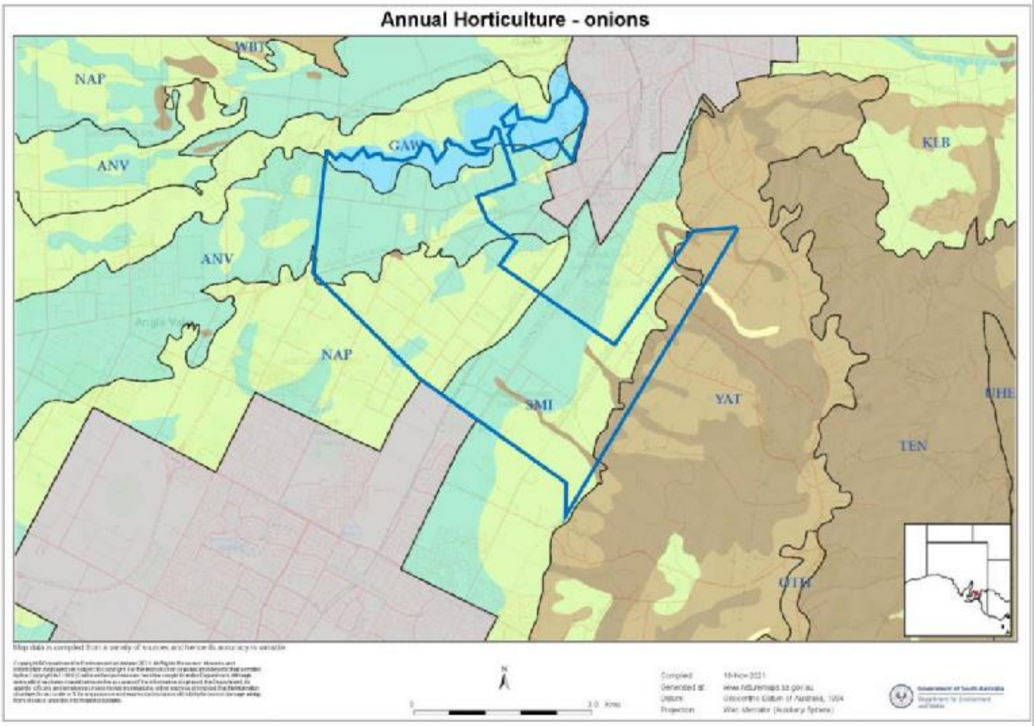
Land system classification for annual horticulture is shown in Table 6-9, with maps showing each land system and its classification for annual horticulture in Table 6-10.

Table 6-9 Annual Horticulture land system classification

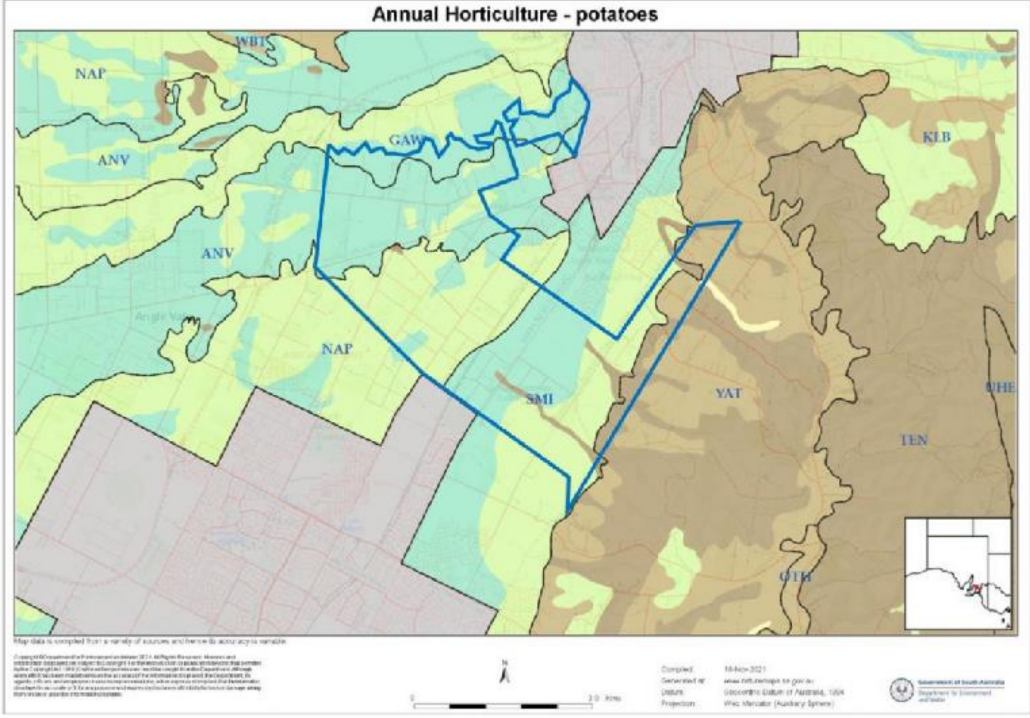
Land Use Category	Crop	Land System	Soil Landscape Unit	Class 1	2	3	4	5	NA	total %	Overall Class	Class Description
Annual Horticulture	carrots	Smithfield	SMIJAB	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Smithfield	SMIJAC	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Northern Adelaide Plains	NAPJqA	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Angle Vale	ANVJpA	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Gawler River	GAWXMA	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Yattalunga	YATAAI	0	0	0	0	100	0	100	5	low potential / <1% mod to high
	onion	Smithfield	SMIJAB	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Smithfield	SMIJAC	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Northern Adelaide Plains	NAPJqA	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Angle Vale	ANVJpA	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Gawler River	GAWXMA	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Yattalunga	YATAAI	0	0	0	0	100	0	100	5	low potential / <1% mod to high
	potato	Smithfield	SMIJAB	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Smithfield	SMIJAC	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Northern Adelaide Plains	NAPJqA	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Angle Vale	ANVJpA	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Gawler River	GAWXMA	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Yattalunga	YATAAI	0	0	0	0	100	0	100	5	low potential / <1% mod to high
	brassicas	Smithfield	SMIJAB	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Smithfield	SMIJAC	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Northern Adelaide Plains	NAPJqA	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Angle Vale	ANVJpA	0	100	0	0	0	0	100	2	moderately high potential / > 60% moderately high
		Gawler River	GAWXMA	0	0	100	0	0	0	100	3	moderate potential / > 60% moderately to high
		Yattalunga	YATAAI	0	0	0	100	0	0	100	4	moderately low potential / <1% mod to high

Table 6-10 Land Use Potential maps for Annual Horticulture

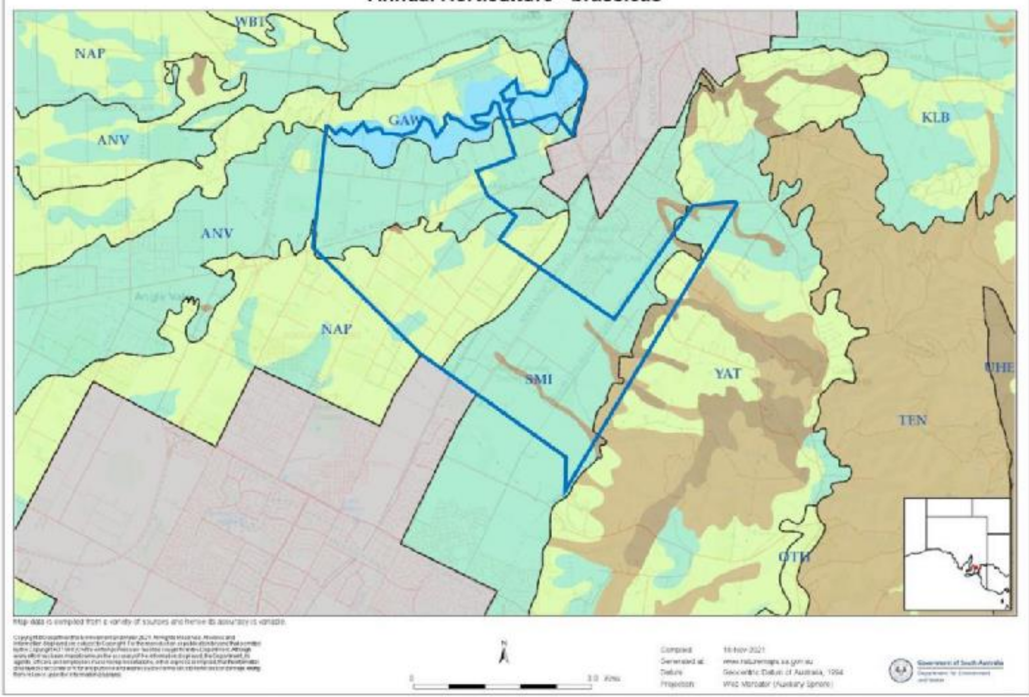




Annual Horticulture - potatoes



Annual Horticulture - brassicas



6.4.2.4 Native Food Crops

A range of new crop industries have been researched by Rural Industries Research and Development Corporation (RIRDC 2008). Plants considered include: Bush tomato; Lemon myrtle; Native citrus; Native pepper; Quandong; and Davidson plum. Of these Bush Tomato, Native Citrus (Desert Lime) and Quandong are ideal for the South Australian Mediterranean climate.

Bush Tomato
Bush Tomato prefer lighter textured, well drained soils and in heavier soils they will require mounding. Deep ripping to encourage root growth is recommended. Production will be increased if a water supply is available and they have some tolerance of saline soil conditions. When grown from seed there is variation in plant growth habit.

Native Citrus (Desert Lime)
Desert Lime or native cumquat (C. glauca) grows in semi-arid regions. They grow on clay soils and tolerate a range of climate conditions from frost to extreme heat. The fruit needs to be frozen within 24 hours.

Quandong
Quandong is tolerant of saline water and drought. They are semi-parasitic and the nature of the host plant will determine production. *Acacia victoriae* (bramble wattle) has been shown to be a useful host that is adaptable to many climates and soil types. Other hosts include *Atriplex, Melaleuca, Myoporum and Allocasuarina*.

7 Land Suitability

Land Suitability for a specific land use or crop type assesses all soil and land limitations and other factors such as climate, infrastructure, water availability and gross margins. There will be variations within these parameters and the final land suitability will depend on the risk a landholder is prepared to undertake to conduct a specified land use without causing environmental harm.

A fair return on agricultural or horticultural investment has been quoted at 12.5% (J Kelly Arris - personal communication) and includes capital growth and income. The definition of Fair Return on Investment (FROI) is the return you would expect to receive in the market place for a riskier investment other than putting the funds in a bank (https://www.business.qld.gov.au/running-business/leaving-business/valuing/key-concepts). It is governed by the level of risk taken. It can be represented as the fair return on net tangible assets, as follows:

- cost of tangible assets minus liabilities = fair return on net tangible assets

These calculations should be conducted by landholders to determine the suitability of a particular enterprise.

7.1 Land size

The Gawler Rural Land Use and Infrastructure Investigation background paper (Jensen 2015) stated that the 1700 ha rural zone has a variety of land uses, allotment sizes and geological features. They noted that there are concentrations of land parcel size as shown in Figure 7.1. Based on this finding they have concluded that the Gawler Rural Zone should not be treated as a generic area and different future management and planning is required across the zone. Once land has been subdivided it is hard for re-amalgamation. The categories of land size identified in the Jensen Report are:

- Small – 1 to 0.4 ha (1 – 4000 m^2)
- Medium - 0.4 to 2.5 ha (4001 – 25,000 m^2)
- Large – 2.5 to 10 ha (25,001 – 100,000 m^2)

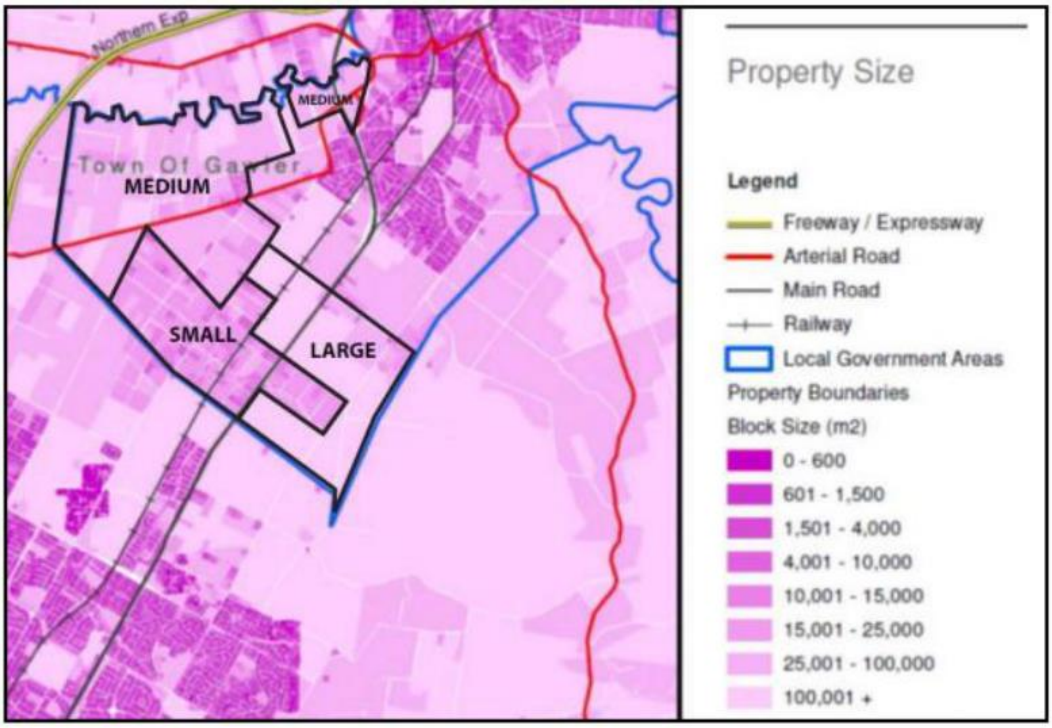


Figure 7-1 Land parcel size (Jensen 2015)

Based on data supplied by Gawler Council in September 2021, 90% of land within the Gawler Rural Zone is less than or equal to 5 ha in size (Table 7.1) (Figure 7-2). The viability of field crops, perennial horticulture and annual horticulture should focus on land sizes less than or equal to 5 ha. Based on the Gawler Council rate valuations for each land parcel the average land value per hectare is $ 295,823 / ha. The majority of land less than or equal to 5 ha has a capital value up to approximately $750,000 (Figure 7.3). These values include land with and without infrastructure (that is houses and shedding) and further refinement of the data would be required to obtain separate land values for vacant land and land with infrastructure. Noting the value of the infrastructure. The data in Figure 7.3 excludes two outliers. These properties are very highly valuated in excess of several M$ on Gale Rd Hillier and Clifford Rd Hillier.

Table 7-1 Land size distribution across the Gawler Rural Zone

Area (ha)	No Properties	% of total		
<1	59	12		
1-2	147	31		
2-3	125	26	69%	
3-4	25	5		
4-5	77	16	21%	90%
5-10	20	4		
10-20	15	3		
20+	10	2	10%	10%
	478		**100%**	**100%**

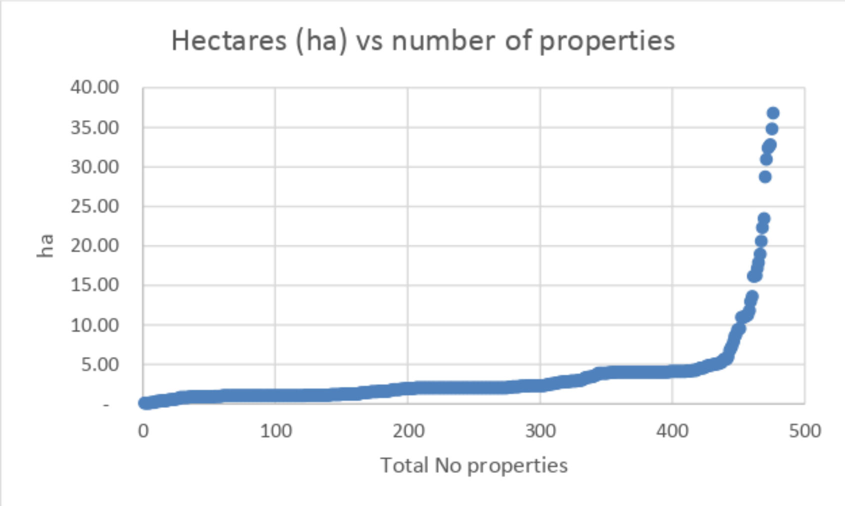


Figure 7-2 Land parcel size (ha)

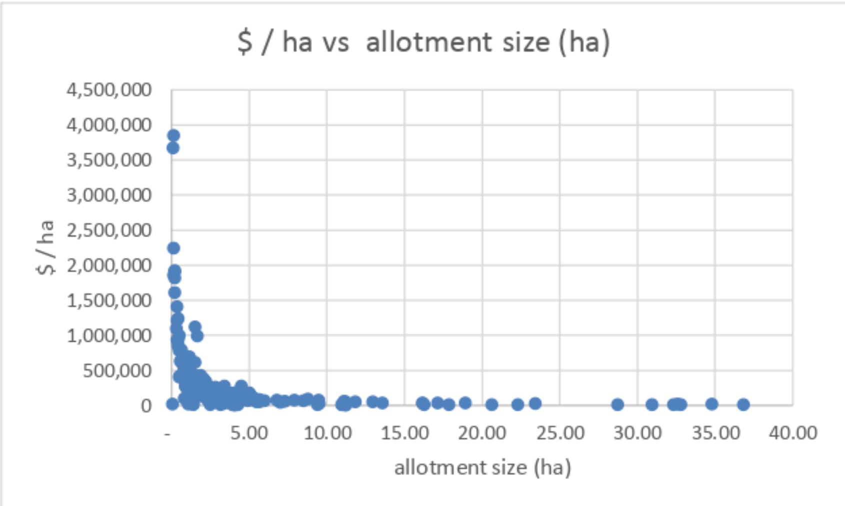


Figure 7-3 Land value per hectare for all allotments within the Gawler Rural Zone

7.2 Water

The availability of reliable, quality water supplies is required for long-term sustainable development of primary production in the Gawler Rural Zone. Water supplies could potential be from a number of sources such as groundwater, River Murray, recycled water (Barossa New Water) or desalinisation. The majority of allotments within the Gawler Rural Zone are 5 ha or less. Water supply for irrigated horticulture to allotments within the Gawler Rural Zone is required to maintain a green belt environment.

Recycled water from Bolivar Waste Water Treatment Plant for use in the Northern Adelaide Plains was studied with regard to the agronomic and environmental impacts of this water (Stevens *et al* 2004). Outcomes of this work included:

- The need to reduce the sodium adsorption ratio (SAR) of the recycled water used on soils within the Northern Adelaide Plains to prevent structural decline of the soils. The 1:5 soil water extract method was suggested as a reliable grower-based management tool for monitoring soil salinity;
- Grower awareness of algae build up with use of recycled water and the need for monitoring;
- Production of a grower manual for use of treated water.

Regional Development Australia - Barossa (RDAB) covers the Barossa Council, Town of Gawler, Light Regional Council and District Council of Mallala. In 2012 they developed a roadmap for issues within the region including water. This included:

- Expansion of rural urban stormwater schemes, including greater capture and reuse of stormwater from all land uses;
- Identification of treated water from Bolivar Waste Water Treatment plant was as a major resource for the Northern Adelaide Plains. There is now a proposal to expand this to the Barossa Valley (Barossa New Water). The Barossa Valley viticultural industry uses other sources of water including BIL water (Barossa Infrastructure Limited) and Murray River water;
- Councils should encourage use of rainwater tanks;
- Potential for small scale desalinisation plants.

In 2016 the Goyder Institute stated that an additional 26 GL water could be made available for economic development, including: 2.5 GL water from Virginia Pipeline Scheme winter water; 20 GL from upgrades of the Bolivar Dissolved Air Flotation and Filtration plant; and 3 GL from water-use efficiency gains from irrigated horticulture in the region.

As stated in the Gawler Rural Land Use and Infrastructure Investigations Background Paper 1 (Jensen 2015) there is a potable mains distribution to most of the Gawler Rural Zone with a 100 or 150 main installed. There are also some indirect water services to some allotments via meters next to the SA Water mainline, however residents need to apply for connections. The groundwater in the area is currently stable with a salinity of 1200 – 1300 mg/l (or 1.88 dS/m). There is currently no recycled water use in the Gawler Rural Zone.

A business case is currently being prepared for the SA Government by Kellogg Brown Root Pty Ltd for the delivery of approximately 8 GL of recycled water from the Bolivar Waste Water Treatment Plant to the Barossa Valley. Expressions of interest and the potential pipeline route is to be determined during the business case phase. The is potential for diversion of recycled water to the Gawler Rural Zone.

An example of recycled water use is the Northern Adelaide Plain (NAP). This region has used recycled water from Bolivar Treatment Plant and SA Water data shows the salinity of recycled water to be 1097 mg/l (or 1.7 dS/m) with a guaranteed maximum of 1500 mg/l (or 2.3 dS/m) (Kelly *et al* 2001). Leaching irrigations will be required and the adopted rate is 10% of standard irrigation rates (Ayers and Westcot 1989). Crop selection will also need to take account of tolerance to water and soil salinity. ***A consistent supply of good quality recycled water is required for the Gawler Rural Zone to be a viable primary production region.***

In the Northern Adelaide Plain the indicative water requirements for crops grown and soil and water salinity threshold levels are given in Table 7-2. This data should be used to determine the amount of recycled water required in the Gawler Rural Zone dependant on crop type. These calculations should form part of a separate feasibility report if Barossa New Water is secured. The water salinity threshold levels will be the same for both recycled water and other water sources. Plants will suffer stress at the levels indicated in Table 7-2.

Table 7-2 Indicative water requirements for crops in the Northern Adelaide Plain and soil and water salinity tolerances

Crop	Indicative Crop Water Requirement (KL/Ha/crop)	Yield Potential based on soil and water salinity								
			100% yield		75% yield		50% yield		0% max level	
			ECe	ECw	ECe	ECw	ECe	ECw	ECe	ECw
Almonds	5500 - 7500		1.5	1.0	2.8	1.9	4.1	2.8	6.8	4.5
Capsicums	3000 - 5000		2.5	1.7	4.4	2.9	6.3	4.2	10.0	6.8
Carrots, parsnips & turnips	4000 - 5000	carrot	1.0	0.7	2.8	1.9	4.6	3.0	8.1	5.4
Cauliflower, cabbage & broccoli	4000 - 5000	broccoli	2.8	1.9	5.5	3.7	8.2	5.5	14.0	9.1
celery	3000- 5000		1.8	1.2	5.8	3.9	9.9	6.6	18.0	12.0
cereal crops	4500 - 6500	barley	8.0	5.3	13.0	8.7	18.0	12.0	28.0	19.0
		wheat	6.0	4.0	9.5	6.3	13.0	8.7	20.0	13.0
cucumbers	120 - 170 / 150 m^2 glasshouse		2.5	1.7	4.4	2.9	6.3	4.2	10.0	6.8
flowers	4000 - 8000									
herbs	1000 - 2000									
lucerne	8000 - 10000		2.0	1.3	5.4	3.6	8.8	5.9	16.0	10.0
olives	5000 - 6500									
onions	5000 - 6000		1.2	0.8	2.8	1.8	4.3	2.9	7.4	5.0
potatoes	4000 - 7000		1.7	1.1	3.8	2.5	5.9	3.9	10.0	6.7
lettuce	4000 - 6000		1.3	0.9	3.2	2.1	5.1	3.4	9.0	6.0
tomatoes	200 - 280 / 150 m^2 glasshouse		2.5	1.7	5.0	3.4	7.6	5.0	13.0	8.4
vines	5000 - 6000		1.5	1.0	4.1	2.7	6.7	4.5	12.0	7.9

source: Kelly *et al* 2001 Sustainable use of reclaimed water on NAP, Grower Manual

ECe -soil salinity (dS/m)
ECw - water salinity (dS/m)
source: Ayers and Westcot 1989 Water quality for agriculture FAO29

Desalinisation of groundwater, brackish water or seawater maybe an alternative water source in the Gawler Rural Zone. There are a number of new emerging desalinisation technologies, they are:

- Forward osmosis. This method uses spontaneous transport of water by osmotic pressure to draw saline water across a semi-permeable membrane. The process can be used as a pre-treatment for reverse osmosis in existing desalination plants;
- Pressure retarded osmosis. This method uses spontaneous transport of water where the difference in osmotic pressure is used between a low salinity water and a pressurized high salinity water across a membrane. Problems occur due to the high pressure and clogging of the membrane;
- Membrane distillation. Thermally driven membrane separation of water. Problem is high energy cost;
- Capacitive deionization. This method of desalination removes ions from the saline water stream at atmospheric pressure using direct current (DC) power. It is a low-cost operation, has reduced brine volumes, minimum technical expertise and can be operated using renewable energy such as solar photovoltaic cells. This maybe an option for the Gawler Rural Zone; and
- Reverse electrodialysis. This method uses the combination of a high concentration solution (seawater) and low concentration solution (tap and river water).

The concentration of brine from desalinisation plants which discharge the brine back into the sea is a major problem for all systems. Research is being conducted to address this issue and the issues associated with membrane performance (Woo *et al* 2019). This topic should be investigated as part of any feasibility into water supplies for the Gawler Rural Zone.

7.2.1 Flood Risk

The Gawler River and Smith Creek Catchment cover much of the Gawler Rural Zone. The Smith Creek Flood Plain and Flood Hazard Study (2015) for a 1 in 100 year flood event shows low, medium and high hazard flooding.

The areas affected by a 1 in 100 year flood event include (Smith Creek Floodplain – Existing 100 yr ARI Flood Hazard Map):

- The majority of the Gawler Rural Zone has low hazard flooding and there is no defined area subject to this level of flooding;
- The north western section of the Gawler Rural Zone is subject to medium hazard flooding in a 1 in 100 flood event. This area extends through Hillier, across Angle Vale Road, Stebonheath Road, Athol Road up to Milne Road;
- Small sections either side of Dalkeith Road are subject to medium hazard flooding;
- Drainage lines from the eastern hills face zone east of Main North Road will cause localised flooding;
- Ponding of water behind Main North Road, Wattle Terrace and railway line will cause medium and high hazard flooding;
- Evanston Gardens will be subject to medium, high and extreme flood hazard in the vicinity of Trinity College.

The impact of flooding will be on infrastructure and primary production. Flooding can cause the development of perched watertables which will mobilise salt within the soil profile. An example area where this may occur is on the eastern side of the railway line and Main North Road where a medium to high flood hazard has been mapped for a 1 in 100 year flood. This may impact plant growth after the flood waters have receded. Soil erosion and loss of topsoil with nutrient and organic matter will also reduce crop yields. Some areas of the catchment may benefit from deposition of the eroded topsoil and crop yields and soil depth may improve in these areas.

7.3 Infrastructure

The Jensen report (2013) suggested the following infrastructure needs to be considered for each property in the Gawler Rural Zone where primary production is operating or planned to operate:

- Water supply;
- Ideally 3 phase power installed or close proximity;
- Gas supply
- Road access for machinery and trucks for markets;
- Shedding, office, access to storage facilities.

7.4 Climate

Weather data is available for Parafield Airport and Nuriootpa, there is no Bureau of Meteorology weather station at Gawler.

7.4.1 Parafield Airport – weather station

Weather data for the Parafield Airport is:

- mean rainfall is **448 mm** (1929 to 2021) (Figure 7.4)
- mean maximum temperature is **22.5°C** (1939 to 2021) (Figure 7.5)
- mean minimum temperature is **11.2°C** (1939 to 2021) (Figure 7.6)
- mean relative humidity is **18%** (1954 to 2010) (Figure 7.7)

- mean wind speed at 3 pm is **34 km/hr** (1939 to 2010) (Figure 7.8)

The Gawler Rural Zone is in the Temperate climate zone (Bureau Meteorology) with distinctly dry (warm) summers. Winter rainfall dominates with 50 mm in June, July and August. Up to 20 mm has been recorded during summer months (December to March). The mean monthly temperature during summer is 30°C during summer and the mean minimum is 7°C. Frosts are possible during winter. The mean monthly 9 am relative humidity is 50% during summer and mould and bacteria related plant diseases are possible following summer rainfall and warm conditions. Wind speeds (3 pm) are consistent throughout the year ranging from 18 km/hr in winter to 25 km/hr in summer.
Weather conditions are ideal for a range of crops with no extreme highs or lows, however irrigation will be required throughout the year particularly during summer (December to March).

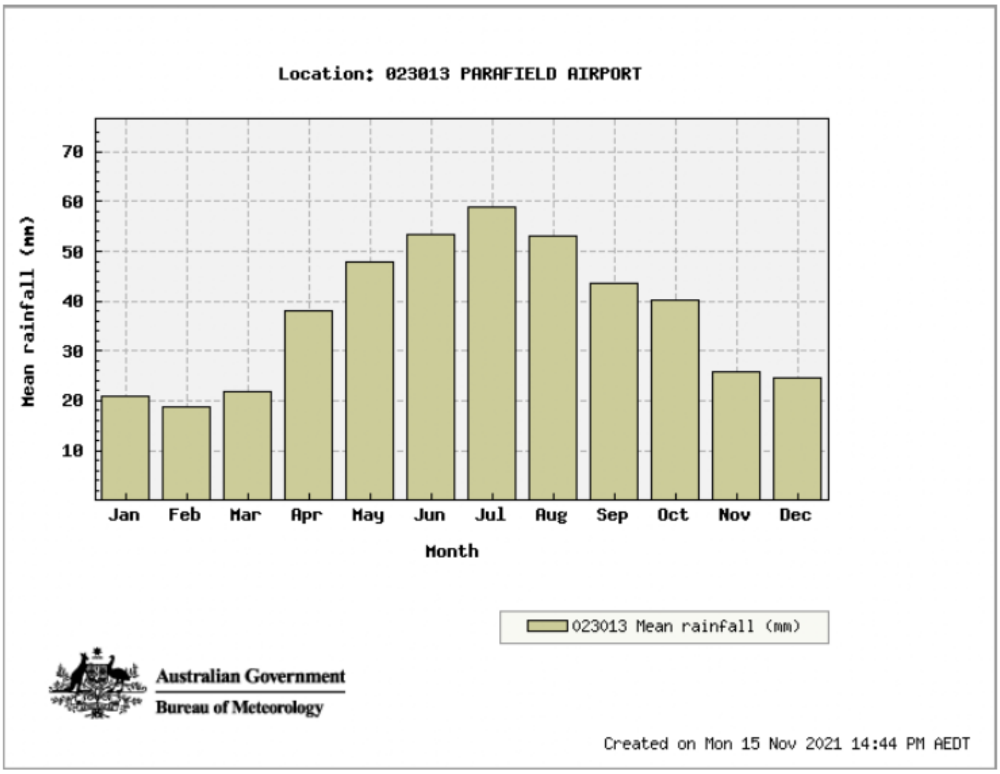


Figure 7-4 Mean rainfall Parafield Airport

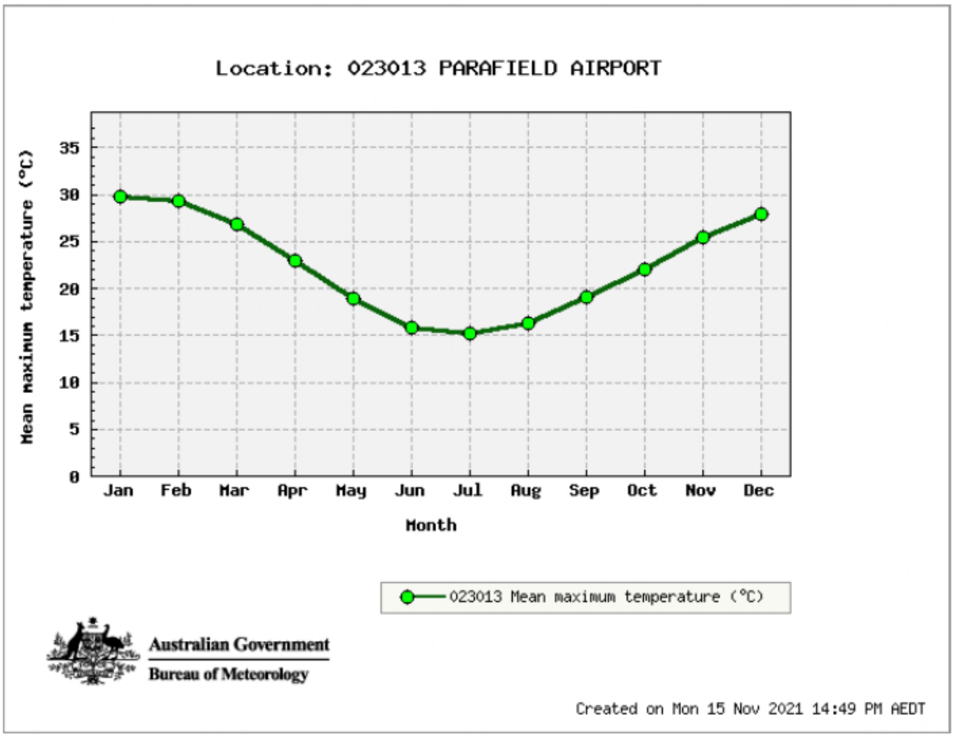


Figure 7-5 Mean maximum temperature Parafield Airport

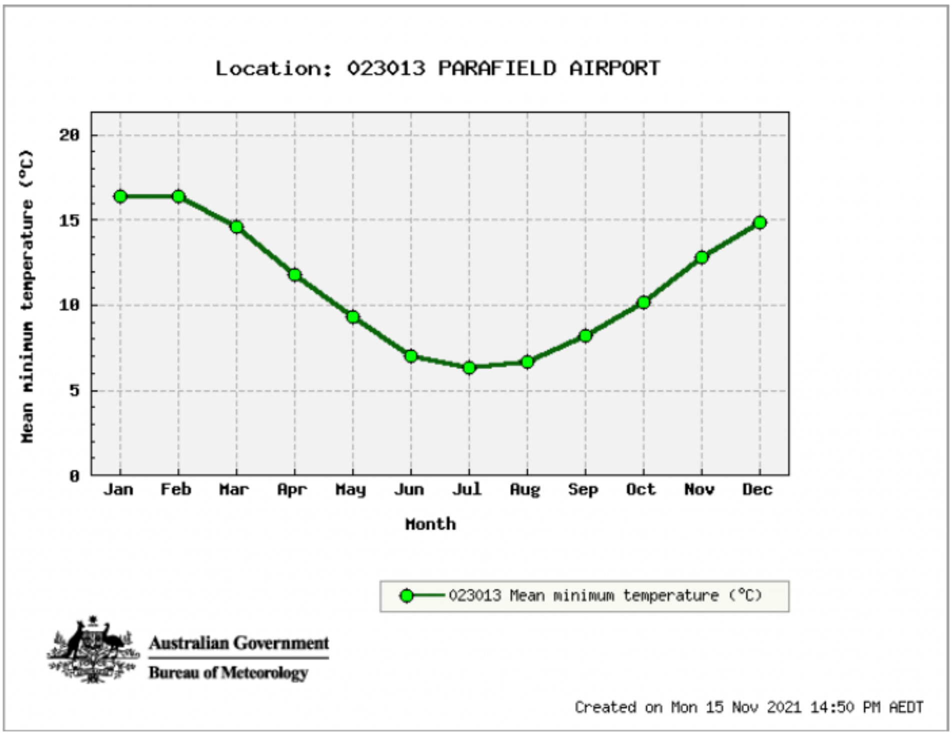


Figure 7-6 Mean minimum temperature Parafield Airport

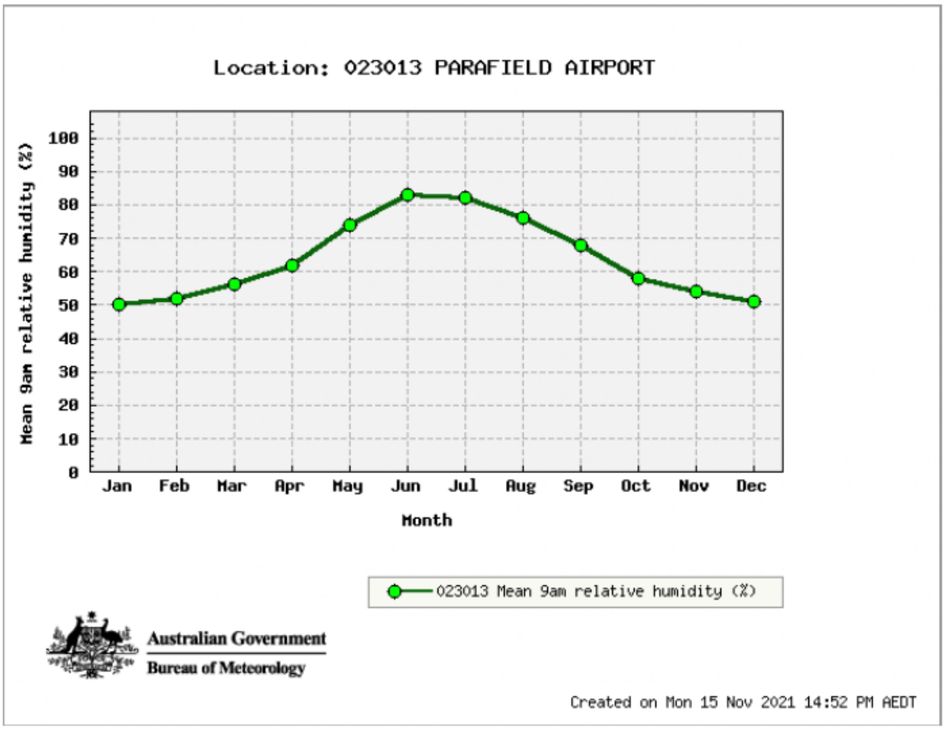


Figure 7-7 Mean relative humidty at 9 am Parafield Airport

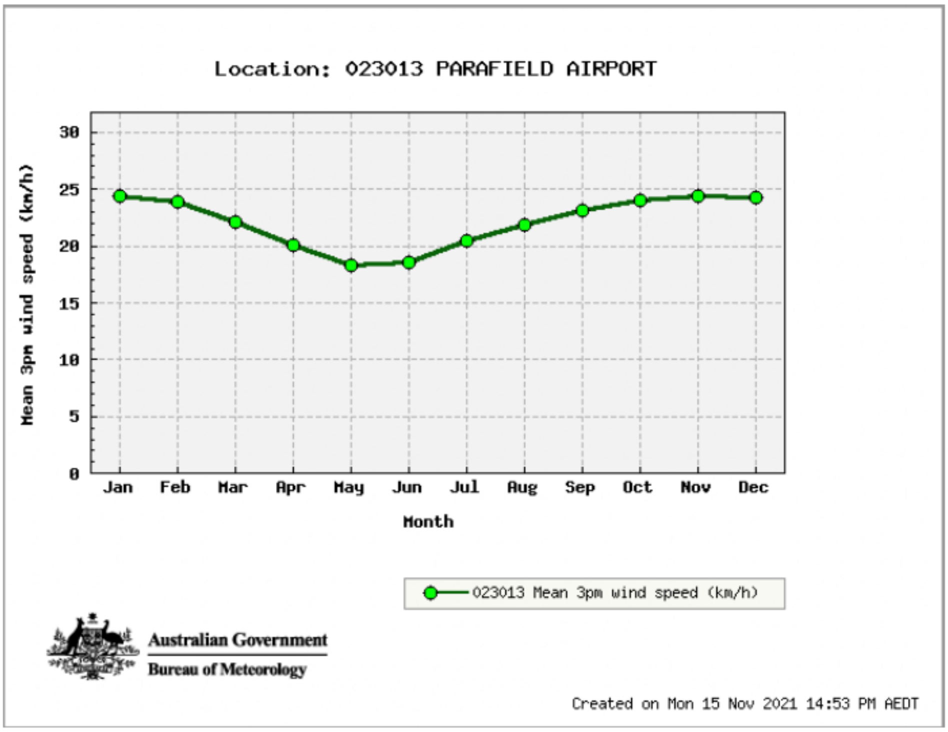


Figure 7-8 Mean wind speed at 3 pm Parafield Airport

7.5 Gross Margin Analysis

The economic analysis provided in this report are general in nature. Costs are estimates only and are based on reasonable expected values collated from several sources (Table 7-3). The values provided do not, nor intend to, provide specific detailed financial advice on the installation and operation of the proposed enterprise and are a guide only. A broad range of sources were used to provide the required data for the gross margin models (see Table 7-3).

Table 7-3 Data sources for economic analysis

Field Crops	PIRSA Gross Margin Guide 2021
Perennial Horticulture	Wine Benchmark Calculator, Wine Australia
	Barossa Wine and Grape Association
	Australian Almond Board. Almond Benchmark project Riverland SA
	Olives - Oil Production - Investment and Gross Margin Analysis - AgriGrowth Tasmania (Dept Natural Resources and Environment Tasmania)
	Citrus Budget Handbook DPI NSW – Gross Margins
Annual Horticulture	Arris – Gross Margin tables (compiled from a range of sources)

7.5.1 Field Crops

Gross margins for field crops based on data supplied in the PIRSA Gross Margin Guide 2021 show a linear increase with increase in land area (ha) (Figure 7-9). Wheat and Phalaris offer the greatest returns, while Lucerne pasture offers the lowest returns. Fixed costs are not included in these gross margins.

The analysis of land parcel size showed 90% of allotments are 5 ha or less. The returns on field crops for a land area of 5 ha is less than $3,000 (Table 7-4 and Figure 7-9). Returns of $10,000 or more are not achieved for most crop types until the land area is approximately 30 ha or greater. There are only 7 properties approximately 30 ha or greater and amalgamation of land or a cooperative arrangement between landholders would be required to make field crops viable.

Table 7-4 Gross margins ($) of field crops

Land (ha)	Wheat	Malt Barley	Feed Barley	Milling Oats	Lupins	Field Peas	Canola Conventional	Lucerne Pasture Cereal	Phalaris Sub Pasture Cereal
1	491	345	336	380	303	320	316	223	573
5	2,455	1,723	1,681	1,901	1,514	1,600	1,580	1,114	2,867
10	4,910	3,447	3,363	3,802	3,028	3,200	3,161	2,227	5,733
15	7,366	5,170	5,044	5,703	4,542	4,800	4,741	3,341	8,600
20	9,821	6,894	6,725	7,604	6,056	6,400	6,321	4,454	11,466
30	14,731	10,341	10,088	11,406	9,084	9,600	9,482	6,681	17,199
40	19,641	13,788	13,451	15,208	12,112	12,800	12,643	8,908	22,932

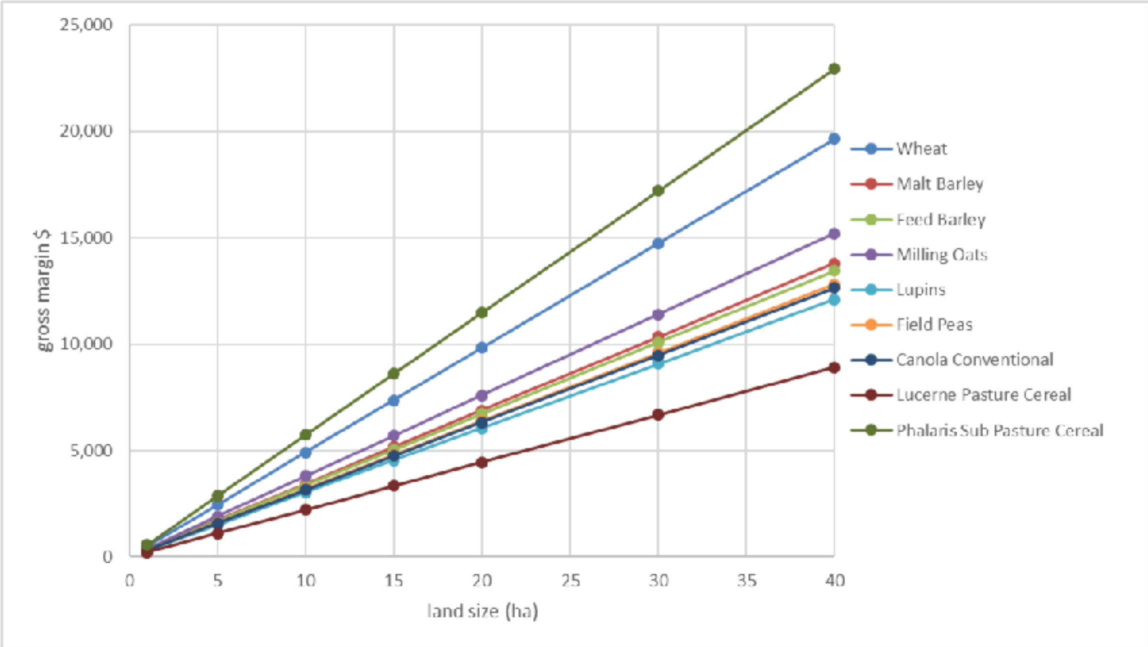


Figure 7-9 Linear increase in gross margins with land size

7.5.2 Perennial Horticulture

7.5.2.1 Vines

The Barossa Valley can be used as a comparison with the Gawler Rural Zone as to the grape varieties that could be grown. Based on data from Barossa Wine (Grape and Wine Association) there are over 40 varieties of vines planted in the Barossa Valley, with red varieties accounting for 84% of plantings (Table 7-5). Shiraz will be used in the gross margin analysis for vines in the Gawler Rural Zone.

Table 7-5 Vine grape varieties applicable to the Gawler Rural Zone

Type	Variety	Hectares
Red	Shiraz	7825
	Cabernet Sauvignon	1907
	Grenache	690
	Merlot	407
	Matara	273
White	Riesling	726
	Chardonnay	592
	Semillon	377

The Wine Benchmark calculator (Wine Australia) has been used to compare the gross margins for Shiraz on 1, 5, 10, 20 and 30 ha parcels within the Gawler Rural Zone. A number of assumptions are used and the winery size and costings from the Wine Benchmark Calculator are shown in Tables 7-6 and 7-7 and Appendix B:

- average 5 t/ha of fruit - extraction rate of juice 600 l/t - production of 3000 l/ha
- tank holding time of 3 months – bottle holding time of 3 months
- wine sold locally not overseas
- winery size less than 100 t capacity (micro) and 100 to 750 t capacity (small)
- retail price per bottle (750 ml) of $20.00 (ex GST)

Table 7-6 Costing for micro and small winery (Wine Benchmerk Calculator)

Winery size (t)	Grape cost per ha	Retail price per bottle	Retail price per dozen	Wholesale price per dozen	Winery sale price per dozen	Total Cost ex winery / doz	Winery GM / doz	Winery GM %
micro	2,496.51	19.99	239.88	130.03	126.63	91.05	35.59	28
small	2,496.51	19.99	239.88	130.04	126.64	81.69	44.96	36

Table 7-7 Winery size ratings Wine Benchmark Calculator

Winery Facility Size (t)	
micro	1 - 100
small	100 - 750
medium	750 - 5000
large	5000 - 20000

Table 7-8 Gross margins for micro and small winery based for land parcel size (ha)

Winery Size t	Land Size ha	production t/ha	total t	Extraction rate l/t	total volume l	total volume dozens	Gross Margin per dozen
micro	1	5	5	600	3,000	333	$ 11,863
micro	5	5	25	600	15,000	1,667	$ 59,317
micro	10	5	50	600	30,000	3,333	$ 118,633
micro	20	5	100	600	60,000	6,667	$ 237,267
small	30	5	150	600	90,000	10,000	$ 449,600
small	40	5	200	600	120,000	13,333	$ 599,467

Land areas less than 20 ha are considered micro wineries (Wine Australia Benchmark Calculator). Analysis of allotment size has shown most land in the Gawler Rural Zone to be 5 ha or less and micro wineries would dominate if the area was to market itself for wine production.

Based on the data presented a 5 ha allotment would have a gross margin of $59,317 (Table 7-8) with a gross margin percentage of 28% (Table 7-6). Wine Australia state a sustainable gross margin of 50% is ideal, however they note that many micro and small winery operations use a figure of 30%. The Wine Grape Council of SA regional report card for the Barossa Valley in 2014 put the cost of production of grapes at $6750.00. This figure excluded water, depreciation, finance costs and return on investment. Removing this cost gives a return of $ 5113.00 for 1 ha planted area of grape vines, compared to $ 52,567.00 for a 5 ha vineyard planting. Based on these figures a 1 ha vineyard planting may not be considered economically.

The figures presented in Tables 7-6 to 7-8 do not include fix costs and are based on the assumption that there are minimal overheads such as bank loans and access to machinery.

Micro-scale (< 100 t) and small-scale (100 to 750 t) viticulture and wine production is feasible in the Gawler Rural Zone on all land systems with Class 2 and Class 3 limitations.

7.5.2.2 Almonds

The Riverland can be used as a comparison with the Gawler Rural Zone for suitability to Almond production with regard to climate and soils. The Smithfield. Angle Vale and Gawler River land systems are potentially more productive than the Northern Adelaide Plains land system where shallow depth to soil carbonate and calcrete with soil pH greater than 8.5 is a major limitation.

The Almond gross margin data present in Table 7-9 is based on 2010 benchmarking data from the Australian Almond Board. More recent data is currently not available.

Table 7-9 Almond gross margin data

Almonds							
Riverland SA - Benchmark costs $/ha							
		1 ha	*5 ha*	*10 ha*	*20 ha*	*30 ha*	*40 ha*
Water Use							
Water Use ML/ha		14	70	140	280	420	560
Income		**$ / ha**					
production t/ha		3.2	16	80	400	2,000	10,000
production ($5500/ha)		$17,600	$88,000	$440,000	$2,200,000	$11,000,000	$55,000,000
grower levy ($40/t)		$ 128	$ 640	$ 3,200	$ 16,000	$ 80,000	$ 400,000
Total Income		**$ 17,472**	**$ 87,360**	**$ 436,800**	**$ 2,184,000**	**$ 10,920,000**	**$ 54,600,000**
Costs							
Disease program		$ 142	$ 710	$ 1,420	$ 2,840	$ 4,260	$ 5,680
Pest Program		$ 233	$ 1,165	$ 2,330	$ 4,660	$ 6,990	$ 9,320
Nutrient Program		$ 104	$ 520	$ 1,040	$ 2,080	$ 3,120	$ 4,160
Fertiliser Program		$ 1,517	$ 7,585	$ 15,170	$ 30,340	$ 45,510	$ 60,680
Herbicides		$ 50	$ 250	$ 500	$ 1,000	$ 1,500	$ 2,000
Bird Control		$ 35	$ 175	$ 350	$ 700	$ 1,050	$ 1,400
Prunning - hand		$ 180	$ 900	$ 1,800	$ 3,600	$ 5,400	$ 7,200
Irrigation							
water leased		$ -	$ -	$ -	$ -	$ -	$ -
power	14000 KL/ha $0.12 c/KL	$ 1,680	$ 8,400	$ 16,800	$ 33,600	$ 50,400	$ 67,200
Pollination							
	6.5 hives/ha @ $75 /hive	$ 488	$ 2,440	$ 4,880	$ 9,760	$ 14,640	$ 19,520
Mechanical Harvesting	$1140 / ha	$ 1,140	$ 5,700	$ 11,400	$ 22,800	$ 34,200	$ 45,600
Unallocated labour	116 hrs @ $21.7/hr	$ 2,519	$ 12,595	$ 25,190	$ 50,380	$ 75,570	$ 100,760
Freight to cracker	$ 0.08 /kg	$ 256	$ 1,280	$ 2,560	$ 5,120	$ 7,680	$ 10,240
Cracker Costs	$ 0.30 /kg	$ 960	$ 4,800	$ 9,600	$ 19,200	$ 28,800	$ 38,400
Total Production Costs		**$ 9,304**	**$ 46,520**	**$ 93,040**	**$ 186,080**	**$ 279,120**	**$ 372,160**
Gross Margin ($/ha)		**$ 8,168**	**$ 40,840**	**$ 343,760**	**$ 1,997,920**	**$ 10,640,880**	**$ 54,227,840**
Note: Source Australian Almond Board - April 2010 data							

7.5.2.3 Olives

Olive production is Class 2 on Smithfield, Angle Vale, Gawler River and parts of Yattalunga land systems, but Class 3 on Northern Adelaide Plains where special management is required due to shallow soil carbonate and calcrete with high (8.5+) soil pH. The gross margin data presented in Table 7-10 is based on 2018 from AgriGrowth Tasmania (Dept Natural Resources and Environment Tasmania). Climate conditions are favourable in Tasmania with cool to cold winters and dry summers. The cool winters favours the chilling requirement for fruiting which occurs in most of Tasmania. The ideal conditions are winter temperatures of 1 - 18°C, with average daily temperature in July of less than 12°C is ideal (Factsheet DNRE Tasmania).

Based on the cooler environment in Tasmania the gross margins presented are expected to be lower with a reduced yield in the Gawler Rural Zone. The gross margin for 5 ha land parcel was $61,275. If a 20% yield loss occurs due to climate factors the return would be $37,546 for a 5 ha allotment and $9,804 for a 1 ha allotment.

Table 7-10 Gross margin data for Olives in Tasmania

OLIVES - oil production						
	$ / ha					
hectares	1	5	10	20	30	40
Income						
Income oil sales	$ 23,100	$ 115,500	$ 231,000	$ 462,000	$ 693,000	$ 924,000
Total income	**$ 23,100**	**$ 115,500**	**$ 231,000**	**$ 462,000**	**$ 693,000**	**$ 924,000**
Nutrients	353	1,765	3,530	7,060	10,590	14,120
Sprays	176	880	1,760	3,520	5,280	7,040
Irrigation	140	700	1,400	2,800	4,200	5,600
Water cost	420	2,100	4,200	8,400	12,600	16,800
Contract harvest	8,400	42,000	84,000	168,000	252,000	336,000
Packing and transport	543	2,715	5,430	10,860	16,290	21,720
Tractor & plant - fuel & repairs	256	1,280	2,560	5,120	7,680	10,240
Casual labour	557	2,785	5,570	11,140	16,710	22,280
Total variable costs	**10,845**	**54,225**	**108,450**	**216,900**	**325,350**	**433,800**
Gross margin	**$ 12,255**	**$ 61,275**	**$ 122,550**	**$ 245,100**	**$ 367,650**	**$ 490,200**
Note: source - AgriGrowth Tasmania Department of Natural Resources and Environment Tasmania updated 2018						

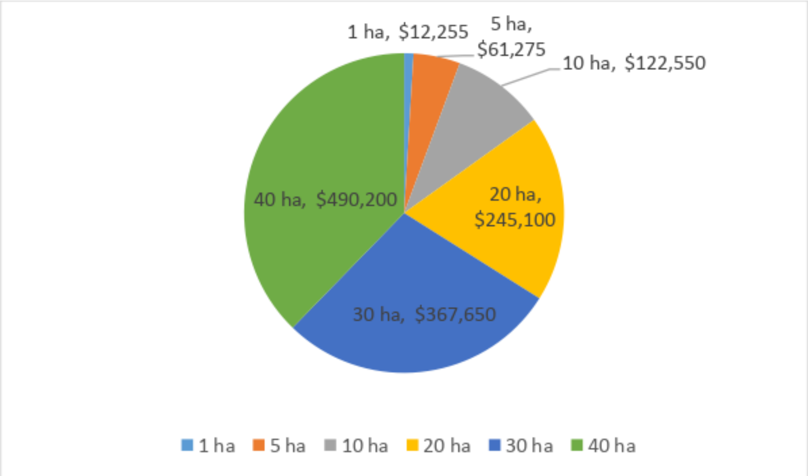


Figure 7-10 Gross Margin for olives per land parcel size

7.5.2.4 Citrus

In the Sunraysia region of Victoria there are 5966 ha of fruit bearing citrus trees, with 90% of orchards under 20 ha in size and of these 43% are less than 5 ha. The data presented is based on gross margins at year 10 to 11 once costs and income are stable (Table 7-11 and Figure 7-11). Citrus production in the Sunraysia is therefore based on small scale production which would suit the Gawler Rural Zone which has direct access to Adelaide markets.

Citrus production in the Gawler Rural Zone is possible on Smithfield, Angle Vale and Gawler River land systems, but is Class 3. That is, special management would be required for production, principally due to shallow depth of soil carbonate and calcrete with a soil pH of 8.5 or greater which limits plant root growth. The Northern Adelaide Plains land system is not suitable for citrus production due to soil carbonate and calcrete.

Citrus production for juice is less productive (Valencia) than eating oranges (Washington Navel), but Mandarins (Aflourer) are highly productive, with a gross margin of $70,870 for a 5 ha land parcel. The return on 1 ha should be considered as viable to cover living costs such as rates and electricity.

Table 7-11 Gross margins for Washington Navel, Valencia Juice and Aflourer Mandarins

	Gross Margins ($) - Citrus		
Land (ha)	Washington navel	Valencia Juice	Aflourer Mandarin
1	6,941	1,720	14,174
5	34,705	8,600	70,870
10	69,410	17,200	141,740
20	138,820	34,400	283,480
30	208,230	51,600	425,220
40	277,640	68,800	566,960

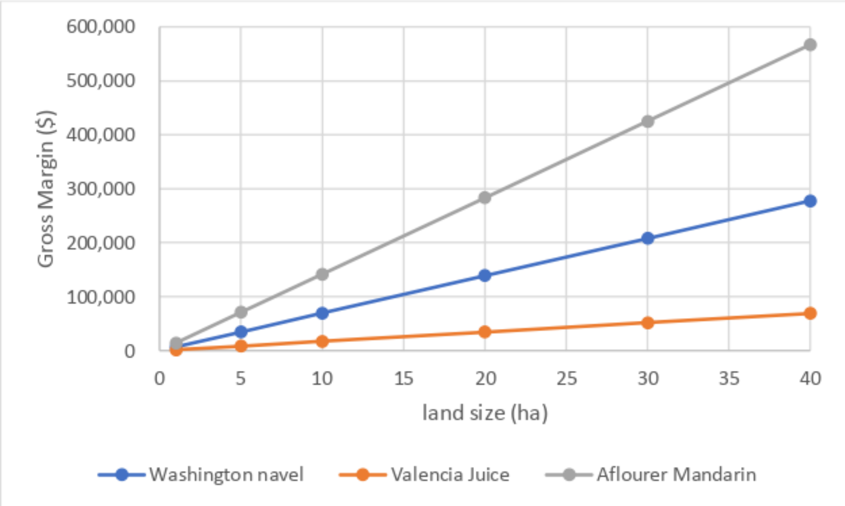


Figure 7-11 Graphic representation of gross margins by citrus variety

7.5.3 Annual Horticulture

The long-term trend (2006 to 2015) in prices ($/kg) for a range of annual horticulture crops (Figure 7.12) shows average value of $2.63/kg across all annual crops. The trends for selected annual horticultural crops including gourmet tomato, capsicums, cauliflower, cabbage and broccoli are shown in Figures 7.13 to 7.17.

Capsicum averages $3.67/kg (2006 to 2015) and is the highest performing annual crop in the examples shown and is the only crop with a value higher than the average for all crops (median $2.63/kg – all crops). Broccoli and Gourmet Tomato are the next performing annual crops with average prices of $2.51 and $2.29/kg. Cauliflower and cabbage are the lowest performing crops with averages of $1.52/kg and $0.66/kg.

Gourmet tomato and capsicums prices are based on low technology polyhouses while cauliflower, cabbage and broccoli are based on field cropping. Gross margins for these crops are presented in Appendix B.

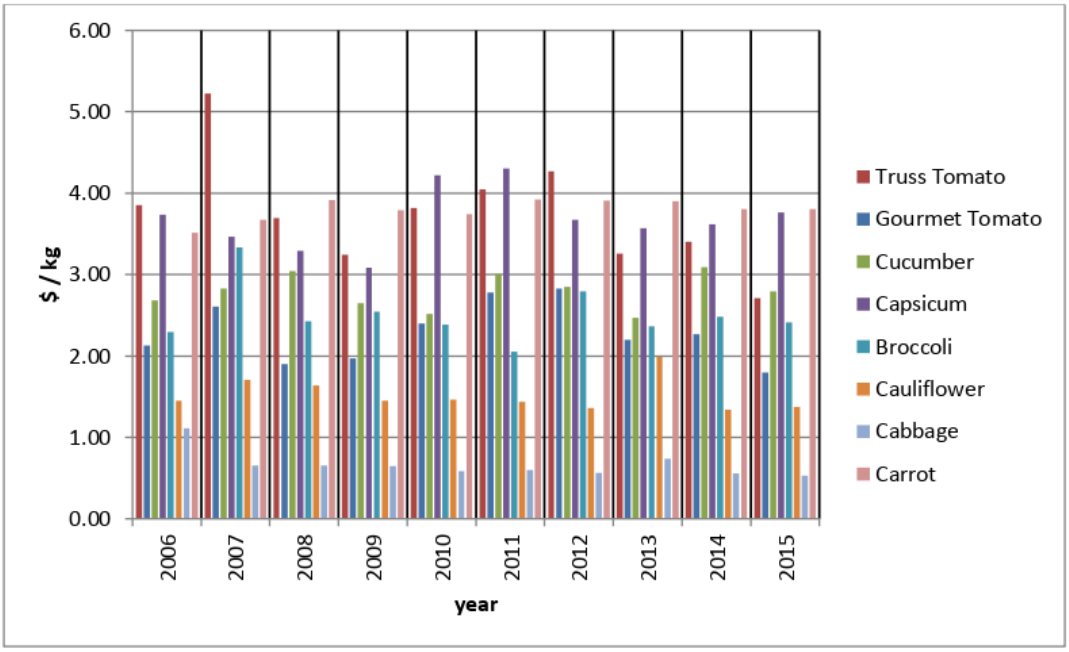


Figure 7-12 Long tern trend in value of annaul horticultural crops ($/kg)

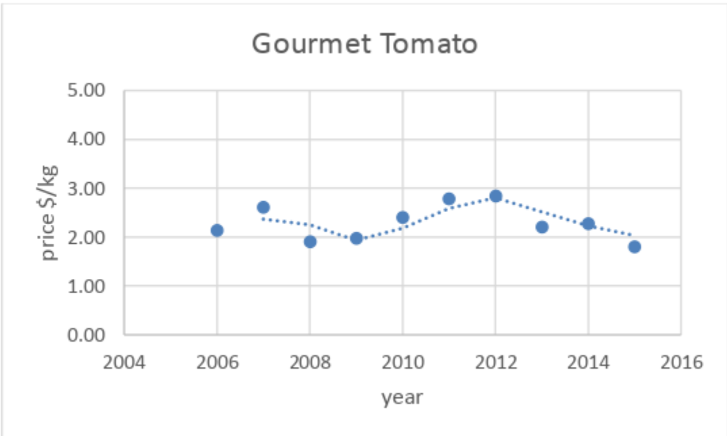


Figure 7-13 Gourmet Tomato average $/kg

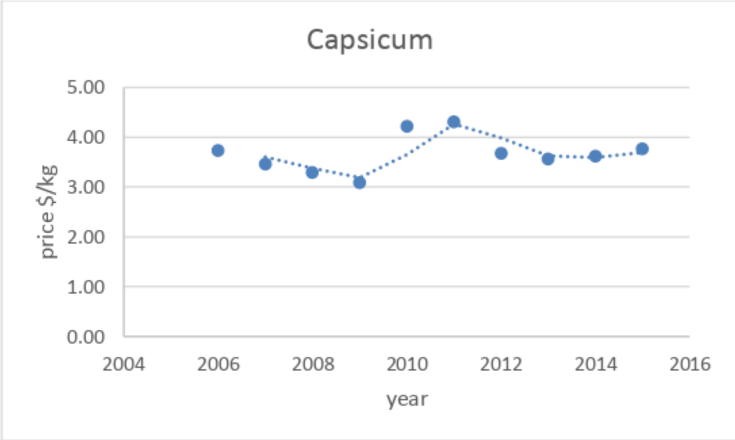


Figure 7-14 Capsicum average $/kg

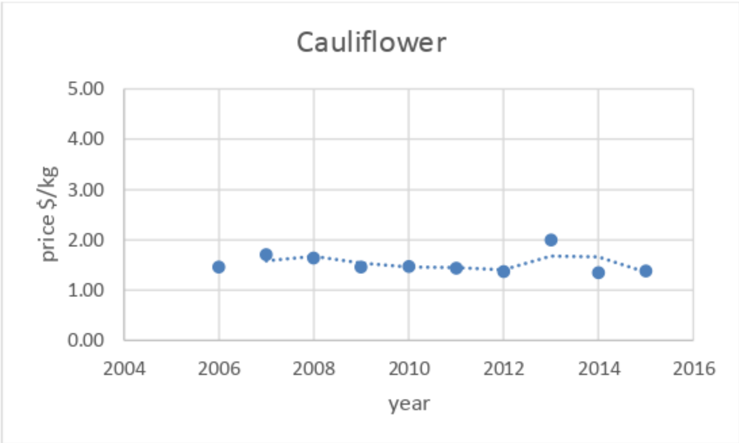


Figure 7-15 Cauliflower average $/kg

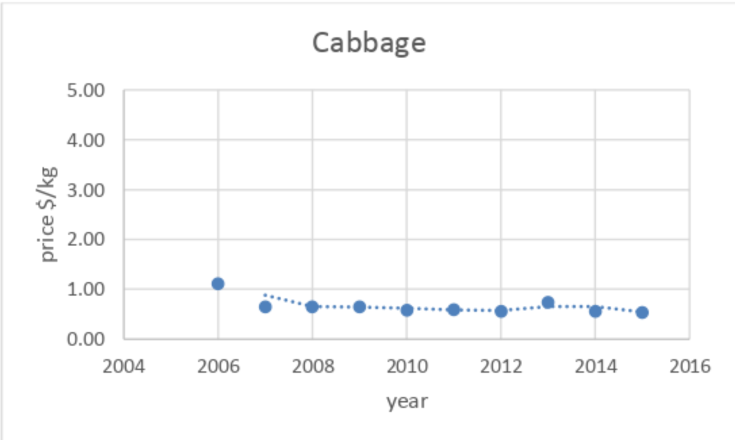


Figure 7-16 Cabbage average $/kg

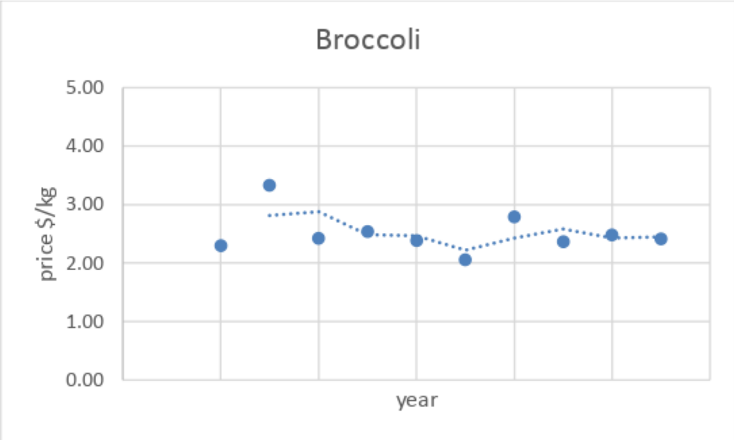


Figure 7-17 Broccoli average $/kg

7.5.3.1 Native Food Crops

Indicative farm-gate prices for a range of Native Food Crops are shown in Table 7-12 (Based on 2004 data RIRDC). The prices indicate a high return, however the cost or production or native harvest are high.

Table 7-12 Farm-gate prices for native food crops (RIRDC 2004 data)

Crop	Produce Type	($/kg)
Aniseed myrtle	Dry and milled leaf	38
Bush tomatoes	Dry whole or ground	20–24
Davidson's plum	Frozen whole	2–6
	Frozen deseeded halves	5–13
	Frozen puree	9–10
Kakadu plum	Frozen whole	15–20
Lemon aspen	Frozen whole	8–12
Lemon myrtle	Whole fresh leaf on stem	2–10
	Dried and milled	22–25
Native citrus	Desert lime frozen whole	5–15
	Finger lime whole	25– 80
Native pepper	Dry and milled leaf	38
Pepperberries	Fresh	6–20
	Dried	30–70
Native mint	Dried and milled leaf	35–38
Riberries	Frozen whole, seedless	13
Quandong	1st grade premium dried	40–60
	Frozen deseeded halves	25–28
Wattle seed	Raw whole seed	15
	Roasted and milled	20-24
source RIRDC 2008		

Bush Tomato

An example of costs for Bush Tomato is presented from Tangentyere Council in Alice Springs, Northern Territory (RIRDC 2008). Plantings were on 1/3 ha with 1.5 m row spacing, 0.5 to 1.0 between plants along the planting row giving 10,000 bushes or 30,000 bushes / ha.

Associated costs are shown in Table 7-13, these include setup and on-going operating costs. Yields from Bush Tomato are variable with higher yields in the first two years. In the first year yields of 150 g per bush or 4.5 t/ha based on 30,000 plants / ha can be expected and in the second year 250 g per bush or 7.5 t/ha. This however declines to 0.5 to 1.0 t/ha from 2 to 3 year old plantings (A. Hele 2001. Bush Tomato Production SA. PIRSA Factsheet) and (RIRDC 2008).

Based on average yield of 100 g per bush (30,000 bushes / ha) a yield of 3000 kg/ha would be expected. At prices of $25/kg a gross income of $75,000.00 and net income of $48,137.00 (minus Table 7-13 expenses) would be expected. However, if yield decreased to 1.0 t/ha then gross income would be $25,000.00 and net income would decrease to a non-viable level of negative -$1863.00/ha.

The production costs would be lower in the Gawler Rural Zone. There would be no remote area fee ($2,500.00) or travel allowances ($2,100.00) and reduced freight costs. Consultant fees could also be removed ($2,500.00). The costs in Table 7-13 could be reduced by $7100.00 making Bush Tomato viable ($26,863.00 – $7,100.00 = $19,763.00). A yield of 1.0 t/ha ($25,000.00) would have a net income of $5237.00 which is low. If planting covered a 5 ha lot in the Gawler Rural Zone then income of $26,185.00 could be expected based on 1.0 t/ha yield.

Table 7-13 Bush Tomato production cost per 1/3 ha

Item	Cost ($)
Fencing	4940.00
Weedmat	2200.00
Trellises	770.00
Irrigation system	1923.00
Fertilizer	2330.00
Seedlings	5000.00
Hire equipment	1000.00
Consultants fees	2500.00
Freight	750.00
Fuel	500.00
Office supplies	100.00
Phone/fax/Email	250.00
Remote area fee	2500.00
Travel allowances	2100.00
Total	**$26,863.00**
source RIRDC 2008	

Native Citrus

Indicative prices for Desert Lime and Finger Lime are shown in Table 7-14 (RIRDC 2008). Native Citrus is usually planted as a monoculture in a similar manner to other horticultural crops with stocking rates of 625 trees/ha. The establishment costs for a 1.0 ha Desert Lime orchard are estimated at $17,375 and include plant stock, fencing and irrigation. The on-going operating costs are estimated at $10,000/ha (Table 7-15).

Based on a yield from mature trees of 15 kg/tree, with 625 trees/ha, the crop yield would be 9375 kg. Given a price of $5.00/kg, the gross margin for Desert Limes would be approximately $36,875 after on-going operating costs.

Table 7-14 Indicative prices for Desert Limes

Variety	Product	Wholesale price ($/kg)
Desert lime	Frozen whole	5–15
Finger lime	Whole	25–80 8–12 (normal range)

Table 7-15 Operational costs of a 1 ha Desert Lime orchard

Item		Cost ($/ha)
Herbicide		50.00
Fertiliser		550.00
Irrigation (excludes water cost)		200.00
Orchard maintenance		2,000.00
Harvest, grading and packing		3,500.00
Marketing		3,700.00
Total	**$**	**10,000.00**

Quandong

Quandongs will grow in a range of soil types, soil pH levels and salinity levels and will not grow in waterlogged conditions. Quandong root systems are shallow and irrigation should be to that of the host plant as Quandongs are semi-parasitic.

Quandong seedlings have variable yield but grafted varieties of Quandong will have increasing yield of 0.5 kg dried fruit/tree/annum up to 15 years (RIRDC 2008). Trees are not expected to yield until year 4. Yield and return of Quandong increases each year with a second income possible at about year 7 to 8 (Table 7-16). The price received for Quandong dried fruit will be variable and Table 7-16 is an indication of expected return only.

Table 7-16 Potential yield and income for Quandong

year	4	5	6	7	8	9	10	11	12	13	14	15
tree yield (kg)	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
Yield (kg) 300 tree orchard	150	300	450	600	750	900	1050	1200	1350	1500	1650	1800
$ 40 / kg	40	40	40	40	40	40	40	40	40	40	40	40
Income (gross)	**6,000**	**12,000**	**18,000**	**24,000**	**30,000**	**36,000**	**42,000**	**48,000**	**54,000**	**60,000**	**66,000**	**72,000**
costs (based on Desert Lime)	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Net Income	**-4,000**	**2,000**	**8,000**	**14,000**	**20,000**	**26,000**	**32,000**	**38,000**	**44,000**	**50,000**	**56,000**	**62,000**

7.5.4 Gross Margin Summary

Indicative gross margins for a range of crops and land size are shown in Table 7-17, Figure 7-18 and Figure 7-19. Based on data presented in section 7.1 showing 90% of land sizes are 5 ha or less, the gross margin analysis for 1 ha and 5 ha land sizes will be assessed.

Field crops are not-viable on a land size of 1 ha or 5ha. The benefit of field crops would be for small quantities of on-property hay and or ground cover and management of pest plants and weeds. Horse agistment would be viable at this scale provided there is a source of external feed.

Perennial horticulture is viable at 1 ha and 5 ha if the income was used to cover land costs such as rates, water and electricity at 1 ha scale, but at 5 ha scale there is scope for a modest second income from the property. At 1 ha size perennial horticulture maybe considered a hobby enterprise and niche local farmer markets maybe an outlet for produce sales. Vines, Olives are suited to all land systems within the Gawler Rural Zone and would be the preferred option for perennial horticulture. Citrus such as Mandarins are marginally more profitable but are limited on some land systems such as the Northern Adelaide Plains due to presence of shallow soil carbonate and calcrete with high soil pH.

Annual horticulture is viable at 1 ha and 5 ha scale when crops are grown either as low technology polyhouses or as in-ground crops. All annual horticultural crops could provide an income from 5 ha with gourmet tomato and capsicum providing the greatest potential income.

The approximate gross margins of native food crops are presented in section 7.5.3.1. Results show that there is potential for high returns from native food crops, however market fluctuations, yields and supply are variable. These are risks that need to be considered in a native food crop enterprise. Local niche markets maybe an avenue for stable, regular income from native food crops.

All costings above are based on assumptions of average yields and exclude fix costs such as mortgage payments, rates and purchase of land or machinery. It is assumed there is a viable water supply for the production of all crops.

Table 7-17 Gross margins for field crops, perrenial and annual horticulture

		1 ha	5 ha	10 ha	20 ha	30 ha	40 ha
Annual crops		$	$	$	$	$	$
wheat		491	2,455	4,910	9,821	14,731	19,641
malting barley		345	1,723	3,447	6,894	10,341	13,788
feed barley		336	1,681	3,363	6,725	10,088	13,451
milling oats		380	1,901	3,802	7,604	11,406	15,208
lupins		303	1,514	3,028	6,056	9,084	12,112
field peas		320	1,600	3,200	6,400	9,600	12,800
canola conventional		316	1,580	3,161	6,321	9,482	12,643
lucerne pasture		223	1,114	2,227	4,454	6,681	8,908
phalaris sub		223	1,114	2,227	4,454	6,681	8,908
Perrenial Horticulture		$	$	$	$	$	$
vines		11,863	59,317	118,633	237,267	449,600	599,467
olives		12,255	61,275	122,550	245,100	367,650	490,200
almonds		8,168	40,840	81,680	163,360	245,040	326,720
citrus	washington navel	6,941	34,705	69,410	138,820	208,230	277,640
	valencia juice	1,720	8,600	17,200	34,400	51,600	68,800
	afourer mandarin	14,174	70,870	141,740	283,480	425,220	566,960
Annual Horticulture		$	$	$	$	$	$
gourmet tomato	low tech polyhouse	66,610	333,050	666,100	1,332,200	1,998,300	2,664,400
capsicum	low tech polyhouse	50,116	250,578	501,155	1,002,310	1,503,465	2,004,620
cauliflower	field	20,120	100,601	201,202	412,403	603,605	804,806
cabbage	field	22,385	111,925	223,850	457,700	671,550	895,400
broccoli	field	17,505	87,527	175,054	360,107	525,161	700,214

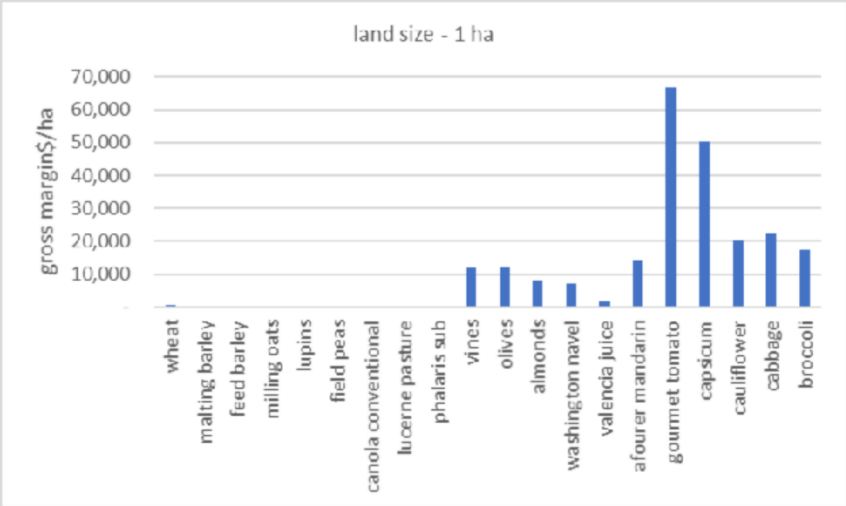


Figure 7-18 Gross margin comparison of field crops, perrenial and annual horticulture on 1 ha.

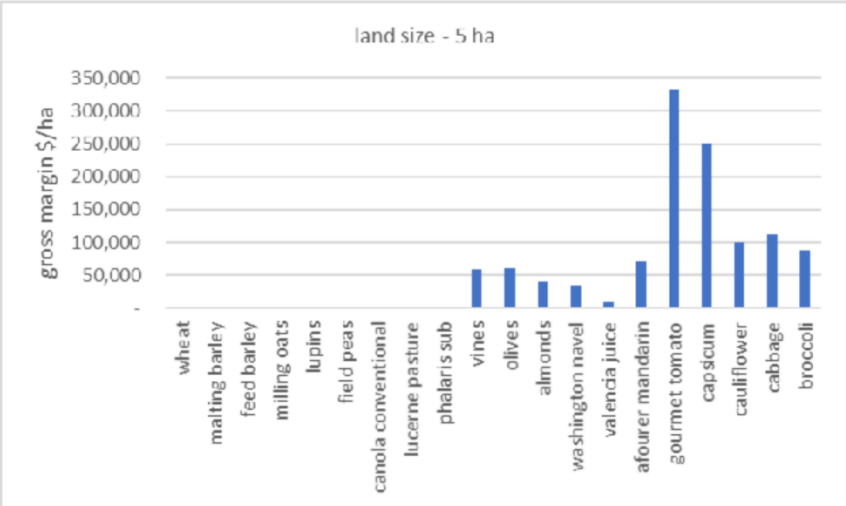


Figure 7-19 Gross margin comparison of field crops, perrenial and annual horticulture on 5 ha.

8 Options for maintaining Gawler Rural Zone green belt

8.1 Small Allotment Horticultural Potential

Land suitability assessment based on data from Town of Gawler show that 90% of allotments are within 5 ha in size (Figure 7.2). Based on this land area gross margin analysis has shown field crops are not viable, perennial horticulture could provide a second income and intensive horticulture could provide a sole income. Therefore soil-based polyhouses are a viable option in the Gawler Rural Zone because of the low capital investment and reduced labour costs associated with these systems.

The main restrictions to perennial or intensive horticulture in the Gawler Rural Zone are:

- Water supply;

- Confirmation of zoning for perennial or intensive horticulture;
- Transport routes;
- Noise.

The State Government in-conjunction with Kellogg Root Brown Pty Ltd are developing the business case for use of recycled water for the Barossa Valley. An opportunity exists for the Town of Gawler to secure water from the "Barossa New Water" project as the pipeline routes have not been finalised.

The storage and supply of reclaimed water will need to meet the Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (2006). The SA government requires that recycled water meets the South Australian Recycled Water Guidelines (2009) after treatment. Recycled water supplied from SA Water meets the requirements for unrestricted agricultural irrigation. The SA Department of Health has always taken the position that once water has been treated as 'fit for purpose' for unrestricted agricultural irrigation it remains so regardless of the storage and delivery system. In practice, this means that the water received and stored will be 'fit for purpose' water and will be reticulated as 'fit for purpose' water to the growers.

The Barossa New Water project may require water sampling as is conducted by Water Reticulated Systems Virginia Pty Ltd (WRSV), who operate the Virginia Pipeline Scheme. They conduct voluntary water sampling from their storage as a risk mitigation practice. This practice would likely be undertaken by sampling water from the storage and having it analysed for suitability for distribution as 'fit for purpose' water.

8.1.1 Example of 5 ha intensive horticultural enterprise using polyhouses

The basic unit is a ***one family enterprise*** which requires approximately 24,500 m^2 (2.5 ha) of polyhouse. This enterprise could be located on a 5 ha allotment.

The basic unit would allow for:

- 70 tunnels, each 7x50 m providing approximately 24,500 m^2 (2.5 ha);
- A 1,000 m^2 footprint for a dwelling, associated with the enterprise only;
- A 1,250 m^2 foot print for a shed which could include packing;
- A dam to store recycled water (if required).

Dam storage if required should provide 7 days of the guaranteed supply, approximately 3.75% of the grower's annual allocation or the required storage requirements to meet crop demand and supply conditions. Assuming a tomato crop on 2.5 ha in the Gawler region with runoff from 2.5 ha of polyhouse the effective dam storage requirement is 2 ML (Table 8.1) (Note: Water storage structures will be required to meet the South Australian EPA Wastewater Lagoon Construction Guidelines).

The above infrastructure equates to a roof area of approximately 25,000m^2 (2.5 ha) which could harvest approximately 8.0 ML of rainwater in a median rainfall year.

The following equation can be used to calculate water capture off roofs (WA Department of Water, 2007):

V = roof area * 0.85 * (rainfall - 24mm)

Where V is in litres,
0.85 is the efficiency of the collection,
rainfall is the local rainfall in mm, and

24mm is the anticipated loss through wetting of materials

Mean average rainfall is 430mm (Edinburgh RAAF)
V = 25000 * 0.85 * (430 - 24)
= 8.6ML

A monthly calculation can be seen in Table 8.1 where the total roof runoff in a median year is 8.0 ML. This is a significant source of water as it represents 18% of the crop water demand and has the benefit of decreasing total salt load by the same factor.

Table 8-1 Calculation of storage requirement for the 10th. median, and 90th percentile rainfall years

Runoff Related Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Runoff (ML)
Days	31	28	31	30	31	30	31	31	30	31	30	31	
Ave Daily Evap (mm)	10.2	9.7	7.3	4.8	2.8	1.8	2.0	2.7	3.9	5.7	8.0	9.6	
Mth Evap (mm)	316	272	226	144	87	54	62	84	117	177	240	298	
Ave Crop Use (ML)	6.9	5.9	4.9	3.1	1.9	1.2	1.3	1.8	2.5	3.8	5.2	6.5	**45ML**
10th %ile RF (mm)	1.9	0.0	3.6	6.4	14.8	20.2	23.6	14.0	20.3	8.7	4.7	5.9	
10th Percentile Roof Runoff (ML)	0.0	0.0	0.0	0.1	0.3	0.4	0.5	0.3	0.4	0.1	0.1	0.1	**2.17ML**
Recycled Water Supply (ML)	7.0	6.0	5.0	3.0	0.0	2.0	1.0	2.0	2.0	3.5	5.0	6.5	**43ML**
10th %ile Cumulative Storage (ML)	1.6	1.7	1.8	1.8	0.2	1.2	1.3	1.8	1.6	1.4	1.3	1.4	**<2ML**
Median RF (mm)	15	10	16	29	45	55	51	57	47	33	25	20	
Median Roof Runoff (ML)	0.3	0.2	0.3	0.6	0.9	1.1	1.0	1.2	0.9	0.7	0.5	0.4	**8.01ML**
Recycled Water Supply (ML)	7.0	5.0	5.0	2.0	0.0	2.0	0.0	1.0	1.0	3.0	5.0	6.0	**37ML**
Median Cumulative Storage (ML)	1.8	1.1	1.5	1.0	0.0	1.9	1.6	2.0	1.4	1.2	1.5	1.4	**<2ML**
90th %ile Rain Fall (mm)	50	51	60	57	73	88	87	82	79	78	40	40	
90th Percentile Roof Runoff (ML)	1.0	1.0	1.2	1.2	1.5	1.8	1.8	1.7	1.6	1.6	0.8	0.8	**16.16 ML**
Recycled Water Supply (ML)	5.5	5.0	3.5	1.0	0.0	0.5	0.0	0.0	0.5	3.0	4.0	6.0	**29ML**
90th %ile Cumulative Storage (ML)	1.5	1.7	1.5	0.5	0.2	1.2	1.6	1.5	1.1	1.9	1.5	1.9	**<2ML**

Assumptions:

1. Water use for 2.5 ha is 45 ML (Source Rural Solutions 1999)
2. Crop tomato
3. Water demand is proportional to pan evaporation
4. Dam is effectively empty at the end of May
5. Assumes 85% roof runoff
6. Assumes 2 mm of rainfall loss per month due to absorption and wetting of surfaces
7. Maximum recycled water daily supply is 0.54% of annual allocation

8.1.2 Polyhouse Construction Details

Protected cropping in Australia is one of the fastest growing industries in the food producing sector and has been estimated to be valued at $1.3 Billion per annum at the farm gate. It represents approximately 20% of Australia's total vegetable and cut flower production and is believed to employ around 10,000 people directly in greenhouse horticulture, with the industry expanding at 4-6% per annum (Protected Cropping Australia, 2015). Polyhouse production can enable faster growth, higher yields and quality crops by improving the growing environment. The controlled environment allows for better use of Integrated Pest Management (IPM) and beneficial insects and reduces the need for pesticide sprays, while allowing the growth of crops out of season or for extended seasons.

There are predominantly three different classes of greenhouses built on the Northern Adelaide Plains including:

- Simple Polyhouses;
- Advanced Polyhouses;
- High Technology Glasshouse or Polyhouse (Figure 8-1), a brief description for each type is included in Table 8-2 (Comparison of different greenhouse structures and production systems).

It is important to note that for each of the protected cropping systems discussed above the water use per hectare remains relatively constant at about 18 ML/ha for tomatoes.

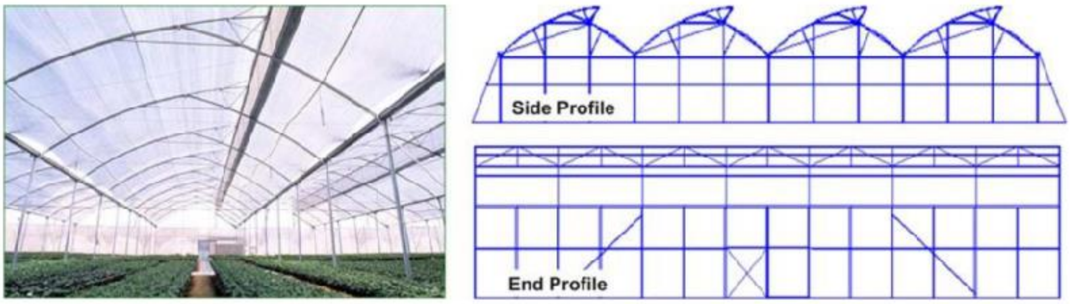
8.1.3 Benefits of Hydroponic versus Soil-based Polyhouse Production

Two different production systems can be adopted within polyhouse practices:

1. Soil-based
2. hydroponic based

In ***soil-based systems*** crops are planted directly into the soil contained in the polyhouse and irrigation is delivered through drip tape. This is known as a single pass system, that is to say the irrigation water is used once and delivered to the plant up to two times a day to ensure soil moisture is maintained at optimum levels. Typical long-term yield for tomatoes in low technology poly tunnels using soil-based production is 6-10kg per m^2 (Table 8-2 Comparison of different greenhouse structures and production systems).

Figure 8-1 High Technology Polyhouse



Hydroponics systems grow plants in nutrient solutions either with (aggregate system) or without (liquid system) the use of an artificial solid support medium (e.g. sand, gravel rockwool, peatmoss etc). Hydroponics can be further categorised as 'open' where the nutrient solution is not reused after circulating through the system, or 'closed where the surplus solution is recovered, disinfested, replenished with nutrients and recycled through the system (Figure 8-2). Hydroponics systems are gaining increased interest in the horticultural industry due to the potential returns and environmental benefits.

The financial and environmental advantages and disadvantages of each growing media are discussed below. However, it should be noted that many of the papers dealing with the economics and environmental effects of greenhouse production assumed hydroponic production in greenhouses, and field production in soil, as it is believed hydroponics is the way of the modern greenhouse industry around the world (Badgery-Parker 2001).

Figure 8-2 Schematic diagram of how a closed hydroponic system works (Protected Cropping Australia 2015)

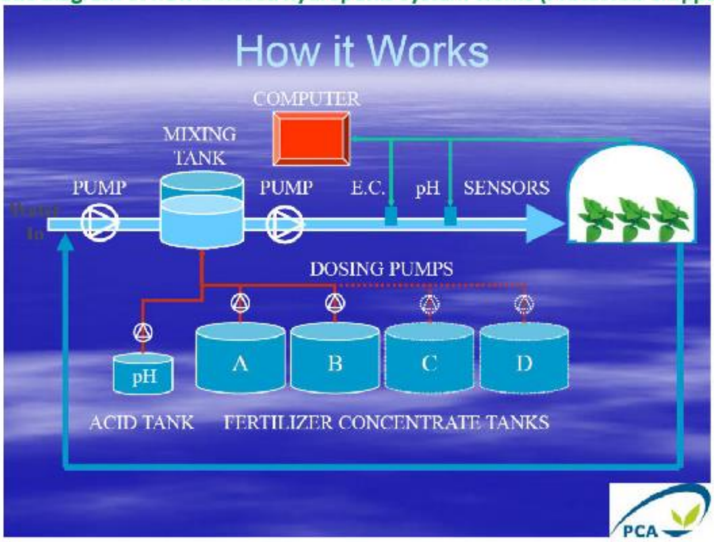


Table 8-2 Comparison of different greenhouse structures and production systems

Structure	Growing System	Climate Control
Low technology poly tunnels Production of 6-10kg tomatoes per m^2	**Soil**: have problems with management of soil borne diseases and salinity. Salinity is a problem as soils do not receive rain for leaching purposes.	Some control, tunnels are heated during the day by sunlight. High temperatures decrease production rates during summer.
Advanced poly tunnels Production of 15-25kg tomatoes per m^2	**Hydroponic**: this mitigates the problems associated with growing in soil. The systems are typically fully computerised with sophisticated water and nutrient management systems	Some control, tunnels are heated during the day by sunlight. High temperatures decrease production rates during summer.
High technology polyhouses Production of 50 - 70kg tomatoes per m^2	**Hydroponic**: fully computerised with sophisticated water and nutrient management systems. The system is designed to optimise production	Increased climate control with heating and cooling systems. The polyhouses have climate control systems that range from low level control through to full control with heating and cooling.
High technology Glasshouse Production of 70 - 80kg tomatoes per m^2	**Hydroponic**: fully computerised with sophisticated water and nutrient management systems. System designed to optimise production.	Increased climate control with heating and cooling systems. The polyhouses have climate control systems that range from low level control through to full control with heating and cooling.

8.1.4 Economic Considerations of polyhouses and high technology glasshouses

8.1.4.1 Soil-based production

The alternative greenhouse production option to hydroponics is traditional soil-based cropping. Soil based cropping has significantly lower capital costs. However, the investment is still dependent on the level of sophistication and equipment included, as well as the scale of the development (e.g. costs per square metre are reduced if developing a larger area).

A basic tunnel polyhouse system can be supplied for around $20/m^2 while a more sophisticated polyhouse with higher gutters, better grade plastic, enhanced climate control, vents and wind ratings is closer to $50-60/m^2 (pers. comm., F. Faber, Faber Greenhouses and Glasshouses and J Kelly, Arris). There is a lower labour cost associated with soil production and the required skill of workers involved is lower when using a soil-based production system. Soil-based production systems provide significant buffering for water and nutrients to the crop whereas hydroponic systems require precise management and control in meeting plant requirements.

The lower capital investment and reduced labour costs associated with soil systems are why soil-based polyhouses are still the dominant cropping system across many smaller scale holdings on the Northern Adelaide Plains. Typically, a family soil-based polyhouse system is in the order of 10,000 m^2 upwards with some as large as 5 ha. These require 3 fulltime employees per ha, but casual labour requirements increase for planting and picking during periods of peak production. Often growers share labour requirements between other family operated greenhouses for peak planting and crop training times.

8.1.4.2 Hydroponic Production

Hydroponic greenhouse production systems with full climate control offer the benefit of faster crop growth, higher yields, lower turnaround times between crops and quality produce by improving the growing environment. In soil-based production systems the crop life is typically 6 months. However, improved management by growers of soil and plant health can extend the productive life up to 9 months. However, in hydroponic systems, depending on the skill of the grower, crop life can be as long as 18 months.

Hydroponic greenhouse production is possibly the most intensive method of crop production with high technology, capital investment and operational capability of the grower. In order to create an economically viable hydroponic production system careful attention must be paid to the greenhouse structure and its environment. In 2001 a Rural Industries Research and Develop Corporation (RIRDC) report (Hassall & Associates Pty Ltd, 2001), noted that there were between 1,000 and 2,000 commercial domestic hydroponic growers. One of the impediments to large scale hydroponic production across Australia is the high capital investment required, with greenhouses for production costing $100 - 200 per square metre, depending on the sophistication and equipment being included in the greenhouse (Hassall & Associates Pty Ltd, 2001).

Protected Cropping Australia (PCA, 2015) state that the average return on investment for soil- based systems is 5-10%, while the potential return on investment for high technology hydroponics is 20-25%. The returns are reported to be modest for entry level investment, as hydroponic products are mainstream and widely consumed, hence do not usually attract a premium. The improved profit is linked to larger scale production and yields, exploitation of niches and on-farm value adding. The RIRDC report of Hassall and Associates (2001) noted that commercial success is linked to the following:

- Establishment of the venture in a realistic economic framework;
- Attention to market requirements before production commences;
- Realistic expectation of price, yield and labour requirements; and

- Experience in horticultural production prior to entry into hydroponics.

By growing in greenhouse environments, particularly hydroponic ones, it enables faster growth and growing out of season, delivers higher yields, on smaller footprints, higher production per unit of water, allows foreign plants to be grown in local climates, increases the brix (sugar) levels to provide sweeter, flavoursome fruit with longer shelf lives, and the returns for farmers efforts are higher than compared to traditional annual vegetables.

As an example, lettuce production is a significant market in Australia and the difference in yields with three different production systems is shown in Table 8-3. The primary benefit of hydroponic investment comes from the increased yields over traditional soil-based systems and greater control of the environment to enable out of season production. However, it is important to note that polyhouse soil-based production tends to yield greater quantities than field conditions presented in the comparison in Table 8-3, due to the localised controlled environment.

A sophisticated hydroponics glasshouse is expected to produce 15-20 times more produce than a field of the same area (Badgery-Parker, 2001). There is also potential for some hydroponic produce to occupy a higher price band due to the fact that where hydroponic produce competes with traditional soil-grown products they tend to have a superior look, taste and there is a more reliable year round supply (Carruthers, 2002).

Table 8-3 Approximate yields per 2 ha footprint for lettuce (PCA 2015)

Production System	Estimated Yield
Field	500,000 units
Standard Fixed Channel Hydroponics	3,000,000 units
Moving Gulley Hydroponics	8,000,000 units

The costs of water and nutrients are often minimised in hydroponic production due to the ability to recycle unused, nutrient rich water in closed systems. Protected Cropping Australia (2015) estimated that growers can reduce their cost of production through saving 40% water and 60% fertiliser over field production, as well as reducing their environmental impact by converting to closed system hydroponics.

However, additional costs are often associated with the high level of treatment required for water required for hydroponics, e.g. reverse osmosis (RO) is often required to purify water to allow accurate nutrient dosing. Reverse osmosis treatment units can be expensive to install and operate and there is the associated problem of management of the brine waste stream. Hydroponic systems mean the issue of soil borne pest management are reduced and no fallow or break crops are required. Nutrient film technique hydroponics have a turnaround of 3-4 days between crops, and aggregate based hydroponics have a turnaround of 10-14 days between plantings (Badgery-Parker, 2001). Some of the financial benefits of continual cropping can be countered by the increased technical management skill and intensity required for sophisticated hydroponic systems.

8.1.5 Environmental considerations of polyhouses and high technology glasshouses

The hydroponic industry grew out of the need for greenhouse soils to be rested, maintained, fumigated, heavily fertilised and even in some cases replaced at frequent intervals, due to degradation from intensive cropping. Another key issue in greenhouse soil cropping is soil-borne diseases, as the growth of crops continuously without rotation or interruption can lead to build up of soil pathogens.

Due to the enclosed nature of greenhouses there are environmental and human health concerns over the use of many fumigants for greenhouse applications. However, it should be noted that with careful management that includes crop rotation, the application of good quality irrigation water with leaching factors, and the use of Integrated Pest Management (IPM) systems, soil-based greenhouse production can be very successful. IPM with beneficial insects has proved very successful in greenhouse operations on the Northern Adelaide Plains and has reduced or even eliminated the need for pesticide sprays.

A major advantage of greenhouse hydroponic systems compared with soil-based systems is the isolation of the crop from soil-based constraints, such as salinity, disease, poor structure and drainage. This means that on poor soils where production traditionally would not have been possible, hydroponics can offer a method of intensive crop production. Hydroponics offer a greater control over the growing environment by carefully managing nutrient contents, pH, available root oxygen and the elimination of soil related insects, fungi and bacteria, and because of this the transplant shock is often reduced (Shrestha and Dunn, osufacts.okstate.edu/docushare/dsweb/Get/Document-6839/HLA-6442web.pdf ; accessed June 2015). However, hydroponic production is not without its own issues, with deficiency symptoms often appearing rapidly when fertiliser ratios are not managed well, and diseases such as *Fusarium* and *Verticillium* can spread quickly through the system if adequate water disinfection is not practiced.

Hydroponic greenhouse systems are environmentally favourable due to their lower impact on the environment given there is no degradation of the soil, there are significantly less or no pesticide sprayings required, and they use less fertiliser and water. This leads to higher production outputs with a lower environmental footprint. When used in conjunction with a closed hydroponic system, crops can be produced with near zero waste water discharge to the environment all year round. In sophisticated greenhouse production operations heating is often used to maintain optimal growth temperatures all year round. The biggest disadvantage of hydroponic systems from an environmental standpoint is the management of concentrated waste streams and the difficulties in disposing of some of the solid growth media.

Britain and The Netherlands have developed novel ways of heating their glasshouses, by co-producing electricity as part of the greenhouse heating process in large scale productions. Power utilities establish mini-electricity plants whereby the heat produced is fed into heating the glasshouse, and the carbon dioxide generated is captured and pumped into the greenhouse to help stimulate photosynthesis. This process creates a beneficial use for the heat energy generated during electricity production as well as capture and consumption of pollutant carbon dioxide. Other suggestions to create secondary environmental and production benefits from protected cropping hydroponic operations include establishing aquaculture systems (Aquaponics) that receive the unused hydroponics water which is then circulated through an aquaculture tank(s) whereby nutrients are added to the water in form of fish manure, algae and decomposing fish feed (Protected Cropping Australia, 2015). These nutrients, if left in the tank, will build up to toxic levels, however, if this nutrient rich water is then fed back into the hydroponic system the nutrients are beneficially removed by the growing crop. The biofiltered water can then be recycled back into the aquaculture tanks, creating a bio-integrated, sustainable food production system Figure 8-3.

Figure 8-3 Aquaponics production system schematis (Protected Cropping Australia 2015)

Overall, in protected cropping polyhouse systems, the primary benefit of a soil-based system is the low capital and labour investment, while with hydroponics it is the increased yields and reduced environmental impacts. Soil-based cropping requires an understanding of soil constraints in the area, while hydroponics can be established anywhere, but at a much higher cost.

8.2 Carbon offset from tree planting

A paper by Murphy *et al* (2003) Paired Site Sampling for Soil Carbon Estimation in New South Wales demonstrated the rapid decline (5 years) in soil carbon stocks after clearing of native vegetation. The agricultural industry in Australia therefore has the opportunity to significantly increase soil carbon stocks as a result of vegetation clearance since European settlement. The Carbon Farming Initiative through the Emissions Reduction Fund and Australian Carbon Credit Units system provides an opportunity for land restoration and land management change through eligible activities.

Carbon sequestration in agricultural soils can be achieved through soil and land management. Soil organic matter and accumulation of soil organic carbon has a number of soil benefits that will improve agricultural production such as maintenance and improvement of soil structure, improve water infiltration, soil permeability and drainage, prevention of soil erosion and improved nutrient availability. Declaration of an eligible offsets project on a carbon estimation area therefore has potential increases in farm productivity as well as soil carbon sequestration benefits.

Improvements in land management practice that increase soil organic matter, encourage biota and microbial activity and abundance will increase soil organic carbon stocks in the less than 2 mm fraction of the soil. This is a potential source of Australian Carbon Credit Units through the Emission Reduction Fund and the Clean Energy Regulator. Reduction in soil disturbance will enhance these soil processes.

A fundamental aspect of the regulatory requirements of the carbon farming initiative is that the project does not commence prior to approval from the Clean Energy Regulatory. Access to Australian Carbon Credit Units will be withdrawn if on-ground works have commenced. Planning, research and financial assessment for the project can commence with input from appropriate consultants. Existing projects will not receive support.

Soil carbon projects must involve the sequestration of soil carbon in agricultural systems through land management change. They must result in eligible carbon abatement in the carbon estimation areas of the project and all projects must be within Australia. Baseline estimation of soil carbon stocks is required and project work should not be implemented until the project is declared by the Clean Energy Regulator. The baseline period is 10 years prior to the implementation of eligible management activities. Once these activities are implemented the project can be declared as an eligible offsets project.

Soil carbon projects must be first registered with the Clean Energy Regulator prior to any on-site activity. Planning and consultation work are permissible prior to registration. Baseline soil sampling is then conducted and the eligible management activities are implemented in the project area and maintained with additional sampling to determine changes in soil carbon stocks. Australian Carbon Credit Units can then be issued for the project which can be sold at latter date, traded or used as a carbon-offset.

8.3 Alternative use of Gawler Rural Zone

There is potential for Gawler Rural Zone to be supplied with recycled water from the Barossa New Water plan and examples of alternative uses are presented. Examples of the issues raised in the Town of Gawler Open Space, Sport & Recreation Plan 2025 have been addressed by other councils in Australia, and overseas such as the: Glenelg to Adelaide Parklands Recycled Water Project; Casey Fields development in Victoria; and Wastewater and reclaimed water use in the City of Apopka, Florida, USA.

8.3.1 Gawler Open Space Sport and Recreation Plan

Provision of reliable, quality water is required for the development of a range of primary production enterprises in the Gawler Rural Zone. This need could be meet by recycled water from the Barossa New Water proposal currently under investigation by the SA State Government. In the event that water is not available then the "Town of Gawler Open Space, Sport & Recreation Plan 2025" developed in 2016 with consultation from council staff, elected members and the community (through a survey) could be enacted in Gawler Rural Zone (Figure 8-4).

The plan identified several reasons and benefits for the development of open space, sport and recreational areas, they are:

- Increased population growth and useability of existing facilities. There is potential to coordinate and partner with adjacent councils;
- There is a need for larger sport hubs which could also support less traditional activities such as BMX, road and track cycling, dog training and equestrian centres;
- An increase in nature-based recreational areas, trials that may link with existing trails and enhancement of the Gawler River and Smith Creek catchments. This may include development of walking, cycling and horse riding trials;
- Protecting and enhancing the nature environment was seen as a key aspect of open space planning;
- Improve the quality and viability of indoor facilities such as the swimming pool.

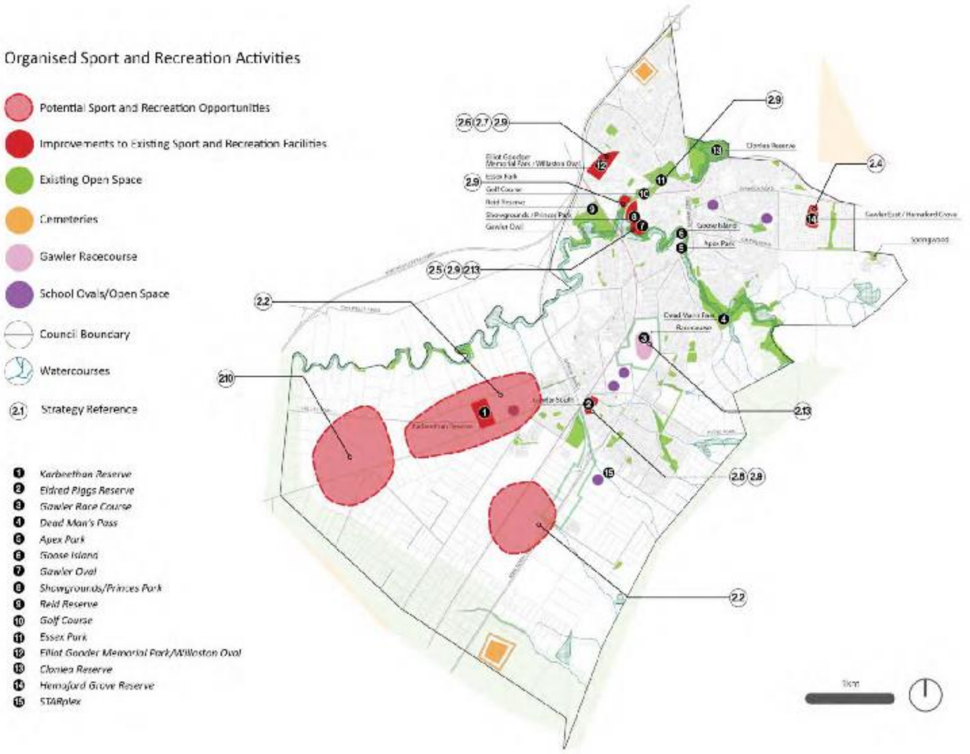


Figure 8-4 Potential open space options within the Gawler Rural Zone

8.3.2 Example - Glenelg to Adelaide Parklands Recycled Water Project

The scheme was completed in 2010 and provides 3.8 billion litres of recycled water for the Adelaide Parklands and the City of Adelaide. The scheme does not use other water sources with recycled water coming from the Glenelg waste water treatment plant. A new plant was installed at Glenelg and water is passed through ultrafiltration membranes, ultraviolet and chlorine disinfection (Figure 8-5). The water has a higher salinity than drinking water but meets water quality standards for irrigation of parks and open space, toilets and commercial uses. Further details are available from SA Water.

Figure 8-5 Glenelg waste water treatment facility

8.3.3 Example - Greenbelt sporting complex and recreational area – Casey Fields

An alternative to irrigated perennial and intensive horticulture in the Gawler Rural Zone is open recreational and sporting complexes similar to those developed at Casey Fields near Melbourne, VIC (Figure 8-6).

The City of Casey in 2009 was successful in obtaining funding assistance of $8.945 million from the Federal Government's Regional Local Community Infrastructure Program – Strategic Projects to undertake the Casey Fields Development Project (https://www.casey.vic.gov.au/casey-fields-masterplan). The Victorian State Government also contributed $400,000 towards the project which forms part of the Community Support Fund. The total project cost was $10.995 million and included Council contribution to the value of the land and project management costs.

The project involved internal access roads and car park construction and landscaping. There was extensive tree planting and garden beds at specific locations throughout the area known as Casey Fields. To date the following facilities have been completed:

- VFL Pavilion extensions (opened 2010 and upgraded in 2020)
- BMX track (opened 2018)
- Regional Play-space (opened 2011)
- Regional Athletics (opened April 2011)
- Regional Rugby League Fields (opened 2009) & Pavilion (opened 2013)
- VFL Football - Casey Scorpions VFL Football Club (opened April 2006)
- AFL Training Base
- Premier Cricket - Casey-South Melbourne Premier Cricket Club (opened November 2006)
- 3 Netball Courts (opened April 2006)
- 12 Tennis Courts (opened April 2006)
- Cycling/ HPV Criterium Track (opened April 2006)
- 2 Rugby League Fields (opened September 2007)
- Village Green (opened March 2006)
- Lakes & Passive Leisure Area (opened March 2006)
- 3km of Walking Paths (over 2 km opened March 2006)
- 4 Football/ Cricket Ovals (opened February 2006)
- Golf Practice Cage (opened July 2006)

Figure 8-6 Casey Fields location, Melbourne, VIC

8.3.4 Example - Wastewater and reclaimed water use – City of Apopka, Florida

The City of Apopka has a policy of 100% wastewater reuse for irrigation of public access land (Figure 8-7). Recycling of wastewater commenced in 1972. This water is used to supplement potable water supplies from the Floridian aquifer, the main water source in the region. It is estimated that each person in Apopka generates approximately 380 litres of domestic wastewater per day and the City of Apopka treats 11,300,000 litres (11.3 ML) of domestic and industrial water daily. Recycled water is used for:

- irrigation of residential lawns;
- irrigation of green spaces;
- agricultural irrigation;
- irrigation of golf courses;
- dust control and road sweeping; and
- recharge of the local aquifer.

The recycling of water by the City of Apopka has been on-going for 50 years and the water is used for irrigation of residential lawns and green spaces, agricultural irrigation, irrigation of golf courses, street sweeping, dust control, and aquifer recharge.

Figure 8-7 City of Apopka waste water facility

9 Summary and Recommendations

9.1 Soil

There are five land systems within the Gawler Rural Zone, they are: Smithfield; Northern Adelaide Plains; Angle Vale; Gawler River and Yattalunga. Soils are variable within these land systems, but the dominant characteristics are:

- *Soil carbonate.* Calcium carbonate (Ca_2CO_3) is the common form of soil carbonate which may occur as hard nodules or in the fine earth fraction of the soil. When present soil pH is high (greater than 8.5). Subsoil carbonate is present under much of the Gawler Rural Zone;
- *Texture contrast soils*. These are soils with marked increase in clay content from the surface soils to the clay horizons in the subsoil. They clay below the topsoil can be dispersive leading to soil permeability issues;
- *Deep uniform or gradational soils.* These soils occur mainly near the Gawler River as a dark coloured cracking clay soil or deep loam soils;
- *Soil on weathered rock with variable depth*. These soils dominant on the western facing slopes of the Mt Lofty Ranges and usually contain weathered rock. Soil depth is variable.

9.2 Land Capability and Land Use potential

The soil and land mapping program developed for South Australia used 5 class system which links *Soil Landscape Mapping* to *Land Use Potential* (Rowland *et al* 2016):

- *Land systems* broad and readily recognisable landscape areas defined by patterns of geology, topography, soils and vegetation with one or more Soil landscape units;
- *Soil landscape map units* defined by recognisable topographic features, formed on specific geological materials with a limited number of soils;
- *Land Use Potential* is defined as the potential of soil and land to sustain a specific crop type. A five-class system is used with class 1 no limitations and class 5 severe limitations.

Land uses most common in the Gawler Rural Zone are: field crops; perennial horticulture; annual horticulture. A range of crops within these land use categories have been assessed against soil attributes within each land system:

- Field crops have a moderately high land use potential. Barley (class 1) has tolerance to soil salinity and alkalinity compared to canola and wheat. Wheat, Canola and Field Peas are class 2. Barley is more susceptible to waterlogging than wheat, canola and field peas which maybe an issue in the Gawler River land system, however barley has a greater water use efficiency than other crops. Field peas are susceptible to high alkalinity and salinity which is common in the Gawler Rural Zone. Wheat, barley and canola are more tolerant of high exchangeable sodium levels;
- Perennial horticulture has a moderate (class 3) to moderately high (class 2) land use potential, with grape vines and olives more favourable compared to citrus and almonds due to tolerance of soil carbonate, high soil pH and salinity. Citrus and almond root growth will be limited by soil carbonate subsoil horizons and high soil boron levels. The Northern Adelaide Plains will be limiting for perennial horticulture due shallow soil carbonate and the Yattalunga land system will be limiting due to shallow weathered rock and low waterholding capacity;
- Annual horticulture has a moderate (class 3) to moderately high (class 2) land use potential. The Smithfield and Angle Vale land systems are preferred for annual horticulture due to less shallow soil carbonate compared to the Northern Adelaide Plains. Flood risk is limiting in the Gawler River land system. The Yattalunga land system is not capable of supporting annual horticulture with severe limitations, including slope, shallow soil depth and high coarse fragment content.

9.3 Gross Margins

Data provided by Gawler Council have shown that 90% of allotments within the Gawler Rural Zone are 5 ha or less, consequently gross margin assessment has been based on this land size and exclude fixed costs such as mortgage payments, rates and purchase of land or machinery.

Field crops are not-viable on a land size of 1 ha or 5ha. The benefit of field crops is soil management with ground cover and management of pest plants and weeds. Small scale hay production for domestic use would be the main use of field crops.

Perennial horticulture is viable at 1 ha and 5 ha with incomes for vines and olives over $50,000 excluding fixed costs. Vines and Olives are suited to all land systems within the Gawler Rural Zone, citrus such as Mandarins are marginally more profitable but production will be limited on the Northern Adelaide Plains due to presence of shallow soil carbonate and calcrete with high soil pH.

Annual horticulture is viable at 1 ha and 5 ha scale when crops are grown either as low technology polyhouses or as in-ground crops. All annual horticultural crops could provide an income from 5 ha with gourmet tomato and capsicum (above $200,000 excluding fixed costs).

Native food crops show high potential return. However, market fluctuations, yields and supply are variable. Local niche markets and closeness to Adelaide maybe an avenue for stable, regular income from native food crops.

A viable water supply for the production of all crops is assumed. There is potential for the Barossa New Water scheme which aims to supply recycled water to the Barossa and Eden Valleys could also supply the Gawler Rural Zone. This scheme is currently in at the business case level and the preferred pipeline routes have not been finalised.

9.4 Recommendations

- Soils in general are not a limitation for primary production in the Gawler Rural Zone. Soil carbonate, soil pH, salinity, waterholding capacity and percentage of coarse fragments will impact all crop yields depending on crop tolerances. Matching crop to soil conditions and soil management will be required;
- Analysis of land size shows 90% of the area is composed of landholdings of 5 ha or less. The Gawler Rural Zone will therefore be suited to small intensive annual horticultural or small-scale perennial horticulture;
- ***Water is the main limitation to primary production in the Gawler Rural Zone. There is an opportunity to acquire water from the Barossa New Water project currently in the business case stage. Gawler Council could approach PIRSA and Kellogg Brown Root Pty Ltd with an expression of interest for water allocations and infrastructure for the Gawler Rural Zone;***
- Based on the assumption of adequate water, there is the potential for the Gawler Rural Zone to produce niche horticultural enterprises with closeness to Adelaide Markets.

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Appendix A Land Use Potential tables

FIELD CROPS

Land Classification Criteria – Barley
February 2006

Land quality		What to measure or look for	Degree of limitation				
			Negligible Class 1	Slight Class 2	Moderate Class 3	High Class 4	Severe Class 5
Waterlogging	w	Length of time that any part of the profile is saturated following heavy rain.	< 2 days w = 1	2-7 days w = 2	1-2 weeks (early) w = 3	Several weeks w = 4	Several months w = 5, 7, 8
Depth to water table	o	Estimate highest level maintained for at least two weeks per year					
		Where s = 1	>100 cm o = 1,2	50-100 cm o = 3	-	0-50 cm o = 4	Above sur o = 5, 7, 8
		Where s = other than 1 (includes 1o, 1+, 1x)	> 200 cm o = 1	100-200 cm o = 2	50-100 cm o = 3	0-50 cm o = 4	Above sur o = 5, 7, 8
Water holding capacity	m	Estimate mm total available water in root zone	> 70 mm m = 1, 2	40-70 mm m = 3	20-40 mm m = 4	<20 mm m = 5	-
Salinity (associated with water table)	s	Observe presence of halophytic plants (eg sea barley grass) **OR**	None	Scattered halophytes	Halophytes common	Mostly halophytes	Halophyte bare
		Measure ECe(dS/m) in surface and subsoil	< 4 (surface) < 8 (subsoil) s = 1,2	4 - 8 (surf) 8 - 16 (sub) s = 3	8-16 (surf) 16-32 (sub) s = 4	16-32 (surf) >32 (sub) s = 5	>16 (surfa > 32 (sub) s = 7, 8
		If w =4,5,7,8	s = 1	s = 2	s = 3	s = 4	s = 5,7,8
Patchy salinity (associated with water table)	s	Proportion of land affected by saline seepages	<10% "s" subs't =o, + **or** absent	10-50% "s" subs't = x	-	-	-
Dry saline land	v	Measure ECe (dS/m) in surface and subsoil.	< 4 (surface) < 8 (subsoil) v = 1,2	4 - 8 (surf) 8 - 16 (subs'l) v = 3	8 – 16 (surf) 16-32 (subs'l) v = 4	-	>16 (surf) > 32 (subs v = 7
Patchy dry saline land	v	Proportion of land affected by dry saline (magnesia) patches	<2% "v" subs't = o **or** absent	2-10% "v" subs't = +	10-50% "v" subs't = x	-	-
Acidity	h	Measure pH $CaCl_2$ at surface & deep subsoil: Surface > Subsoil 1 = > 5.4 1=> 6.9 2,3 = 4.5 - 5.4 2 = 5.5 - 6.9 4,5 = < 4.5 3 = 4.5 - 5.4 4 = < 4.5	h = 1>*, 2>1, 2>2,	h = 2>3, 3>1, 3>2, 3>3	h = 2>4, 3>4, 4>2, 4>3, 5>3	h = 4>4, 5>4	-
		Downgrade if aluminium present (ta = 2 or 3):	h = 1>*	h = 2>1, 2>2	h = 2>3, 3>1, 3>2, 3>3	h = 2>4, 3>4, 4>2, 4>3, 4>4, 5>3, 5>4	-
Alkalinity	i	Measure pH (water) at surface & deep subsoil: Surface > Subsoil 1 = < 8.0 1 = < 8.0 2 = 8.0 - 9.2 2 = 8.0 - 9.2 3 = > 9.2 (10-30) 3 = > 9.2 4 = > 9.2 (0-10)	i = 1>*, 2>1, 2>2	i = 2>3, 3>3	i = 4>3	-	-
Surface CO_3	ka	Reaction to 1M HCl	Nil to mod. ka = 1,2	Strong ka = 3	-	-	-
Subsoil CO_3	kb	Depth to strong reaction to 1M HCl	>30 cm kb = 1,2,3	-	-	-	-
Inherent fertility	n	Identify soil type	Mod - v. high n = 1,2	Mod. low n = 3	Low n = 4	Very low n = 5	-

Toxic elements	tb	Determine depth to boron levels of > 15 mg/kg	>100 cm tb = 1	50-100 cm tb = 2	25-50 cm tb = 3	10-25 cm tb = 4	<10 cm tb = 5
	ts	Determine depth to exchangeable sodium percentage of > 25%	>50 cm ts = 1,2	25-50 cm ts = 3	10-25 cm ts = 4	-	<10 cm ts = 5
Rockiness	r	Estimate proportion of surface rock and stone	Nil - slight r = 1,2	Pick or roll r = 3	Semi arable r = 4	-	Non arabl r = 5, 6, 8
Surface condition	c	Hardness / dispersiveness of surface soil	Loose, soft, friable, hard c = 1,2	-	Dispersive c = 3	Str. disp. c = 4	-
Subsoil structure	p	Determine depth to and nature of subsoil. eg Depth to dispersive clay: Where soil class E1,E2 E3 = >30%	> 30 cm p = 1,2	20-30 cm p = 3	< 20 cm p = 4,5	-	-
		Other soils	> 30 cm p = 1,2	20-30 cm p = 3	10-20 cm p = 4	<10 cm p=5	-
Scalding	z	Assess the percentage of land affected	None z = 1	Up to 5% z = 2	5 - 10% z = 4	10 - 50% z = 5	> 50% z = 7
Water repellence	u	Measure time taken for drop of water to be absorbed into soil	Non repellent u = 1	Repellent u = 2	Str. repellent u = 3	-	-
Water erosion potential	e	Refer handbook for water erosion classes	Low - mod low e = 1,2	Moderate e = 3	Mod. high e = 4	High e = 5	Very high extreme e = 6,7
Wind erosion potential	a	Refer handbook for wind erosion classes	Low - mod low a = 1,2	Moderate a = 3	Mod. high a = 4	High a = 5	Extreme a = 7
Gully erosion	g	Assess percentage of land affected	< 5% g = 1,2	5-10% g = 3	10-20% g = 4	-	>20% g = 7, 5x,7
Mass movement	1	Estimate area affected or at risk	None present 1 = 1	-	None present (potential) 1 = 4	Up to 5% of land affected 1 = 5	> 5% of la affected 1 = 7
Exposure	y	Estimate degree of wind exposure	Nil y = 1	Moderate y = 2	High (coast) y = 3	-	-

Land Classification Criteria – Wheat

September 2006

Land quality		What to measure or look for	Degree of limitation				
			Negligible Class 1	Slight Class 2	Moderate Class 3	High Class 4	Severe Class 5
Waterlogging	w	Length of time that any part of the profile is saturated following heavy rain	< 1 week w = 1, 1-2, 1-3, 2-1, 2, 2-3	1-2 weeks (early) w = 1-4, 1-5, 2-4, 2-5, 3-1, 3-2, 3	Several weeks w = 3-4, 3-5, 3-7, 4-2, 4-3, 4	Several mths w = 4-5, 4-7, 4-8, 5-1, 5-2, 5-3, 5-4, 5	Most of yea w = 5-7, 5-8 *, 8-*
Depth to water table	o	Estimate highest level maintained for at least two weeks per year					
		Where s = 1	>100 cm o = 1,2	50-100 cm o = 3	-	0-50 cm o = 4	Above surf. o = 5, 7, 8
		Where s = other than 1 (includes 1o, 1+, 1*)	> 200 cm o = 1	100-200 cm o = 2	50-100 cm o = 3	0-50 cm o = 4	Above surf. o = 5, 7, 8
Water holding capacity	m	Estimate mm total available water in root zone	>100 mm m = 1	70-100 mm m = 2	40-70 mm m = 3	20-40 mm m = 4	<20 mm m = 5
Salinity (associated with water table)	s	Observe presence of halophytic plants (eg sea barley grass) **OR**	None present	None present but subsoil is mod. saline	Scattered halophytes	Halophytes common	Mostly halophytes
		Measure ECe (dS/m) in surface and subsoil	< 2 (surface) < 4 (subsoil) s = 1	2 - 4 (surf.) 4 - 8 (subs'l) s = 2	4 - 8 (surf.) 8 - 16 (subs'l) s = 3	8-16 (surf.) 16-32 (subs) s = 4	>16 (surfac >32 (subs'l) s = 5,7,8
		If w =4,5,7,8	s = 1	-	s = 2	s = 3	s = 4,5,7,8
Patchy salinity (associated with water table)	s	Proportion of land affected by saline seepages	<2% "s" subs't =o **or** absent	2-10% "s" subs't = +	10-50% "s" subs't = x	-	-
Dry saline land	v	Measure ECe(dS/m) in surface and subsoil.	< 2 (surface) < 4 (subsoil) v = 1	2 - 4 (surf.) 4 - 8 (subs'l) v = 2	4 - 8 (surf.) 8 - 16 (subs'l) v = 3	8 - 16 (surf.) 16-32 (subs'l) v = 4	>16 (surfac 32 (subs'l) v = 7
Patchy dry saline land	v	Proportion of land affected by dry saline (magnesia) patches	<2% "v" subs't = o **or** absent	2-10% "v" subs't = +	10-50% "v" subs't = x	-	-
Acidity	h	Measure pH $CaCl_2$ at surface & deep subsoil: Surface > Subsoil 1 = > 5.4 1= > 6.9 2,3 = 4.5 - 5.4 2 = 5.5 - 6.9 4,5 = < 4.5 3 = 4.5 - 5.4 4 = < 4.5	h = 1>*, 2>1, 2>2,	h = 2>3, 3>1, 3>2, 3>3	h = 2>4, 3>4, 4>2, 4>3, 5>3	h = 4>4, 5>4	-
		Downgrade if aluminium present (ta = 2 or 3):	h = 1>*	h = 2>1, 2>2	h = 2>3, 3>1, 3>2, 3>3	h = 2>4, 3>4, 4>2, 4>3, 4>4, 5>3, 5>4	-
Alkalinity	i	Measure pH (water) at surface & deep subsoil: Surface > Subsoil 1 = < 8.0 1 = < 8.0 2 = 8.0 - 9.2 2 = 8.0 - 9.2 3 = > 9.2 (10-30) 3 = > 9.2 4 = > 9.2 (0-10)	i = 1>*, 2>1, 2>2	i = 2>3	i = 3>3, 4>3	-	-
Surface CO_3	ka	Reaction to 1M HCl	Nil to mod. ka = 1,2	Strong ka = 3	-	-	-
Subsoil CO_3	kb	Depth to strong reaction to 1M HCl	>30 cm kb = 1,2	< 30 cm kb = 3	-	-	-
Inherent fertility	n	Identify soil type	High, v. high n = 1	Moderate n = 2	Mod. low n = 3	Low n = 4	Very low n = 5
Toxic elements	tb	Determine depth to boron levels of > 15 mg/kg	>100 cm tb = 1	50-100 cm tb = 2	25-50 cm tb = 3	10-25 cm tb = 4	<10 cm tb = 5
	ts	Determine depth to exchangeable sodium percentage of > 25%	>100 cm ts = 1	50-100 cm ts = 2	25-50 cm ts = 3	10-25 cm ts = 4	<10 cm ts = 5

Rockiness	r	Estimate proportion of surface rock and stone	Nil - slight r = 1,2	Picking or rolling r = 3	Semi arable r = 4	-	Non arable r = 5, 6, 8
Surface condition	c	Hardness / dispersiveness of surface soil	Loose, soft, friable, hard c = 1,2	-	Dispersive c = 3	Str. dispersive c = 4	-
Subsoil structure	p	Determine depth to and nature of subsoil. eg Depth to dispersive clay: Where soil class E1,E2 E3 = >30%	> 30 cm p = 1,2	20-30 cm p = 3	< 20 cm p = 4,5	-	-
		Other soils	> 30 cm p = 1,2	20-30 cm p = 3	10-20 cm p = 4	<10 cm p=5	-
Scalding	z	Assess the percentage of land affected	None z = 1	Up to 5% z = 2	5 - 10% z = 4	10 - 50% z = 5	> 50% z = 7
Water repellence	u	Measure time taken for drop of water to be absorbed into soil	Non repellent u = 1	Repellent u = 2	Str. repellent u = 3	-	-
Water erosion potential	e	Refer handbook for water erosion classes	Low - mod low e = 1,2	Moderate e = 3	Mod. high e = 4	High e = 5	Very high - extreme e = 6,7
Wind erosion potential	a	Refer handbook for wind erosion classes	Low - mod low a = 1,2	Moderate a = 3	Mod. high a = 4	High a = 5	Extreme a = 7
Gully erosion	g	Assess percentage of land affected	< 5% g = 1,2	5-10% g = 3	10-20% g = 4	-	>20% g = 7, 5x, 7x
Mass movement	l	Estimate area affected or at risk	None present l = 1	-	None present (potential) l = 4	Up to 5% of land affected l = 5	> 5% of lan affected l = 7
Exposure	y	Estimate degree of wind exposure	Nil y = 1	Moderate y = 2	High (coast) y = 3	-	-

Land Classification Criteria – Canola

February 2006

Land quality		What to measure or look for	Degree of limitation				
			Negligible Class 1	Slight Class 2	Moderate Class 3	High Class 4	Severe Class 5
Waterlogging	w	Length of time that any part of the profile is saturated following heavy rain.	< 1 week w = 1,2	1-2 weeks (early) w = 3	Several weeks w = 4	Several mths w = 5	Most of ye w = 7,8
Depth to water table	o	Estimate highest level maintained for at least two weeks per year					
		Where s = 1	>100 cm o = 1,2	50-100 cm o = 3	-	0-50 cm o = 4	Above sur o = 5, 7, 8
		Where s = other than 1 (includes 1o, 1+, 1x)	> 200 cm o = 1	100-200 cm o = 2	50-100 cm o = 3	0-50 cm o = 4	Above sur o = 5, 7, 8
Water holding capacity	m	Estimate mm total available water in root zone	>100 mm m = 1	70-100 mm m = 2	40-70 mm m = 3	20-40 mm m = 4	<20 mm m = 5
Salinity (associated with water table)	s	Observe presence of halophytic plants (eg sea barley grass) **OR**	None present	None present but subsoil is mod. saline	Scattered halophytes	Halophytes common	Mostly halophytes
		Measure ECe (dS/m) in surface and subsoil	< 2 (surface) < 4 (subsoil) s = 1	2 - 4 (surf) 4 - 8 (subs'l) s = 2	4 - 8 (surf) 16 (subs'l) s = 3	8-16 (surf) 16-32(subs'l) s = 4	>16 (surf) >32 (subs'l s = 5,7,8
		If w =4,5,7,8	s = 1	-	s = 2	s = 3	s = 4,5,7,8
Patchy salinity (associated with water table)	s	Proportion of land affected by saline seepages	<2% "s" subs't =o **or** absent	2-10% "s" subs't = +	10-50% "s" subs't = x	-	-
Dry saline land	v	Measure ECe (dS/m) in surface and subsoil.	< 2 (surface) < 4 (subsoil) v = 1	2 - 4 (surf) 4 - 8 (subs'l) v = 2	4 - 8 (surf) 8 - 16 (subs'l) v = 3	8 - 16 (surf) 16-32 (subs'l) v = 4	>16 (surf) > 32 (subs' v = 7
Patchy dry saline land	v	Proportion of land affected by dry saline (magnesia) patches	<2% "v" subs't = o **or** absent	2-10% "v" subs't = +	10-50% "v" subs't = x	-	-
Acidity	h	Measure pH $CaCl_2$ at surface & deep subsoil: Surface > Subsoil 1 = > 5.4 1= > 6.9 2,3 = 4.5 - 5.4 2 = 5.5 - 6.9 4,5 = < 4.5 3 = 4.5 - 5.4 4 = < 4.5	h = 1> *, 2>1, 2>2, 2>3	h = 2>4, 3>*	h = 4>*, 5>*	-	-
		Downgrade if aluminium present (ta = 2 or 3):	h = 1>*	h = 2>1, 2>2, 2>3	h = 2>4, 3>*	h = 4>*, 5>*	-
Alkalinity	i	Measure pH (water) at surface & deep subsoil: Surface > Subsoil 1 = < 8.0 1 = < 8.0 2 = 8.0 - 9.2 2 = 8.0 - 9.2 3 = > 9.2 (10-30) 3 = > 9.2 4 = > 9.2 (0-10)	i = 1>1, 1>2, 2>1, 2>2	i = 1>3, 2>3	i = 3>3	i = 4>3	-
Surface CO_3	ka	Reaction to 1M HCl	Nil to mod. ka = 1,2	Strong ka = 3	-	-	-
Subsoil CO_3	kb	Depth to strong reaction to 1M HCl	>30 cm kb = 1,2	< 30 cm kb = 3	-	-	-
Inherent fertility	n	Identify soil type	High, v. high n = 1	Moderate n = 2	Mod. low n = 3	Low n = 4	Very low n = 5
Toxic elements	tb	Determine depth to boron levels of > 15 mg/kg	>100 cm tb = 1	50-100 cm tb = 2	25-50 cm tb = 3	10-25 cm tb = 4	<10 cm tb = 5
	ts	Determine depth to exchangeable sodium percentage of > 25%	>50 cm ts = 1,2	25-50 cm ts= 3	10-25 cm ts = 4	-	<10 cm ts = 5

Rockiness	r	Estimate proportion of surface rock and stone	Nil - slight r = 1,2	Picking or rolling r = 3	Semi arable r = 4	-	Non arable r = 5, 6, 8
Surface condition	c	Hardness / dispersiveness of surface soil	Loose, soft, friable c = 1	Hard c = 2	Dispersive c = 3	Str. dispersive c = 4	-
Subsoil structure	p	Determine depth to and nature of subsoil. eg Depth to dispersive clay:	> 30 cm p = 1,2	20-30 cm p = 3	10-20 cm p = 4	<10 cm p=5	-
Scalding	z	Assess the percentage of land affected	None z = 1	Up to 5% z = 2	5 - 10% z = 4	10 - 50% z = 5	> 50% z = 7
Water repellence	u	Measure time taken for drop of water to be absorbed into soil	Non repellent u = 1	Repellent u = 2	Strongly repellent u = 3	-	-
Water erosion potential	e	Refer handbook for water erosion classes	Low - mod low e = 1,2	Moderate e = 3	Mod. high e = 4	High e = 5	Very high extreme e = 6,7
Wind erosion potential	a	Refer handbook for wind erosion classes	Low - mod low a = 1,2	Moderate a = 3	Mod. high a = 4	High a = 5	Extreme a = 7
Gully erosion	g	Assess percentage of land affected	< 5% g = 1,2	5-10% g = 3	10-20% g = 4	-	>20% g = 7, 5x,7
Mass movement	l	Estimate area affected or at risk	None present l = 1	-	None present (potential) l = 4	Up to 5% of land affected l = 5	> 5% of la affected l = 7
Exposure	y	Estimate degree of wind exposure	Nil y = 1	Moderate y = 2	High (coast) y = 3	-	-

Land Classification Criteria – Field Peas

February 2006

Land quality		What to measure or look for	Degree of limitation				
			Negligible Class 1	Slight Class 2	Moderate Class 3	High Class 4	Severe Class 5
Waterlogging	w	Length of time that any part of the profile is saturated following heavy rain	< 2 days w = 1	2-7 days w = 2	1-2 weeks (early) w = 3	Several weeks w = 4	Several months w = 5, 7, 8
Depth to water table	o	Estimate highest level maintained for at least two weeks per year					
		Where s = 1	>100 cm o = 1,2	50-100 cm o = 3	-	0-50 cm o = 4	Above sur o = 5, 7, 8
		Where s = other than 1 (includes 1o, 1+, 1x)	> 200 cm o = 1	100-200 cm o = 2	50-100 cm o = 3	0-50 cm o = 4	Above sur o = 5, 7, 8
Water holding capacity	m	Estimate mm total available water in root zone	>70 mm m = 1,2	40-70 mm m = 3	20-40 mm m = 4	<20 mm m = 5	-
Salinity (associated with water table)	s	Observe presence of halophytic plants (eg sea barley grass) **OR**	None present	None present but subsoil is slight. saline	None present but subsoil is mod. saline	Scattered halophytes	Mostly halophytes
		Measure ECe (dS/m) in surface and subsoil	< 2 (surface) < 4 (subsoil) s = 1	2 - 4 (surf.) 4 - 8 (subs'l) s = 2	2 - 8 (surf.) 4 - 16(subs'l) s = 3-1, 3-2	4 - 8 (surf.) 8 - 16 (subs'l) s = 3,3-4,3-5, 3-7	>8 (surfac >16 (subs'l s = 4,5,7,8
		If w =4,5,7,8	s = 1	-	s = 2	s = 3-1, 3-2	s = 3,3-4,3 3-7,4,5,7,8
Patchy salinity (associated with water table)	s	Proportion of land affected by saline seepages	0% No "s" subs't	0-2% "s" subs't =o	2-10% "s" subs't = +	10-50% "s" subs't = x	-
Dry saline land	v	Measure ECe (dS/m) in surface and subsoil.	< 2 (surface) < 4 (subsoil) v = 1	2 - 4 (surf.) 4 - 8 (subs'l) v = 2	4 - 8 (surf.) 8 - 16 (subs'l) v = 3	8 - 16 (surf.) 16-32 (subs'l) v = 4	>16 (surfa > 32 (subs v = 7
Patchy dry saline land	v	Proportion of land affected by dry saline (magnesia) patches	<2% "v" subs't = o **or** absent	2-10% "v" subs't = +	10-50% "v" subs't = x	-	-
Acidity	h	Measure pH $CaCl_2$ at surface & deep subsoil: Surface > Subsoil 1 = > 5.4 — 1=> 6.9 2,3 = 4.5 - 5.4 — 2 = 5.5 - 6.9 4,5 = < 4.5 — 3 = 4.5 - 5.4 4 = < 4.5	h = 1>*	h = 2>1, 2>2, 3>1, 3>2	h = 2>3, 3>3	h = 2>4, 3>4, 4>*, 5>*	-
		Downgrade if aluminium present (ta = 2 or 3):	h = 1>*	-	h = 2>1, 2>2, 3>1, 3>2	h = 2>3, 2>4, 3>3, 3>4, 4>*, 5>*	-
Alkalinity	i	Measure pH (water) at surface & deep subsoil: Surface > Subsoil 1 = < 8.0 — 1 = < 8.0 2 = 8.0 - 9.2 — 2 = 8.0 - 9.2 3 = > 9.2 (10-30) — 3 = > 9.2 4 = > 9.2 (0-10)	i = 1>*, 2>1, 2>2,	i = 2>3, 3>3	i = 4>3	-	-
Surface CO_3	ka	Reaction to 1M HCl	Nil to mod. ka = 1,2	Strong ka = 3	-	-	-
Subsoil CO_3	kb	Depth to strong reaction to 1M HCl	>30 cm kb = 1,2	< 30 cm kb = 3	-	-	-
Inherent fertility	n	Identify soil type	High, v. high n = 1	Moderate n = 2	Mod. low, low n = 3, 4	Very low n = 5	-
Toxic elements	tb	Determine depth to boron levels of > 15 mg/kg	>100 cm tb = 1	50-100 cm tb = 2	25-50 cm tb = 3	10-25 cm tb = 4	<10 cm tb = 5
	ts	Determine depth to exchangeable sodium percentage of > 25%	>100 cm ts = 1	50-100 cm ts = 2	25-50 cm ts= 3	10-25 cm ts = 4	<10 cm ts = 5

Rockiness	r	Estimate proportion of surface rock and stone	Nil r = 1	Slight r = 2	Picking or rolling r = 3	Semi arable r = 4	Non arable r = 5, 6, 8
Surface condition	c	Hardness / dispersiveness of surface soil	Loose, soft, friable c = 1	Hard c = 2	Dispersive c = 3	Str. dispersive c = 4	-
Subsoil structure	p	Determine depth to and nature of subsoil. eg Depth to dispersive clay:	> 30 cm p = 1,2	20-30 cm p = 3	10-20 cm p = 4	<10 cm p=5	-
Scalding	z	Assess the percentage of land affected	None z = 1	Up to 5% z = 2	5 - 10% z = 4	10 - 50% z = 5	> 50% z = 7
Water repellence	u	Measure time taken for drop of water to be absorbed into soil	Non repellent u = 1	Repellent u = 2	Str. repellent u = 3	-	-
Water erosion potential	e	Refer handbook for water erosion classes	Low - mod low e = 1,2	Moderate e = 3	Mod. high e = 4	High e = 5	Very high extreme e = 6,7
Wind erosion potential	a	Refer handbook for wind erosion classes	Low a = 1	Mod. low a = 2	Moderate a = 3	Mod. high a = 4	High - extr a = 5, 7
Gully erosion	g	Assess percentage of land affected	< 5% g = 1,2	5-10% g = 3	10-20% g = 4	-	>20% g = 7, 5x,7
Mass movement	l	Estimate area affected or at risk	None present l = 1	-	None present (potential) l = 4	Up to 5% of land affected l = 5	> 5% of la affected l = 7
Exposure	y	Estimate degree of wind exposure	Nil y = 1	Moderate y = 2	High (coast) y = 3	-	-

PERRENIAL HORTICULTURE

Land Classification Criteria – Almonds

February 2006

Land quality		What to measure or look for	Degree of limitation				
			Negligible Class 1	Slight Class 2	Moderate Class 3	High Class 4	Severe Class 5
Potential rootzone depth	db	Depth of soil above limiting clay, carbonate or hard rock	> 80 cm db = 1,2	50-80 cm db =3, 4	30-50 cm db = 5,6	20-30 cm db = 7	< 20 cm db = 8
Deep drainage	b	Depth to impermeable clay (eg Qph)	> 150 cm b = 1	100-150 cm b = 2	-	50-100 cm b = 3	< 50 cm b = 4,5
Waterlogging	w	Length of time that any part of the profile is saturated following heavy rain / irrigation	<1 day w = 1	Up to a week w = 2, 2-1	Variable up to 2 weeks w = 2-3, 2-4, 2-5	1 to 3 weeks w = 3	> 3 weeks w = 4,5,7,8
Depth to water table	o	Estimate highest level maintained for at least two weeks per year	>200 cm o = 1	>100 cm o = 1-*	100-200 cm o = 2	50-100 cm o = 3	< 50 cm o = 4,5,7,8
Salinity (associated with water table)	s	Observe presence of halophytic plants (eg sea barley grass) OR	None present	-	None present but subsoil is mod. saline	Scattered halophytes	Mostly halophytes
		Measure ECe(dS/m) in surface and subsoil Where "depth to water table (o)" =1 (excludes 1-*) and "deep drainage (b)" =1 (excludes 1-*):	< 2 (surface) < 4 (subsoil) s = 1	-	2 - 4 (surf) 4 - 8 (subs'l) s = 2	4 - 8 (surf) 8 - 16 (subs'l) s = 3	>8 (surf) > 16 (subs s = 4,5,7,8
		Where "depth to water table (o)" >1, and / or "deep drainage (b)" >1:	< 2 (surface) < 4 (subsoil) s = 1	-	-	2 – 4 (surf) 4 – 8 (subs.) s = 2	>4 (surfac > 8 (subs'l s = 3,4,5,7
Patchy salinity (associated with water table)	s	Proportion of land affected by saline seepages	0 No "s" subs't	-	< 2% "s" subs't = o	2-10% "s" subs't = +	10-50% "s" subs't =
Dry saline land	v	Measure ECe (dS/m) in surface and subsoil. Where deep drainage is impeded (b=2,3,4,5):	< 2 (surface) < 4 (subsoil) v = 1	-	2 - 4 (surf) 4 - 8 (subs'l) v = 2	4 - 8 (surf) 8 – 16 (subs'l) v = 3	>8 (surfac > 16 (subs v = 4,7
		Measure ECe (dS/m) in surface and subsoil. Where deep drainage is un-impeded (b=1):	< 2 (surface) < 4 (subsoil) v = 1	2 - 4 (surf) 4 - 8 (subs'l) v = 2	4 - 8 (surf) 8 – 16 (subs'l) v = 3	8 - 16 (surf) 16-32 (subs'l) v = 4	>16 (surfa > 32 (subs v = 7
Patchy dry saline land	v	Proportion of land affected by dry saline (magnesia) patches	0 No "v" subs't	< 2% "v" subs't = o	-	2-10% "v" subs't = +	10-50% "v" subs't =
Acidity	h	Measure pH $CaCl_2$ at surface & deep subsoil: Surface > Subsoil 1 = > 5.4 — 1= > 6.9 2,3 = 4.5 - 5.4 — 2 = 5.5 - 6.9 4,5 = < 4.5 — 3 = 4.5 - 5.4 4 = < 4.5	h = 1>1, 1>2	h = 1>3, 1>4, 2>1, 2>2, 3>1, 3>2	h = 2>3, 3>3	h = 2>4, 3>4, 4>2, 4>3, 4>4, 5>3, 5>4	-
Alkalinity	i	Measure pH (water) at surface & deep subsoil: Surface > Subsoil 1 = < 8.0 — 1 = < 8.0 2 = 8.0 - 9.2 — 2 = 8.0 - 9.2 3 = > 9.2 (10-30) — 3 = > 9.2 4 = > 9.2 (0-10)	i = 1>1, 1>2	i = 1>3, 2>1, 2>2, 2>3	i = 3>3	i = 4>3	-
Surface CO_3	ka	Reaction to 1M HCl	Nil ka = 1	Sl. to mod ka = 2	Strong ka = 3	-	-
Subsoil CO_3	kb	Depth to strong reaction to 1M HCl	>60 cm kb = 1	<60 cm kb = 2, 3	-	-	-
Inherent fertility	n	Identify soil type	Mod.- v. high n = 1,2	Mod. low n = 3	Low n = 4	Very low n = 5	-

Toxic elements	tb	Determine depth to boron levels of > 15 mg/kg	> 100 cm tb = 1	-	50-100 cm tb = 2	25-50 cm tb = 3	< 25 cm tb = 4,5
	ta	Measure extractable aluminium in root zone	<2 mg/kg ta = 1	2-4 mg / kg ta = 2	> 4 mg/kg ta = 3	-	-
	ts	Determine depth to exchangeable sodium percentage of > 25%	> 100 cm ts = 1	50-100 cm ts = 2	25-50 cm ts = 3	-	< 25 cm ts = 4, 5
Rockiness	r	Estimate proportion of surface rock and stone	Nil r = 1	Slight r = 2	-	Stone pick/roll r = 3	Semi-non arable r = 4,5,6,8
Surface condition	c	Hardness / dispersiveness of surface soil	Non disp. c = 1,2	Dispersive c = 3	Str. disp. c = 4	-	-
Subsoil structure	p	Determine depth to and nature of subsoil. eg Depth to dispersive clay:	> 60 cm p = 1	30-60 cm p = 2	20-30 cm p = 3	10-20 cm p = 4	<10 cm p=5
Scalding	z	Assess the percentage of land affected	None z = 1	Up to 5% z = 2	5 - 10% z = 4	10 - 50% z = 5	> 50% z = 7
Water repellence	u	Measure time taken for drop of water to be absorbed into soil	Instantly (non rep.) u = 1	Repellent, str. repellent u = 2,3	-	-	-
Water erosion potential	e	Refer handbook for water erosion classes	Low, mod. low, mod. e = 1,2,3	Moderately high to high e = 4,5	-	Very high e = 6	Extreme e = 7
Wind erosion potential	a	Refer handbook for wind erosion classes	Low, mod. low, mod. a = 1,2,3	Moderately high to high a = 4,5	-	Extreme a = 7	-
Gully erosion	g	Assess percentage of land affected	< 5% g = 1,2	5-10% g = 3	10-20% g = 4	-	> 20% g = 7, 5x,7
Mass movement	1	Estimate area affected or at risk	None, slope < 30% 1= 1	-	None, slope > 30% 1= 4	Up to 5% of land affected 1= 5	> 5% of la affected 1= 7
Exposure	y	Estimate degree of wind exposure	Nil - slight y = 1	Moderate y = 2	High (coast) y = 3	-	-

Land Classification Criteria – Grape Vines

February 2006

Land quality		What to measure or look for	Degree of limitation				
			Negligible Class 1	Slight Class 2	Moderate Class 3	High Class 4	Severe Class 5
Potential rootzone depth	dc	For deep sandy soils (where soil classes H1, H2, H3, I1 or I2 occupy >30% of area), depth to impeding layer (crop type C)	> 80 cm dc = 1,2	50-80 cm dc =3, 4	30-50 cm dc = 5, 6	20-30 cm dc = 7	< 20 cm dc = 8
		For other soils, depth of soil above limiting clay, carbonate or hard rock (crop type C)	> 50 cm dc = 1,2,3,4	30-50 cm dc =5,6	20-30 cm dc = 7	< 20 cm dc = 8	-
Deep drainage	b	Depth to impermeable clay (eg Qph)	> 150 cm b = 1	100 - 150 cm b = 2	50 - 100 cm b = 3	-	<50 cm b = 4,5
Waterlogging	w	Length of time that any part of the profile is saturated following heavy rain / irrigation Where p = 1, 1-2, 1-3, 2-1, 2	Up to a week w = 1, 2, 2-1	1 to 3 weeks w = 2-3,2-4, 2-5, 3, 3-1, 3-2	~ 3 weeks w = 3-4, 3-5, 3-7	3 to 6 weeks w = 4	> 6 weeks w = 5,7,8
		Where p = 1-4, 2-3, 2-4, 3, 3-*, 4, 4-*, 5, 5-*	<2 days w = 1	Up to a week w = 2	1 to 3 weeks w = 3	3 to 6 weeks w = 4	> 6 weeks w = 5,7,8
Depth to water table	o	Estimate highest level maintained for at least two weeks per year	>200 cm o = 1	>100 cm o = 1-*, 2	50-100 cm o = 3	-	< 50 cm o = 4,5,7,8
Salinity (associated with water table)	s	Observe presence of halophytic plants (eg sea barley grass) OR	None present	Subsoil salinity	Scattered halophytes	Halophytes common	Mostly halophytes
		Measure ECe (dS/m) in surface and subsoil Where "depth to water table (o)" =1 (excludes 1-*) and "deep drainage (b)" = 1 (excludes 1-*):	< 2 (surface) < 4 (subsoil) s = 1	2 - 4 (surf) 4 – 8 (subs'l) s = 2	4 – 8 (surf) 8-16 (subs'l) s = 3	8 – 16 (surf) 16 – 32 (sub) s = 4	>16 (surf) >32 (subs'l s = 5, 7, 8
		Where "depth to water table (o)" >1, and / or "deep drainage (b)" >1:	< 2 (surface) < 4 (subsoil) s = 1	-	2 – 4 (surf) 4 – 8 (subs.) s = 2	4 - 8 (surf) 8 - 16 (subs'l) s = 3	>8 (surface > 16 (subs' s = 4,5,7,8
Patchy salinity (associated with water table)	s	Proportion of land affected by saline seepages	None. No "s" subs't	< 10% "s" subscipt = o,+	10-50% "s" subs't = x	-	-
Dry saline land	v	Measure ECe (dS/m) in surface and subsoil. Where deep drainage is impeded (b=2,3,4,5):	< 2 (surface) < 4 (subsoil) v = 1	2 - 4 (surf) 4 - 8 (subs'l) v = 2	4 – 8 (surf) 8 - 16 (subs'l) v = 3	8 - 16 (surf) 16-32 (subs'l) v = 4	>16 (surfac > 32 (subs' v = 7
		Measure ECe (dS/m) in surface and subsoil. Where deep drainage is un-impeded (b=1):	< 4 (surface) < 8 (subsoil) v = 1, 2	4 – 8 (surf) 8 - 16 (subs'l) v = 3	8 - 16 (surf) 16-32 (subs'l) v = 4	>16 (surface) > 32 (subs'l) v = 7	-
Patchy dry saline land	v	Proportion of land affected by dry saline (magnesia) patches	0 No "v" subs't	< 2% "v" subs't = o	2-10% "v" subs't = +	10-50% "v" subs't = x	-
Acidity	h	Measure pH $CaCl_2$ at surface & deep subsoil: Surface > Subsoil 1 = > 5.4 1= > 6.9 2,3 = 4.5 - 5.4 2 = 5.5 - 6.9 4,5 = < 4.5 3 = 4.5 - 5.4 4 = < 4.5	h = 1>1, 1>2, 1>3, 2>1, 2>2, 2>3, 3>1, 3>2, 3>3	h = 1>4, 4>2, 4>3, 5>3	h = 2>4, 3>4, 4>4, 5>4	-	-
Alkalinity	i	Measure pH (water) at surface & deep subsoil: Surface > Subsoil 1 = < 8.0 1 = < 8.0 2 = 8.0 - 9.2 2 = 8.0 - 9.2 3 = > 9.2 (10-30) 3 = > 9.2 4 = > 9.2 (0-10)	i = 1>1, 1>2, 2>1, 2>2	i = 1>3, 2>3	i = 3>3	i = 4>3	-

Surface CO_3	ka	Reaction to 1M HCl	Nil to mod. ka = 1,2	Strong ka = 3	-	-	-
Subsoil CO_3	kb	Depth to strong reaction to 1M HCl	>30 cm kb = 1,2	< 30 cm kb = 3	-	-	-
Inherent fertility	n	Identify soil type	Mod. low-high n = 1,2,3	Low n = 4	Very low n = 5	-	-
Toxic elements	tb	Determine depth to boron levels of > 15 mg/kg	> 100 cm tb = 1	50-100 cm tb = 2	25-50 cm tb = 3	10-25 cm tb = 4	< 10 cm tb = 5
	ta	Measure extractable aluminium in root zone	<4 mg/kg ta = 1,2	>4 mg / kg ta = 3	-	-	-
	ts	Determine depth to exchangeable sodium percentage of > 25%	> 100 cm ts = 1	50-100 cm ts = 2	25-50 cm ts = 3	10-25 cm ts = 4	< 10 cm ts = 5
Rockiness	r	Estimate proportion of surface rock and stone. For Land Type (first character of SLU) = A,B,C,D,E,I,Q,R,S,U,Y	Nil - mod. stoniness r = 1,2,3	-	Semi arable r = 4	Non arable r = 5	Non access r = 6,8
		For other Land Type (with rippable calcrete)	r = 1,2,3,4	r = 5	r = 6,8	-	-
Surface condition	c	Hardness / dispersiveness of surface soil	Non disp. c = 1,2	Dispersive c = 3	Str. disp. c = 4	-	-
Subsoil structure	p	Determine depth to and nature of subsoil. eg Depth to dispersive clay:	> 60 cm p = 1, 1-2, 1-3	30-60 cm p = 1-4, 2, 3-1, 3-2	20-30 cm p = 3, 3-4, 3-5	10-20 cm p = 4	<10 cm p=5
Scalding	z	Assess the percentage of land affected	None z = 1	Up to 5% z = 2	5 - 10% z = 4	10 - 50% z = 5	> 50% z = 7
Water repellence	u	Measure time taken for drop of water to be absorbed into soil	Instantly (non rep.) u = 1	Repellent, str. repellent u = 2,3	-	-	-
Water erosion potential	e	Refer handbook for water erosion classes	Low, mod. low, mod. e = 1,2,3	Moderately high to high e = 4,5	-	Very high e = 6	Extreme e = 7
Wind erosion potential	a	Refer handbook for wind erosion classes	Low, mod. low, mod. a = 1,2,3	Moderately high to high a = 4,5	-	Extreme a = 7	-
Gully erosion	g	Assess percentage of land affected	< 5% g = 1,2	5-10% g = 3	10-20% g = 4	-	> 20% g = 7, 5x,7:
Mass movement	l	Estimate area affected or at risk	None, slope < 30% l = 1	-	None, slope > 30% l = 4	Up to 5% of land affected l = 5	> 5% of lar affected l = 7
Exposure	y	Estimate degree of wind exposure	Nil - slight y = 1	Moderate y = 2	High (coast) y = 3	-	-

Land Classification Criteria – Citrus

February 2006

Land quality		What to measure or look for	Degree of limitation				
			Negligible Class 1	Slight Class 2	Moderate Class 3	High Class 4	Severe Class 5
Potential rootzone depth	da	Depth of soil above limiting clay, carbonate or hard rock	> 100 cm da = 1,2	60-100 cm da = 3,4	40-60 cm da = 5,6	20-40 cm da = 7	< 20 cm da = 8
Deep drainage	b	Depth to impermeable clay (eg Qph)	> 150 cm b = 1	-	100-150 cm b = 2	50-100 cm b = 3	< 50 cm b = 4,5
Waterlogging	w	Length of time that any part of the profile is saturated following heavy rain / irrigation	<1 day w = 1	Up to a week w = 1-*, 2, 2-1	Variable up to 2 weeks w = 2-3, 2-4, 2-5	1 to 3 weeks w = 3	> 3 weeks w = 4,5,7,8
Depth to water table	o	Estimate highest level maintained for at least two weeks per year	>200 cm o = 1	>100 cm o = 1-*	100-200 cm o = 2	50-100 cm o = 3	< 50 cm o = 4,5,7,8
Salinity (associated with water table)	s	Observe presence of halophytic plants (eg sea barley grass) OR	None present	-	None present but subsoil is mod. saline	Scattered halophytes	Mostly halophytes
		Measure ECe(dS/m) in surface and subsoil Where "depth to water table (o)" =1 (excludes 1-*) and "deep drainage (b)" =1 (excludes 1-*):	< 2 (surface) < 4 (subsoil) s = 1	-	2 - 4 (surf) 4 - 8 (subs'l) s = 2	4 - 8 (surf) 8 - 16 (subs'l) s = 3	>8 (surf) > 16 (subs' s = 4,5,7,8
		Where "depth to water table (o)" >1, and / or "deep drainage (b)" >1:	< 2 (surface) < 4 (subsoil) s = 1	-	-	2 – 4 (surf) 4 – 8 (subs.) s = 2	>4 (surface > 8 (subs'l) s = 3,4,5,7,
Patchy salinity (associated with water table)	s	Proportion of land affected by saline seepages	0 No "s" subs't	-	< 2% "s" subs't = o	2-10% "s" subs't = +	10-50% "s" subs't =
Dry saline land	v	Measure ECe (dS/m) in surface and subsoil. Where deep drainage is impeded (b=2,3,4,5):	< 2 (surface) < 4 (subsoil) v = 1	-	2 - 4 (surf) 4 - 8 (subs'l) v = 2	4 - 8 (surf) 8 – 16 (subs'l) v = 3	>8 (surface > 16 (subs' v = 4,7
		Measure ECe (dS/m) in surface and subsoil. Where deep drainage is un-impeded (b=1):	< 2 (surface) < 4 (subsoil) v = 1	2 - 4 (surf) 4 - 8 (subs'l) v = 2	4 - 8 (surf) 8 – 16 (subs'l) v = 3	8 - 16 (surf) 16-32 (subs'l) v = 4	>16 (surfac > 32 (subs' v = 7
Patchy dry saline land	v	Proportion of land affected by dry saline (magnesia) patches	0 No "v" subs't	< 2% "v" subs't = o	-	2-10% "v" subs't = +	10-50% "v" subs't =
Acidity	h	Measure pH $CaCl_2$ at surface & deep subsoil: Surface > Subsoil 1 = > 5.4 1= > 6.9 2,3 = 4.5 - 5.4 2 = 5.5 - 6.9 4,5 = < 4.5 3 = 4.5 - 5.4 4 = < 4.5	h = 1>1, 1>2, 1>3	h = 1>4, 2>1, 2>2, 3>1, 3>2	h = 2>3, 3>3	h = 2>4, 3>4, 4>2, 4>3, 4>4, 5>3, 5>4	-
Alkalinity	i	Measure pH (water) at surface & deep subsoil: Surface > Subsoil 1 = < 8.0 1 = < 8.0 2 = 8.0 - 9.2 2 = 8.0 - 9.2 3 = > 9.2 (10-30) 3 = > 9.2 4 = > 9.2 (0-10)	i = 1>1, 1>2	i = 1>3, 2>1, 2>2, 2>3	i = 3>3	i = 4>3	-
Surface CO_3	ka	Reaction to 1M HCl	Nil ka = 1	Sl. to mod ka = 1-2, 1-3, 2-1, 2	Mod to strong ka = 2-3	Strong ka = 3-1, 3-2, 3	-
Subsoil CO_3	kb	Depth to strong reaction to 1M HCl	>60 cm kb = 1	~60 cm kb = 1-2, 1-3, 2-1	30-60 kb = 2, 2-3	< 30 kb = 3	-
Inherent fertility	n	Identify soil type	Mod.- v. high n = 1,2	Mod. low - low n = 3,4	very low n = 5	-	-

Toxic elements	tb	Determine depth to boron levels of > 15 mg/kg	> 100 cm tb = 1	-	50-100 cm tb = 2	25-50 cm tb = 3	< 25 cm tb = 4,5
	ta	Measure extractable aluminium in root zone	<2 mg/kg ta = 1	2-4 mg / kg ta = 2	> 4 mg/kg ta = 3	-	-
	ts	Determine depth to exchangeable sodium percentage of > 25%	> 100 cm ts = 1	50-100 cm ts = 2	25-50 cm ts = 3	-	< 25 cm ts = 4, 5
Rockiness	r	Estimate proportion of surface rock and stone	Nil – slight r = 1,2	Moderate r = 3	Semi arable r = 4	Non arable r = 5	Non access r = 6,8
Surface condition	c	Hardness / dispersiveness of surface soil	Non disp. c = 1,2	Dispersive c = 3	Str. disp. c = 4	-	-
Subsoil structure	p	Determine depth to and nature of subsoil. eg Depth to dispersive clay:	> 60 cm p = 1	30-60 cm p = 2	20-30 cm p = 3	10-20 cm p = 4	<10 cm p=5
Scalding	z	Assess the percentage of land affected	None z = 1	Up to 5% z = 2	5 - 10% z = 4	10 - 50% z = 5	> 50% z = 7
Water repellence	u	Measure time taken for drop of water to be absorbed into soil	Non rep., rep u = 1, 2	Str. repellent u = 3	-	-	-
Water erosion potential	e	Refer handbook for water erosion classes	Low, mod. low, mod. e = 1,2,3	Moderately high to high e = 4,5	-	Very high e = 6	Extreme e = 7
Wind erosion potential	a	Refer handbook for wind erosion classes	Low, mod. low, mod. a = 1,2,3	Moderately high to high a = 4,5	-	Extreme a = 7	-
Gully erosion	g	Assess percentage of land affected	< 5% g = 1,2	5-10% g = 3	10-20% g = 4	-	> 20% g = 7, 5x,7x
Mass movement	1	Estimate area affected or at risk	None, slope < 30% 1 = 1	-	None, slope > 30% 1 = 4	Up to 5% of land affected 1 = 5	> 5% of lan affected 1 = 7
Exposure	y	Estimate degree of wind exposure	Nil - slight y = 1	Moderate y = 2	High (coast) y = 3	-	-

Land Classification Criteria – Olives

February 2006

Land quality		What to measure or look for	Degree of limitation				
			Negligible Class 1	Slight Class 2	Moderate Class 3	High Class 4	Severe Class 5
Potential rootzone depth	dc	Depth to impeding layer (crop type C)	> 80 cm db = 1,2	50-80 cm db =3, 4	30-50 cm db = 5,6	20-30 cm db = 7	< 20 cm db = 8
Deep drainage	b	Depth to impermeable clay (eg Qph)	> 150 cm b = 1	100 - 150 cm b = 2	50 - 100 cm b = 3	-	<50 cm b = 4,5
Waterlogging	w	Length of time that any part of the profile is saturated following heavy rain / irrigation	< 2 days w = 1	Up to a week w = 2	1 to 3 weeks w = 3	3 to 6 weeks w = 4	> 6 weeks w = 5,7,8
Depth to water table	o	Estimate highest level maintained for at least two weeks per year	>200 cm o = 1	>100 cm o = 1-*	100-200 cm o = 2	50-100 cm o = 3	< 50 cm o = 4,5,7,8
Salinity (associated with water table)	s	Observe presence of halophytic plants (eg sea barley grass) OR	None present	Subsoil salinity	Scattered halophytes	Halophytes common	Mostly halophytes
		Measure ECe (dS/m) in surface and subsoil Where "depth to water table (o)" =1 (excludes 1-*) and "deep drainage (b)" =1 (excludes 1-*):	< 2 (surface) < 4 (subsoil) s = 1	2 - 4 (surf) 4 – 8 (subs'l) s = 2	4 – 8 (surf) 8-16 (subs'l) s = 3	8 – 16 (surf) 16 – 32 (sub) s = 4	>16 (surf) >32 (subs' s = 5, 7, 8
		Where "depth to water table (o)" >1, and / or "deep drainage (b)" >1:	< 2 (surface) < 4 (subsoil) s = 1	2 – 4 (surf) 4 – 8 (subs.) s = 2	4 - 8 (surf) 8 - 16 (subs'l) s = 3	-	>8 (surfac > 16 (subs s = 4,5,7,8
Patchy salinity (associated with water table)	s	Proportion of land affected by saline seepages	0 No "s" subs't	< 2% "s" subs't = o	2-10% "s" subs't = +	10-50% "s" subs't = x	-
Dry saline land	v	Measure ECe (dS/m) in surface and subsoil. Where deep drainage is impeded (b=2,3,4,5):	< 2 (surface) < 4 (subsoil) v = 1	2 - 4 (surf) 4 - 8 (subs'l) v = 2	4 - 8 (surf) 8 - 16 (subs'l) v = 3	8 - 16 (surf) 16-32 (subs'l) v = 4	>16 (surfa > 32 (subs v = 7
		Measure ECe (dS/m) in surface and subsoil. Where deep drainage is un-impeded (b=1):	< 4 (surface) < 8 (subsoil) v = 1,2	4 - 8 (surf) 8 - 16 (subs'l) v = 3	8 – 16 (surf) 16-32 (subs'l) v = 4	>16 (surf) > 32 (subs'l) v = 7	-
Patchy dry saline land	v	Proportion of land affected by dry saline (magnesia) patches	0 No "v" subs't	< 2% "v" subs't = o	2-10% "v" subs't = +	10-50% "v" subs't = x	-
Acidity	h	Measure pH $CaCl_2$ at surface & deep subsoil: Surface > Subsoil 1 = > 5.4 1= > 6.9 2,3 = 4.5 - 5.4 2 = 5.5 - 6.9 4,5 = < 4.5 3 = 4.5 - 5.4 4 = < 4.5	h = 1>1, 1>2, 1>3	h = 1>4, 2>1, 2>2, 3>1, 3>2, 2>3, 3>3	h = 4>2, 4>3, 5>3, 2>4, 3>4	h= 4>4, 5>4	
Alkalinity	i	Measure pH (water) at surface & deep subsoil: Surface > Subsoil 1 = < 8.0 1 = < 8.0 2 = 8.0 - 9.2 2 = 8.0 - 9.2 3 = > 9.2 (10-30) 3 = > 9.2 4 = > 9.2 (0-10)	i = 1>1, 1>2, 2>1, 2>2	i = 1>3, 2>3	i = 3>3	i = 4>3	-
Surface CO_3	ka	Reaction to 1M HCl	Nil to mod. ka = 1,2	Strong ka = 3	-	-	-
Subsoil CO_3	kb	Depth to strong reaction to 1M HCl	>30 cm kb = 1,2	< 30 cm kb = 3	-	-	-
Inherent fertility	n	Identify soil type	Mod.- v. high n = 1,2	Mod. low n = 3	Low n = 4	Very low n = 5	-
Toxic elements	tb	Determine depth to boron levels of > 15 mg/kg	> 100 cm tb = 1	50-100 cm tb = 2	25-50 cm tb = 3	-	< 25 cm tb = 4,5

	ta	Measure extractable aluminium in root zone	<2 mg/kg ta = 1	2-4 mg / kg ta = 2	> 4 mg/kg ta = 3	-	-
	ts	Determine depth to exchangeable sodium percentage of > 25%	> 100 cm ts = 1	50-100 cm ts = 2	25-50 cm ts = 3	10-25 cm ts = 4	< 10 cm ts = 5
Rockiness	r	Estimate proportion of surface rock and stone	Nil – slight r = 1,2	Moderate r = 3	Semi arable r = 4	Non arable r = 5	Non acces r = 6,8
Surface condition	c	Hardness / dispersiveness of surface soil	Non disp. c = 1,2	Dispersive c = 3	Str. disp. c = 4	-	-
Subsoil structure	p	Determine depth to and nature of subsoil. eg Depth to dispersive clay:	> 60 cm p = 1	30-60 cm p = 2	20-30 cm p = 3	10-20 cm p = 4	<10 cm p=5
Scalding	z	Assess the percentage of land affected	None z = 1	Up to 5% z = 2	5 - 10% z = 4	10 - 50% z = 5	> 50% z = 7
Water repellence	u	Measure time taken for drop of water to be absorbed into soil	Instantly (non repel) u = 1	Repellent, str. repellent u = 2,3	-	-	-
Water erosion potential	e	Refer handbook for water erosion classes	Low, mod. low, mod. e = 1,2,3	Moderately high to high e = 4,5	-	Very high e = 6	Extreme e = 7
Wind erosion potential	a	Refer handbook for wind erosion classes	Low, mod. low, mod. a = 1,2,3	Moderately high to high a = 4,5	-	Extreme a = 7	-
Gully erosion	g	Assess percentage of land affected	< 5% g = 1,2	5-10% g = 3	10-20% g = 4	-	> 20% g = 7, 5x,7
Mass movement	l	Estimate area affected or at risk	None, slope < 30% l = 1	-	None, slope > 30% l = 4	Up to 5% of land affected l = 5	> 5% of la affected l = 7
Exposure	y	Estimate degree of wind exposure	Nil – slight y = 1	Moderate y = 2	High (coast) y = 3	-	-

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Land Classification Criteria – Carrots

February 2006

Land quality		What to measure or look for	Degree of limitation				
			Negligible Class 1	Slight Class 2	Moderate Class 3	High Class 4	Severe Class 5
Potential rootzone depth	dd	Depth to impeding layer (crop type D)	> 50 cm dd = 1,2,3,4	40 - 50 cm dd = 5	30 - 40 cm dd = 6	20 - 30 cm dd = 7	< 20 cm dd = 8
Deep drainage	b	Depth to impermeable clay (eg Qph)	> 100 cm b = 1,2	50-100 cm b = 3	-	25-50 cm b = 4	< 25 cm b = 5
Waterlogging	w	Length of time that any part of the profile is saturated following heavy rain / irrigation	<1 day w = 1	Up to a week w = 2	1 to 3 weeks w = 3	3 to 6 weeks w = 4	> 6 weeks w = 5,7,8
Depth to water table	o	Estimate highest level maintained for at least two weeks per year	>200 cm o = 1	>100 cm o = 1-*	100-200 cm o = 2	50-100 cm o = 3	< 50 cm o = 4,5,7,8
Salinity (associated with water table)	s	Observe presence of halophytic plants (eg sea barley grass) OR	None present	-	-	Usually no vegetative indicators	Halophyte evident
		Measure ECe (dS/m) in surface and subsoil: Where "depth to water table (o)" =1 and "deep drainage (b)" =1:	< 2 (surface) < 4 (subsoil) s = 1	2 - 4 (surf) 4 – 8 (subs'l) s = 2, 2-1	4 – 8 (surf) 8-16 (subs'l) s = 2-(≥3), 3	8 – 16 (surf) 16 – 32 (sub) s = 4	>16 (surf) >32 (subs' s = 5, 7, 8
		Where "depth to water table (o)" >1(includes 1-*), and / or "deep drainage (b)" >1 (includes 1-*):	< 2 (surface) < 4 (subsoil) s = 1	-	2 – 4 (surf) 4 – 8 (subs.) s = 2	4 - 8 (surf) 8 - 16 (subs'l) s = 3	>8 (surfac > 16 (subs s = 4,5,7,8
Patchy salinity (associated with water table)	s	Proportion of land affected by saline seepages	0 No "s" subs't	-	< 2% "s" subs't = o	2-10% "s" subs't = +	10-50% "s" subs't =
Dry saline land	v	Measure ECe (dS/m) in surface and subsoil. Where deep drainage is impeded (b=2,3,4,5):	< 2 (surface) < 4 (subsoil) v = 1	2 - 4 (surf.) 4 - 8 (subs'l) v = 2	4 - 8 (surf.) 8 - 16 (subs'l) v = 3	8 - 16 (surf) 16-32 (subs'l) v = 4	>16 (surfa > 32 (subs v = 7
		Measure ECe (dS/m) in surface and subsoil. Where deep drainage is un-impeded (b=1):	< 4 (surface) < 8 (subsoil) v = 1,2	4 - 8 (surf) 8 - 16 (subs'l) v = 3	8 - 16 (surf) 16-32 (subs'l) v = 4	>16 (surface) > 32 (subs'l) v = 7	-
Patchy dry saline land	v	Proportion of land affected by dry saline (magnesia) patches	0 No "v" subs't	-	< 2% "v" subs't = o	2-10% "v" subs't = +	10-50% "v" subs't =
Acidity	h	Measure pH $CaCl_2$ at surface & deep subsoil: Surface > Subsoil 1 = > 5.4 1= > 6.9 2,3 = 4.5 - 5.4 2 = 5.5 - 6.9 4,5 = < 4.5 3 = 4.5 - 5.4 4 = < 4.5	pH > or = 4.5 h = 1>*, 2>*, 3>*	pH < 4.5 h = 4>*, 5>*	-	-	-
Alkalinity	i	Measure pH (water) at surface & deep subsoil: Surface > Subsoil 1 = < 8.0 1 = < 8.0 2 = 8.0 - 9.2 2 = 8.0 - 9.2 3 = > 9.2 (10-30) 3 = > 9.2 4 = > 9.2 (0-10)	i = 1>1, 1>2	i = 1>3	i = 2>1, 2>2, 2>3	i = 3>3	i = 4>3
Surface CO_3	ka	Reaction to 1M HCl	Nil ka = 1	Slight to mod ka = 2	Strong ka = 3	-	-
Subsoil CO_3	kb	Depth to strong reaction to 1M HCl	>30 cm kb = 1,2	< 30 cm kb = 3	-	-	-
Inherent fertility	n	Identify soil type	Mod.- v. high n = 1,2	Mod. low - low n = 3,4	Very low n = 5	-	-

Toxic elements	tb	Determine depth to boron levels of > 15 mg/kg	> 50 cm tb = 1, 2-1,2	~ 50 cm tb = 2-(3,4,5)	25-50 cm tb = 3	-	< 25 cm tb = 4,5
	ta	Measure extractable aluminium in root zone	<2 mg/kg ta = 1	2-4 mg / kg ta = 2	> 4 mg/kg ta = 3	-	-
	ts	Determine depth to exchangeable sodium percentage of > 25%	> 50 cm ts = 1, 2-1,2	~ 50 cm ts = 2-(3,4,5)	25-50 cm ts = 3	-	< 25 cm ts = 4,5
Rockiness	r	Estimate proportion of surface rock and stone	Nil r = 1	Slight r = 2	-	Moderate r = 3	Semi / non arable r = 4,5, 6,
Surface condition	c	Hardness / dispersiveness of surface soil	Non hard set. c = 1	Hard setting c = 2	Dispersive c = 3	Str. disp. c = 4	-
Subsoil structure	p	Determine depth to and nature of subsoil. eg Depth to dispersive clay:	> 60 cm p = 1	30-60 cm p = 2	20-30 cm p = 3	10-20 cm p = 4	<10 cm p=5
Surface texture		Assess surface texture	S, LS, SL,L	SCL, CL	-	CN, CC	-
Scalding	z	Assess the percentage of land affected	None z = 1	Up to 5% z = 2	5 - 10% z = 4	10 - 50% z = 5	> 50% z = 7
Water repellence	u	Measure time taken for drop of water to be absorbed into soil	Instantly (non rep.) u = 1	Repellent, str. repellent u = 2,3	-	-	-
Water erosion potential	e	Refer handbook for water erosion classes	Low e = 1	Moderately low e = 2	Moderate e =3	Moderately high e = 4	High to extreme e = 5, 6, 7
Wind erosion potential	a	Refer handbook for wind erosion classes	Low - mod low a = 1,2	Moderate a = 3	Mod. high a = 4	High a = 5	Extreme a = 7
Gully erosion	g	Assess percentage of land affected	< 5% g = 1,2	5-10% g = 3	10-20% g = 4	-	> 20% g = 7, 5x,7
Mass movement	l	Estimate area affected or at risk	None, slope < 30% l = 1	-	None, slope > 30% l = 4	Up to 5% of land affected l = 5	> 5% of la affected l = 7
Exposure	y	Estimate degree of wind exposure	Nil - slight y = 1	Moderate y = 2	High (coast) y = 3	-	-

Land Classification Criteria - Potatoes

February 2006

Land quality		What to measure or look for	Degree of limitation				
			Negligible Class 1	Slight Class 2	Moderate Class 3	High Class 4	Severe Class 5
Potential rootzone depth	dd	Depth to impeding layer (crop type D)	> 50 cm dd = 1,2,3,4	40 - 50 cm dd = 5	30 - 40 cm dd = 6	20 - 30 cm dd = 7	< 20 cm dd = 8
Deep drainage	b	Depth to impermeable clay (eg Qph)	> 100 cm b = 1,2	50-100 cm b = 3	-	25-50 cm b = 4	< 25 cm b = 5
Waterlogging	w	Length of time that any part of the profile is saturated following heavy rain / irrigation	<1 week w = 1,2	1 to 3 weeks w = 3	3 to 6 weeks w = 4	Several mths w = 5	Most of tir w = 7, 8
Depth to water table	o	Estimate highest level maintained for at least two weeks per year	>200 cm o = 1	>100 cm o = 1-*	100-200 cm o = 2	50-100 cm o = 3	< 50 cm o = 4,5,7,8
Salinity (associated with water table)	s	Observe presence of halophytic plants (eg sea barley grass) OR	None present	-	-	Usually no vegetative indicators	Halophyte evident
		Measure ECe (dS/m) in surface and subsoil: Where "depth to water table (o)" =1 and "deep drainage (b)" =1:	< 2 (surface) < 4 (subsoil) s = 1	2 - 4 (surf) 4 – 8 (subs'l) s = 2	4 – 8 (surf) 8-16 (subs'l) s = 3	8 – 16 (surf) 16 – 32 (sub) s = 4	>16 (surf) >32 (subs' s = 5, 7, 8
		Where "depth to water table (o)" >1, and / or "deep drainage (b)" >1:	< 2 (surface) < 4 (subsoil) s = 1	-	2 – 4 (surf) 4 – 8 (subs.) s = 2	4 - 8 (surf) 8 - 16 (subs'l) s = 3	>8 (surface > 16 (subs s = 4,5,7,8
Patchy salinity (associated with water table)	s	Proportion of land affected by saline seepages, where water tables are absent (ie o=1, excluding 1-*)	None. No "s" subs't	< 2% "s" subs't = o	2-10% "s" subs't = +	10-50% "s" subs't = x	-
		Proportion of land affected by saline seepages, where water tables are present (ie o>1, including 1-*)	None. No "s" subs't	-	< 2% "s" subs't = o	2-10% "s" subs't = +	10-50% "s" subs't =
Dry saline land	v	Measure ECe (dS/m) in surface and subsoil. Where deep drainage is impeded (b=2,3,4,5):	< 2 (surface) < 4 (subsoil) v = 1	2 - 4 (surf) 4 - 8 (subs'l) v = 2	4 - 8 (surf) 8 - 16 (subs'l) v = 3	8 - 16 (surf) 16-32 (subs'l) v = 4	>16 (surf) > 32 (subs v = 7
		Measure ECe (dS/m) in surface and subsoil. Where deep drainage is un-impeded (b=1):	< 4 (surface) < 8 (subsoil) v = 1,2	4 - 8 (surf) 8 - 16 (subs'l) v = 3	8 - 16 (surf) 16-32 (subs'l) v = 4	>16 (surf) > 32 (subs'l) v = 7	-
Patchy dry saline land	v	Proportion of land affected by dry saline (magnesia) patches	0 No "v" subs't	< 2% "v" subs't = o	2-10% "v" subs't = +	10-50% "v" subs't = x	-
Acidity	h	Measure pH $CaCl_2$ at surface & deep subsoil: Surface > Subsoil 1 = > 5.4 1=> 6.9 2,3 = 4.5 - 5.4 2 = 5.5 - 6.9 4,5 = < 4.5 3 = 4.5 - 5.4 4 = < 4.5	pH > or = 4.5 h = 1>*, 2>*, 3>*	pH < 4.5 h = 4>*, 5>*	-	-	-
Alkalinity	i	Measure pH (water) at surface & deep subsoil: Surface > Subsoil 1 = < 8.0 1 = < 8.0 2 = 8.0 - 9.2 2 = 8.0 - 9.2 3 = > 9.2 (10-30) 3 = > 9.2 4 = > 9.2 (0-10)	For surface texture = S, LS				
			i = 1>1	i = 1>2, 1>3, 2>1, 2>2, 2>3	-	i = 3>3	i = 4>3
			For all other surface textures				
			i = 1>1	i = 1>2, 1>3	i = 2>1, 2>2, 2>3	-	i = 3>3, 4>

Surface CO_3	ka	Reaction to 1M HCl: Where surface texture = S, LS	Nil ka = 1	Sl. – mod ka = 2	-	Strong ka = 3	-
		Other surface texture	Nil ka = 1	-	Sl. - mod ka = 2	Strong ka = 3	-
Subsoil CO_3	kb	Depth to strong reaction to 1M HCl	>60 cm kb = 1	30 – 60 cm kb = 2	< 30 cm kb = 3	-	-
Inherent fertility	n	Identify soil type	Mod.- v. high n = 1,2	Mod.low-low n = 3,4,5	-	-	-
Toxic elements	tb	Determine depth to boron levels of > 15 mg/kg	> 50 cm tb = 1, 2-1,2	~ 50 cm tb = 2-(3,4,5)	25-50 cm tb = 3	-	< 25 cm tb = 4,5
	ta	Measure extractable aluminium in root zone	<2 mg/kg ta = 1	2-4 mg / kg ta = 2	> 4 mg/kg ta = 3	-	-
	ts	Determine depth to exchangeable sodium percentage of > 25%	> 50 cm ts = 1, 2-1,2	~ 50 cm ts = 2-(3,4,5)	25-50 cm ts = 3	-	< 25 cm ts = 4,5
Rockiness	r	Estimate proportion of surface rock and stone	Nil r = 1	Slight r = 2	-	Moderate r = 3	Non arable r = 4,5, 6,
Surface condition	c	Hardness / dispersiveness of surface soil	Non hard set. c = 1	Hard setting c = 2	Dispersive c = 3	Str. disp. c = 4	-
Subsoil structure	p	Determine depth to and nature of subsoil. eg Depth to dispersive clay:	> 60 cm p = 1	30-60 cm p = 2	20-30 cm p = 3	10-20 cm p = 4	<10 cm p=5
Surface texture		Assess surface texture	S, LS, SL,L	SCL, CL	-	CN, CC	-
Scalding	z	Assess the percentage of land affected	None z = 1	Up to 5% z = 2	5 – 10% z = 4	10 – 50% z = 5	> 50% z = 7
Water repellence	u	Measure time taken for drop of water to be absorbed into soil	Non repellent u = 1	Rep.- str. rep. u = 2,3	-	-	-
Water erosion potential	e	Refer handbook for water erosion classes	Low e = 1	Mod. low e = 2	Moderate e =3	Mod. high e = 4	High -extr e = 5, 6, 7
Wind erosion potential	a	Refer handbook for wind erosion classes	Low, m. low a = 1, 2	Moderate a = 3	Mod. high a = 4	High a = 5	Extreme a = 7
Gully erosion	g	Assess percentage of land affected	< 5% g = 1,2	5-10% g = 3	10-20% g = 4	-	> 20% g = 7, 5x,7
Mass movement	1	Estimate area affected or at risk	None, slope < 30% 1= 1	-	None, slope > 30% 1= 4	Up to 5% of land affected 1= 5	> 5% of la affected 1= 7
Exposure	y	Estimate degree of wind exposure	Nil – slight y = 1	Moderate y = 2	High (coast) y = 3	-	-

Land Classification Criteria - Onions

February 2006

Land quality		What to measure or look for	Degree of limitation				
			Negligible Class 1	Slight Class 2	Moderate Class 3	High Class 4	Severe Class 5
Potential rootzone depth	dd	Depth to impeding layer (crop type D)	> 50 cm dd = 1,2,3,4	40-50 cm dd = 5	30-40 cm dd = 6	20-30 cm dd = 7	<20 cm dd = 8
Deep drainage	b	Depth to impermeable clay (eg Qph)	> 100 cm b = 1,2	50-100 cm b = 3	-	25-50 cm b = 4	< 25 cm b = 5
Waterlogging	w	Length of time that any part of the profile is saturated following heavy rain / irrigation	<1 day w = 1	Up to a week w = 2	1 to 3 weeks w = 3	3 to 6 weeks w = 4	> 6 weeks w = 5,7,8
Depth to water table	o	Estimate highest level maintained for at least two weeks per year	>200 cm o = 1	>100 cm o = 1-*	100-200 cm o = 2	50-100 cm o = 3	< 50 cm o = 4,5,7,8
Salinity (associated with water table)	s	Observe presence of halophytic plants (eg sea barley grass) OR	None present	-	-	Usually no vegetative indicators	Halophyte evident
		Measure ECe (dS/m) in surface and subsoil: Where "depth to water table (o)" =1 and "deep drainage (b)" =1:	< 2 (surface) < 4 (subsoil) s = 1	2 - 4 (surf) 4 – 8 (subs'l) s = 2, 2-1	4 – 8 (surf) 8-16 (subs'l) s = 2-(≥3), 3	8 – 16 (surf) 16 – 32 (sub) s = 4	>16 (surf) >32 (subs' s = 5, 7, 8
		Where "depth to water table (o)" >1 (including 1-*), and / or "deep drainage (b)" >1:	< 2 (surface) < 4 (subsoil) s = 1	-	2 – 4 (surf) 4 – 8 (subs.) s = 2	4 - 8 (surf) 8 - 16 (subs'l) s = 3	>8 (surface > 16 (subs s = 4,5,7,8
Patchy salinity (associated with water table)	s	Proportion of land affected by saline seepages	0 No "s" subs't	-	< 2% "s" subs't = o	2-10% "s" subs't = +	10-50% "s" subs't =
Dry saline land	v	Measure ECe (dS/m) in surface and subsoil. Where deep drainage is impeded (b=2,3,4,5):	< 2 (surface) < 4 (subsoil) v = 1	2 - 4 (surf) 4 - 8 (subs') v = 2	4 - 8 (surf) 8 - 16 (subs'l) v = 3	8 - 16 (surf) 16-32 (subs'l) v = 4	>16 (surfa > 32 (subs' v = 7
		Measure ECe (dS/m) in surface and subsoil. Where deep drainage is un-impeded (b=1):	< 4 (surface) < 8 (subsoil) v = 1,2	4 - 8 (surf) 8 - 16 (subs'l) v = 3	8 - 16 (surf) 16-32 (subs'l) v = 4	>16 (surface) > 32 (subs'l) v = 7	-
Patchy dry saline land	v	Proportion of land affected by dry saline (magnesia) patches	0 No "v" subs't	-	< 2% "v" subs't = o	2-10% "v" subs't = +	10-50% "v" subs't =
Acidity	h	Measure pH $CaCl_2$ at surface & deep subsoil: Surface > Subsoil 1 = > 5.4 ; 1= > 6.9 2,3 = 4.5 - 5.4 ; 2 = 5.5 - 6.9 4,5 = < 4.5 ; 3 = 4.5 - 5.4 4 = < 4.5	pH > or = 4.5 h = 1>*, 2>*, 3>*	pH < 4.5 h = 4>*, 5>*	-	-	-
Alkalinity	i	Measure pH (water) at surface & deep subsoil: Surface > Subsoil 1 = < 8.0 ; 1 = < 8.0 2 = 8.0 - 9.2 ; 2 = 8.0 - 9.2 3 = > 9.2 (10-30) ; 3 = > 9.2 4 = > 9.2 (0-10)	i = 1>1, 1>2	i = 1>3	i = 2>1, 2>2, 2>3	i = 3>3	i = 4>3
Surface CO_3	ka	Reaction to 1M HCl	Nil ka = 1	Slight to mod ka = 2	Strong ka = 3	-	-
Subsoil CO_3	kb	Depth to strong reaction to 1M HCl	>30 cm kb = 1,2	< 30 cm kb = 3	-	-	-
Inherent fertility	n	Identify soil type	Mod.- v. high n = 1,2	Mod. low - low n = 3,4	Very low n = 5	-	-
Toxic elements	tb	Determine depth to boron levels of > 15 mg/kg	> 50 cm tb = 1, 2-1,2	~ 50 cm tb = 2-(3,4,5)	25-50 cm tb = 3	-	< 25 cm tb = 4,5

	ta	Measure extractable aluminium in root zone	<2 mg/kg ta = 1	2-4 mg / kg ta = 2	> 4 mg/kg ta = 3	-	-
	ts	Determine depth to exchangeable sodium percentage of > 25%	> 50 cm ts = 1, 2-1,2	~ 50 cm ts = 2-(3,4,5)	25-50 cm ts = 3	-	< 25 cm ts = 4,5
Rockiness	r	Estimate proportion of surface rock and stone	Nil r = 1	Slight r = 2	-	Moderate r = 3	Semi / non arable r = 4,5, 6, [illegible]
Surface condition	c	Hardness / dispersiveness of surface soil	Non hard set. c = 1	Hard setting c = 2	Dispersive c = 3	Str. disp. c = 4	-
Subsoil structure	p	Determine depth to and nature of subsoil. eg Depth to dispersive clay:	> 60 cm p = 1	30-60 cm p = 2	20-30 cm p = 3	10-20 cm p = 4	<10 cm p=5
Surface texture		Assess surface texture	S, LS, SL,L	SCL, CL	-	CN, CC	-
Scalding	z	Assess the percentage of land affected	None z = 1	Up to 5% z = 2	5 - 10% z = 4	10 - 50% z = 5	> 50% z = 7
Water repellence	u	Measure time taken for drop of water to be absorbed into soil	Instantly (non rep.) u = 1	Repellent, str. repellent u = 2,3	-	-	-
Water erosion potential	e	Refer handbook for water erosion classes	Low e = 1	Moderately low e = 2	Moderate e =3	Moderately high e = 4	High to extreme e = 5, 6, 7
Wind erosion potential	a	Refer handbook for wind erosion classes	Low - mod low a = 1,2	Moderate a = 3	Mod. high a = 4	High a = 5	Extreme a = 7
Gully erosion	g	Assess percentage of land affected	< 5% g = 1,2	5-10% g = 3	10-20% g = 4	-	> 20% g = 7, 5x,7
Mass movement	l	Estimate area affected or at risk	None, slope < 30% l = 1	-	None, slope > 30% l = 4	Up to 5% of land affected l = 5	> 5% of la[illegible] affected l = 7
Exposure	y	Estimate degree of wind exposure	Nil - slight y = 1	Moderate y = 2	High (coast) y = 3	-	-

Land Classification Criteria – Brassicas

February 2006

Land quality		What to measure or look for	Degree of limitation				
			Negligible Class 1	Slight Class 2	Moderate Class 3	High Class 4	Severe Class 5
Potential rootzone depth	de	Depth to impeding layer (crop type E)	> 50 cm de = 1,2,3,4	30-50 cm de = 5, 6	20-30 cm de = 7	-	<20 cm de = 8
Deep drainage	b	Depth to impermeable clay (eg Qph)	> 100 cm b = 1,2	50-100 cm b = 3	-	25-50 cm b = 4	< 25 cm b = 5
Waterlogging	w	Length of time that any part of the profile is saturated following heavy rain / irrigation	<1 day w = 1	Up to a week w = 2	1 to 3 weeks w = 3	3 to 6 weeks w = 4	> 6 weeks w = 5,7,8
Depth to water table	o	Estimate highest level maintained for at least two weeks per year	>200 cm o = 1	>100 cm o = 1-*	100-200 cm o = 2	50-100 cm o = 3	< 50 cm o = 4,5,7,8
Salinity (associated with water table)	s	Observe presence of halophytic plants (eg sea barley grass) OR	None present	-	-	Usually no vegetative indicators	Halophyte evident
		Measure ECe (dS/m) in surface and subsoil: Where "depth to water table (o)" =1 and "deep drainage (b)" =1:	< 2 (surface) < 4 (subsoil) s = 1, 2-1	2 - 4 (surf) 4 – 8 (subs'l) s = 2, 2-≥3	4 – 8 (surf) 8-16 (subs'l) s = 3	8 – 16 (surf) 16 – 32 (sub) s = 4	>16 (surf) >32 (subs' s = 5, 7, 8
		Where "depth to water table (o)" >1, and / or "deep drainage (b)" >1:	< 2 (surface) < 4 (subsoil) s = 1	2 - 4 (surf) 4 – 8 (subs'l) s = 2	4 – 8 (surf) 8-16 (subs'l) s = 3	8 – 16 (surf) 16 – 32 (sub) s = 4	>16 (surf) >32 (subs' s = 5, 7, 8
Patchy salinity (associated with water table)	s	Proportion of land affected by saline seepages	0 No "s" subs't	< 2% "s" subs't = o	2-10% "s" subs't = +	-	10-50% "s" subs't =
Dry saline land	v	Measure ECe (dS/m) in surface and subsoil. Where deep drainage is impeded (b=2,3,4,5):	< 2 (surface) < 4 (subsoil) v = 1	2 - 4 (surf) 4 - 8 (subs'l) v = 2	4 - 8 (surf) 8 - 16 (subs'l) v = 3	8 - 16 (surf) 16-32 (subs'l) v = 4	>16 (surf) > 32 (subs v = 7
		Measure ECe (dS/m) in surface and subsoil. Where deep drainage is un-impeded (b=1):	< 4 (surface) < 8 (subsoil) v = 1,2	4 - 8 (surf) 8 - 16 (subs'l) v = 3	8 - 16 (surf) 16-32 (subs'l) v = 4	>16 (surf) > 32 (subs'l) v = 7	-
Patchy dry saline land	v	Proportion of land affected by dry saline (magnesia) patches	0 No "v" subs't	< 2% "v" subs't = o	2-10% "v" subs't = +	-	10-50% "v" subs't =
Acidity	h	Measure pH $CaCl_2$ at surface & deep subsoil: Surface > Subsoil 1 = > 5.4 1= > 6.9 2,3 = 4.5 - 5.4 2 = 5.5 - 6.9 4,5 = < 4.5 3 = 4.5 - 5.4 4 = < 4.5	pH > or = 4.5 h = 1>*, 2>*, 3>*	pH < 4.5 h = 4>*, 5>*	-	-	-
Alkalinity	i	Measure pH (water) at surface & deep subsoil: Surface > Subsoil 1 = < 8.0 1 = < 8.0 2 = 8.0 - 9.2 2 = 8.0 - 9.2 3 = > 9.2 (10-30) 3 = > 9.2 4 = > 9.2 (0-10)	i = 1>1, 1>2	i = 1>3	i = 2>1, 2>2, 2>3	i = 3>3	i = 4>3
Surface CO_3	ka	Reaction to 1M HCl	Nil ka = 1	Slight to mod ka = 2	Strong ka = 3	-	-
Subsoil CO_3	kb	Depth to strong reaction to 1M HCl	>30 cm kb = 1,2	< 30 cm kb = 3	-	-	-
Inherent fertility	n	Identify soil type and corresponding fertility rating	Mod.- v. high n = 1,2	Mod. low n = 3	Low n = 4	Very low n = 5	-
Toxic elements	tb	Determine depth to boron levels of > 15 mg/kg	> 50 cm tb = 1, 2-1,2	~ 50 cm tb = 2-(3,4,5)	25-50 cm tb = 3	-	< 25 cm tb = 4,5
	ta	Measure extractable aluminium in root zone	<2 mg/kg ta = 1	2-4 mg / kg ta = 2	> 4 mg/kg ta = 3	-	-

	ts	Determine depth to exchangeable sodium percentage of > 25%	> 50 cm ts = 1, 2-1,2	~ 50 cm ts = 2-(3,4,5)	25-50 cm ts = 3	-	< 25 cm ts = 4,5
Rockiness	r	Estimate proportion of surface rock and stone	Nil r = 1	Slight r = 2	Moderate r = 3	Semi arable r = 4	Non arable r = 5, 6, 8
Surface condition	c	Hardness / dispersiveness of surface soil	Non hard setting c = 1	Hard setting c = 2	Dispersive c = 3	Str. disp. c = 4	-
Subsoil structure	p	Determine depth to and nature of subsoil. eg Depth to dispersive clay:	> 60 cm p = 1	30-60 cm p = 2	20-30 cm p = 3	10-20 cm p = 4	<10 cm p=5
Surface texture		Assess surface texture	SL, L, SCL, CL	S, LS	CN, CC	-	-
Scalding	z	Assess the percentage of land affected	None z = 1	Up to 5% z = 2	5 - 10% z = 4	10 - 50% z = 5	> 50% z = 7
Water repellence	u	Measure time taken for drop of water to be absorbed into soil	Instantly (non rep.) u = 1	Repellent, str. repellent u = 2,3	-	-	-
Water erosion potential	e	Refer handbook for water erosion classes	Low - mod low e = 1,2	Moderate e = 3	Mod. high e = 4	High e = 5	Very high extreme e = 6,7
Wind erosion potential	a	Refer handbook for wind erosion classes	Low - mod low a = 1,2	Moderate a = 3	Mod. high a = 4	High a = 5	Extreme a = 7
Gully erosion	g	Assess percentage of land affected	< 5% g = 1,2	5-10% g = 3	10-20% g = 4	-	> 20% g = 7, 5x,7
Mass movement	l	Estimate area affected or at risk	None, slope < 30% l = 1	-	None, slope > 30% l = 4	Up to 5% of land affected l = 5	> 5% of la affected l = 7
Exposure	y	Estimate degree of wind exposure	Nil - slight y = 1	Moderate y = 2	High (coast) y = 3	-	-

Appendix B Gross Margin – Field Crops

Crop	Area	Gross Margin		Income		Seed		Fertiliser		Chemicals		Operations		Total Var Costs	
	ha	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total
Wheat	1	491	491	912	912	58	58	102	102	131	131	130	130	421	421
Malt Barley	1	345	345	752	752	76	76	97	97	92	92	142	142	407	407
Feed Barley	1	336	336	736	736	69	69	97	97	92	92	142	142	400	400
Milling Oats	1	380	380	700	700	55	55	91	91	56	56	117	117	320	320
Lupins	1	303	303	595	595	67	67	36	36	95	95	94	94	292	292
Field Peas	1	320	320	646	646	68	68	36	36	111	111	110	110	326	326
Canola Conventional	1	316	316	825	825	51	51	113	113	181	181	164	164	509	509
Lucerne Pasture Cereal	1	223	223	384	384	33	33	36	36	668	668	40	40	777	777
Phalaris Sub Pasture Cereal	1	573	573	690	690	82	82	95	95	740	740	41	41	958	958

Crop	Area	Gross Margin		Income		Seed		Fertiliser		Chemicals		Operations		Total Var Costs	
	ha	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total
Wheat	5	491	2,455	912	4,560	58	288	102	512	131	657	130	648	421	2,105
Malt Barley	5	345	1,723	752	3,760	76	380	97	485	92	461	142	710	407	2,037
Feed Barley	5	336	1,681	736	3,680	69	343	97	485	92	461	142	709	400	1,999
Milling Oats	5	380	1,901	700	3,500	55	277	91	455	56	280	117	587	320	1,599
Lupins	5	303	1,514	595	2,975	67	334	36	180	95	476	94	471	292	1,461
Field Peas	5	320	1,600	646	3,230	68	342	36	180	111	557	110	552	326	1,630
Canola Conventional	5	316	1,580	825	4,125	51	255	113	567	181	903	164	820	509	2,545
Lucerne Pasture Cereal	5	223	1,114	384	1,920	33	166	36	180	668	3,339	40	200	777	3,884
Phalaris Sub Pasture Cereal	5	573	2,867	690	3,450	82	411	95	473	740	3,698	41	207	958	4,788

Crop	Area	Gross Margin		Income		Seed		Fertiliser		Chemicals		Operations		Total Var Costs	
	ha	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total
Wheat	10	491	4,910	912	9,120	58	576	102	1,024	131	1,314	130	1,295	421	4,210
Malt Barley	10	345	3,447	752	7,520	76	761	97	970	92	922	142	1,420	407	4,073
Feed Barley	10	336	3,363	736	7,360	69	686	97	970	92	922	142	1,419	400	3,997
Milling Oats	10	380	3,802	700	7,000	55	554	91	910	56	561	117	1,174	320	3,198
Lupins	10	303	3,028	595	5,950	67	668	36	360	95	951	94	943	292	2,922
Field Peas	10	320	3,200	646	6,460	68	684	36	360	111	1,113	110	1,103	326	3,260
Canola Conventional	10	316	3,161	825	8,250	51	510	113	1,134	181	1,806	164	1,639	509	5,089
Lucerne Pasture Cereal	10	223	2,227	384	3,840	33	332	36	360	668	6,678	40	399	777	7,769
Phalaris Sub Pasture Cereal	10	573	5,733	690	6,900	82	822	95	945	740	7,396	41	414	958	9,577

Crop	Area	Gross Margin		Income		Seed		Fertiliser		Chemicals		Operations		Total Var Costs	
	ha	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total
Wheat	15	491	7,366	912	13,680	58	864	102	1,536	131	1,971	130	1,943	421	6,314
Malt Barley	15	345	5,170	752	11,280	76	1,141	97	1,455	92	1,383	142	2,130	407	6,110
Feed Barley	15	336	5,044	736	11,040	69	1,030	97	1,455	92	1,383	142	2,128	400	5,996
Milling Oats	15	380	5,703	700	10,500	55	830	91	1,365	56	841	117	1,761	320	4,797
Lupins	15	303	4,542	595	8,925	67	1,002	36	540	95	1,427	94	1,414	292	4,383
Field Peas	15	320	4,800	646	9,690	68	1,025	36	540	111	1,670	110	1,655	326	4,890
Canola Conventional	15	316	4,741	825	12,375	51	765	113	1,701	181	2,709	164	2,459	509	7,634
Lucerne Pasture Cereal	15	223	3,341	384	5,760	33	497	36	540	668	10,017	40	599	777	11,653
Phalaris Sub Pasture Cereal	15	573	8,600	690	10,350	82	1,233	95	1,418	740	11,094	41	621	958	14,365

Crop	Area	Gross Margin		Income		Seed		Fertiliser		Chemicals		Operations		Total Var Costs	
	ha	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total
Wheat	20	491	9,821	912	18,240	58	1,152	102	2,048	131	2,628	130	2,591	421	8,419
Malt Barley	20	345	6,894	752	15,040	76	1,521	97	1,940	92	1,844	142	2,841	407	8,146
Feed Barley	20	336	6,725	736	14,720	69	1,373	97	1,940	92	1,844	142	2,838	400	7,995
Milling Oats	20	380	7,604	700	14,000	55	1,107	91	1,820	56	1,121	117	2,348	320	6,396
Lupins	20	303	6,056	595	11,900	67	1,336	36	720	95	1,903	94	1,886	292	5,844
Field Peas	20	320	6,400	646	12,920	68	1,367	36	720	111	2,227	110	2,206	326	6,520
Canola Conventional	20	316	6,321	825	16,500	51	1,020	113	2,268	181	3,612	164	3,279	509	10,179
Lucerne Pasture Cereal	20	223	4,454	384	7,680	33	663	36	720	668	13,357	40	798	777	15,538
Phalaris Sub Pasture Cereal	20	573	11,466	690	13,800	82	1,644	95	1,890	740	14,792	41	828	958	19,154

Crop	Area	Gross Margin		Income		Seed		Fertiliser		Chemicals		Operations		Total Var Costs	
	ha	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total
Wheat	30	491	14,731	912	27,360	58	1,729	102	3,072	131	3,942	130	3,886	421	12,629
Malt Barley	30	345	10,341	752	22,560	76	2,282	97	2,910	92	2,766	142	4,261	407	12,219
Feed Barley	30	336	10,088	736	22,080	69	2,059	97	2,910	92	2,766	142	4,257	400	11,992
Milling Oats	30	380	11,406	700	21,000	55	1,661	91	2,730	56	1,682	117	3,521	320	9,594
Lupins	30	303	9,084	595	17,850	67	2,003	36	1,080	95	2,854	94	2,829	292	8,766
Field Peas	30	320	9,600	646	19,380	68	2,051	36	1,080	111	3,340	110	3,309	326	9,780
Canola Conventional	30	316	9,482	825	24,750	51	1,530	113	3,402	181	5,418	164	4,918	509	15,268
Lucerne Pasture Cereal	30	223	6,681	384	11,520	33	995	36	1,080	668	20,035	40	1,197	777	23,307
Phalaris Sub Pasture Cereal	30	573	17,199	690	20,700	82	2,466	95	2,835	740	22,188	41	1,242	958	28,731

Crop	Area	Gross Margin		Income		Seed		Fertiliser		Chemicals		Operations		Total Var Costs	
	ha	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total	$/ha	Total
Wheat	40	491	19,641	912	36,480	58	2,305	102	4,096	131	5,256	130	5,182	421	16,839
Malt Barley	40	345	13,788	752	30,080	76	3,042	97	3,880	92	3,688	142	5,681	407	16,292
Feed Barley	40	336	13,451	736	29,440	69	2,745	97	3,880	92	3,688	142	5,676	400	15,989
Milling Oats	40	380	15,208	700	28,000	55	2,214	91	3,640	56	2,242	117	4,695	320	12,792
Lupins	40	303	12,112	595	23,800	67	2,671	36	1,440	95	3,805	94	3,772	292	11,688
Field Peas	40	320	12,800	646	25,840	68	2,734	36	1,440	111	4,453	110	4,412	326	13,040
Canola Conventional	40	316	12,643	825	33,000	51	2,040	113	4,536	181	7,223	164	6,558	509	20,357
Lucerne Pasture Cereal	40	223	8,908	384	15,360	33	1,326	36	1,440	668	26,713	40	1,596	777	31,076
Phalaris Sub Pasture Cereal	40	573	22,932	690	27,600	82	3,288	95	3,780	740	29,583	41	1,656	958	38,307

Appendix C Gross Margin - Vines

Wine benchmark calculator – MICRO WINERY – < 100 t capacity

The information you provided has been used to calculate a series of assumptions. In turn, these assumptions have been used to create a benchmark financial result. A summary of your criteria, the associated assumptions and derived financial results are located below.

When you have examined your results click on the **Benchmark Comparison** button to proceed to the next step where you can make changes to your data entries to see the effect on your gross margin. This is the function that allows you to run different scenarios, changing your data inputs to compare with the original scenario.

<< Previous

Your data	
	Benchmark result (AUD)
Region	Barossa Valley
Variety	Shiraz
Export date	09 Jun 2022
Destination	Australia
Retail price point (AUD)	19.99 AUD

Winery size	Micro
Tank holding period (months)	3
Barrel price	$0.00
Bottle holding period (months)	3
Alcohol content (per cent)	10
Calculated assumptions	
	Benchmark result (AUD)
Grape cost (AUD per tonne)	$2,496.51
Extraction rate (litres per tonne)	600
Processing cost (AUD per litre)	$3.30
Holding cost (AUD per litre per month)	$0.075
Packaging cost (AUD per dozen)	$17.00
Direct to consumer commission	0.00 %
Importer Commission	0.00 %
WET	29.00 %
Federal excise (per dozen)	$0.00
Customs duties	$0.00
Other taxes	$0.00
Ocean freight (per dozen)	$0.00
Domestic freight (per dozen)	$3.40
Waste factor	4.00 %
Retail margin	30.00 %
GST	10.00 %
Exchange rate	1.00 AUD/AUD

Your results	

	Benchmark result (AUD)
Retail price point (AUD per bottle)	**$19.99**
Retail price (AUD per dozen)	**$239.88**
Less:	
GST (AUD per dozen)	$21.81
Retailer margin (AUD per dozen)	$50.33
Excise/duty/taxes (AUD per dozen)	$0.00
Wine equalisation tax (AUD per dozen)	$37.71
Wholesale price (AUD per dozen)	**$130.03**
Less:	
Direct to consumer commission (AUD per dozen)	$0.00
Importer commission (AUD per dozen)	$0.00
Ocean freight (AUD per dozen)	$0.00
Australian domestic freight (AUD per dozen)	$3.40
Winery sale price (AUD per dozen)	**$126.63**
Production cost:	
Grape cost (AUD per tonne)	$2,496.51
Extraction Rate (litres per tonne)	600
Cost of juice (AUD per litre)	**$4.16**
Processing cost (AUD per litre)	$3.30
Oak cost (AUD per litre)	$0.00
Holding cost (AUD per litre)	$0.45
Wastage cost (AUD per litre)	$0.32
Wine cost (AUD per litre)	**$8.23**
Wine cost (AUD per dozen)	**$74.05**
Packaging cost (AUD per dozen)	$17.00
Total cost ex winery (AUD per dozen)	**$91.05**
Winery gross margin (AUD per dozen)	**$35.59**

Winery gross margin (per cent)	**28.10 %**
Sustainable gross margin	**50.00 %**
Gross margin is revenue less cost of goods sold and is expressed as a percentage. For example, revenue of $1 million and cost of goods sold of $600,000 would equal 40% gross margin. The calculation is $1 million - $600,000 divided by $1 million.	

Wine benchmark calculator – SMALL WINERY – 100 to 750 t capacity

The information you provided has been used to calculate a series of assumptions. In turn, these assumptions have been used to create a benchmark financial result. A summary of your criteria, the associated assumptions and derived financial results are located below.

When you have examined your results click on the **Benchmark Comparison** button to proceed to the next step where you can make changes to your data entries to see the effect on your gross margin. This is the function that allows you to run different scenarios, changing your data inputs to compare with the original scenario.

<< Previous

Your data	
	Benchmark result (AUD)
Region	Barossa Valley
Variety	Shiraz
Export date	09 Jun 2022
Destination	Australia
Retail price point (AUD)	19.99 AUD
Winery size	Small
Tank holding period (months)	3
Barrel price	$0.00
Bottle holding period (months)	3
Alcohol content (per cent)	10
Calculated assumptions	

	Benchmark result (AUD)
Grape cost (AUD per tonne)	$2,496.51
Extraction rate (litres per tonne)	600
Processing cost (AUD per litre)	$2.30
Holding cost (AUD per litre per month)	$0.075
Packaging cost (AUD per dozen)	$17.00
Direct to consumer commission	0.00 %
Importer Commission	0.00 %
WET	29.00 %
Federal excise (per dozen)	$0.00
Customs duties	$0.00
Other taxes	$0.00
Ocean freight (per dozen)	$0.00
Domestic freight (per dozen)	$3.40
Waste factor	4.00 %
Retail margin	30.00 %
GST	10.00 %
Exchange rate	1.00 AUD/AUD

Your results	
	Benchmark result (AUD)
Retail price point (AUD per bottle)	**$19.99**
Retail price (AUD per dozen)	**$239.88**
Less:	
GST (AUD per dozen)	$21.81
Retailer margin (AUD per dozen)	$50.32
Excise/duty/taxes (AUD per dozen)	$0.00

Wine equalisation tax (AUD per dozen)	$37.71
Wholesale price (AUD per dozen)	**$130.04**
Less:	
Direct to consumer commission (AUD per dozen)	$0.00
Importer commission (AUD per dozen)	$0.00
Ocean freight (AUD per dozen)	$0.00
Australian domestic freight (AUD per dozen)	$3.40
Winery sale price (AUD per dozen)	**$126.64**
Production cost:	
Grape cost (AUD per tonne)	$2,496.51
Extraction Rate (litres per tonne)	600
Cost of juice (AUD per litre)	**$4.16**
Processing cost (AUD per litre)	$2.30
Oak cost (AUD per litre)	$0.00
Holding cost (AUD per litre)	$0.45
Wastage cost (AUD per litre)	$0.28
Wine cost (AUD per litre)	**$7.19**
Wine cost (AUD per dozen)	**$64.69**
Packaging cost (AUD per dozen)	$17.00
Total cost ex winery (AUD per dozen)	**$81.69**
Winery gross margin (AUD per dozen)	**$44.96**
Winery gross margin (per cent)	**35.50 %**
Sustainable gross margin	**50.00 %**

Gross margin is revenue less cost of goods sold and is expressed as a percentage.

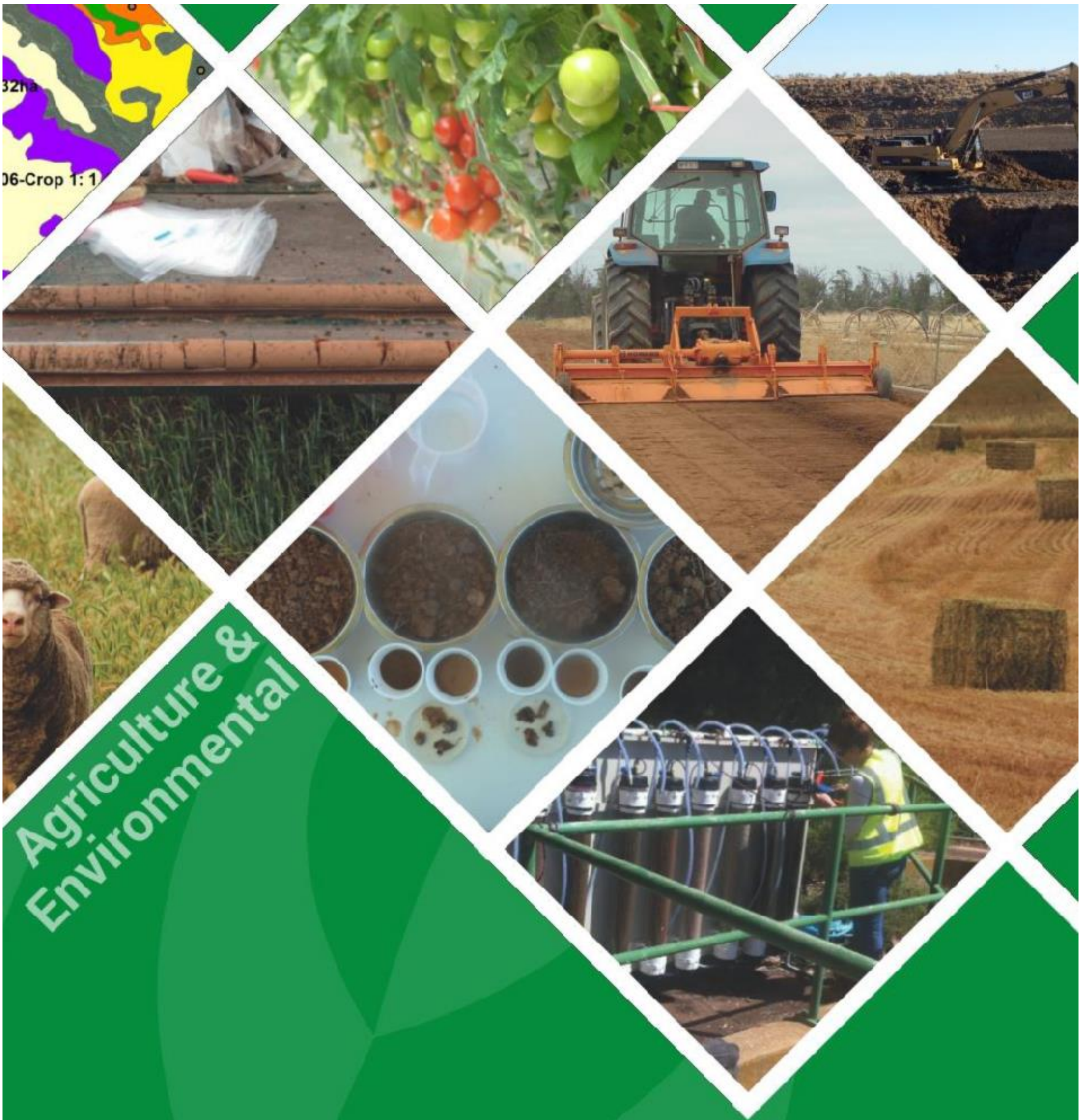
For example, revenue of $1 million and cost of goods sold of $600,000 would equal 40% gross margin.
The calculation is $1 million - $600,000 divided by $1 million

Appendix D Gross Margins - Citrus

	Crop Washington Navels					
	1 ha	*5 ha*	*10 ha*	*20 ha*	*30 ha*	*40 ha*
Water Use						
Water Use ML/ha	10	50	100	200	300	400
Income						
yield t/ha	$ 40	$ 200	$ 400	$ 800	$ 1,200	$ 1,600
fruit prices $/t	$ 450	$ 2,250	$ 4,500	$ 9,000	$ 13,500	$ 18,000
Total Income	$ 18,000	$ 90,000	$ 180,000	$ 360,000	$ 540,000	$ 720,000
Costs						
Irrigation	$ 1,502	$ 7,510	$ 15,020	$ 30,040	$ 45,060	$ 60,080
herbicide	$ 130	$ 650	$ 1,300	$ 2,600	$ 3,900	$ 5,200
fertiliser	$ 842	$ 4,210	$ 8,420	$ 16,840	$ 25,260	$ 33,680
fungicides	$ 86	$ 430	$ 860	$ 1,720	$ 2,580	$ 3,440
insecticides	$ 604	$ 3,020	$ 6,040	$ 12,080	$ 18,120	$ 24,160
crop management spray	$ 239	$ 1,195	$ 2,390	$ 4,780	$ 7,170	$ 9,560
pruning	$ 901	$ 4,505	$ 9,010	$ 18,020	$ 27,030	$ 36,040
crop management	$ 369	$ 1,845	$ 3,690	$ 7,380	$ 11,070	$ 14,760
tractor	$ 866	$ 4,330	$ 8,660	$ 17,320	$ 25,980	$ 34,640
harvest and cartage	$ 4,120	$ 20,600	$ 41,200	$ 82,400	$ 123,600	$ 164,800
levies	$ 140	$ 700	$ 1,400	$ 2,800	$ 4,200	$ 5,600
overhead and fixed costs	$ 1,260	$ 6,300	$ 12,600	$ 25,200	$ 37,800	$ 50,400
Total costs	$ 11,059	$ 55,295	$ 110,590	$ 221,180	$ 331,770	$ 442,360
I - C	$ 6,941	$ 34,705	$ 69,410	$ 138,820	$ 208,230	$ 277,640
Note: Source NSW DPI Sunraysia data - 2018 updated						

	Crop Valencia - juice					
	1 ha	*5 ha*	*10 ha*	*20 ha*	*30 ha*	*40 ha*
Water Use						
Water Use ML/ha	10	50	100	200	300	400
Income						
yield t/ha	$ 45	$ 225	$ 450	$ 900	$ 1,350	$ 1,800
fruit prices $/t	$ 250	$ 1,250	$ 2,500	$ 5,000	$ 7,500	$ 10,000
Total Income	$ 11,250	$ 56,250	$ 112,500	$ 225,000	$ 337,500	$ 450,000
Costs						
Irrigation	$ 1,502	$ 7,510	$ 15,020	$ 30,040	$ 45,060	$ 60,080
herbicide	$ 58	$ 290	$ 580	$ 1,160	$ 1,740	$ 2,320
fertiliser	$ 466	$ 2,330	$ 4,660	$ 9,320	$ 13,980	$ 18,640
fungicides	$ 42	$ 210	$ 420	$ 840	$ 1,260	$ 1,680
insecticides	$ 407	$ 2,035	$ 4,070	$ 8,140	$ 12,210	$ 16,280
crop management spray	$ -	$ -	$ -	$ -	$ -	$ -
pruning	$ 378	$ 1,890	$ 3,780	$ 7,560	$ 11,340	$ 15,120
crop management	$ 39	$ 195	$ 390	$ 780	$ 1,170	$ 1,560
tractor	$ 586	$ 2,930	$ 5,860	$ 11,720	$ 17,580	$ 23,440
harvest and cartage	$ 4,635	$ 23,175	$ 46,350	$ 92,700	$ 139,050	$ 185,400
levies	$ 158	$ 790	$ 1,580	$ 3,160	$ 4,740	$ 6,320
overhead and fixed costs	$ 1,260	$ 6,300	$ 12,600	$ 25,200	$ 37,800	$ 50,400
Total costs	$ 9,530	$ 47,650	$ 95,300	$ 190,600	$ 285,900	$ 381,200
I - C	$ 1,720	$ 8,600	$ 17,200	$ 34,400	$ 51,600	$ 68,800
Note: Source NSW DPI Sunraysia data - 2018 updated						

	Crop **Afourer Mandarin - seedless**					
	1 ha	*5 ha*	*10 ha*	*20 ha*	*30 ha*	*40 ha*
Water Use						
Water Use ML/ha	10	50	100	200	300	400
Income						
yield t/ha	$ 50	$ 250	$ 500	$ 1,000	$ 1,500	$ 2,000
fruit prices $/t	$ 800	$ 4,000	$ 8,000	$ 16,000	$ 24,000	$ 32,000
Total Income	$ 40,000	$ 200,000	$ 400,000	$ 800,000	$ 1,200,000	$ 1,600,000
Costs						
Irrigation	$ 1,502	$ 7,510	$ 15,020	$ 30,040	$ 45,060	$ 60,080
herbicide	$ 65	$ 325	$ 650	$ 1,300	$ 1,950	$ 2,600
fertiliser	$ 1,323	$ 6,615	$ 13,230	$ 26,460	$ 39,690	$ 52,920
fungicides	$ 129	$ 645	$ 1,290	$ 2,580	$ 3,870	$ 5,160
insecticides	$ 844	$ 4,220	$ 8,440	$ 16,880	$ 25,320	$ 33,760
crop management spray	$ 253	$ 1,265	$ 2,530	$ 5,060	$ 7,590	$ 10,120
pruning	$ 2,472	$ 12,360	$ 24,720	$ 49,440	$ 74,160	$ 98,880
crop management	$ 4,156	$ 20,780	$ 41,560	$ 83,120	$ 124,680	$ 166,240
tractor	$ 1,147	$ 5,735	$ 11,470	$ 22,940	$ 34,410	$ 45,880
harvest and cartage	$ 12,500	$ 62,500	$ 125,000	$ 250,000	$ 375,000	$ 500,000
levies	$ 175	$ 875	$ 1,750	$ 3,500	$ 5,250	$ 7,000
overhead and fixed costs	$ 1,260	$ 6,300	$ 12,600	$ 25,200	$ 37,800	$ 50,400
Total costs	$ 25,826	$ 129,130	$ 258,260	$ 516,520	$ 774,780	$ 1,033,040
I - C	$ 14,174	$ 70,870	$ 141,740	$ 283,480	$ 425,220	$ 566,960
Note: Source NSW DPI Sunraysia data - 2018 updated						



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Summary of Submissions - Attachment 3

Rural Areas Land Capability Assessment - Public Consultation - 8 June - 1 July 2022					
Ref No.	TRIM Ref.	Author	Method of Submission	Wish to speak - Y/N	Key Issues Raised
1	CR22/43103	Department for Environment and Water	E-mail	Y	DEW own land in the area and supports a Greenbelt with native trees. Recently have undertaken consultation regarding type of small scale development. Walking trails and BBQ's supported. Large scale sporting hubs not supported Wishes to be consulted directly on any proposed planning processes or changes relating to zoning changes
2	CR22/43338 CR22/43337	Adrian Shackley	E-mail	Y	Support for open space and retention of vistas. Not support State Government "take charge" of discussions in the rural zone Looks forward to further council and community discussion on the issues.
3	CR22/43058	URPS for Andrea Gonis	E-mail	Y	Areas zoned as rural are no longer viable for primary production. A clear shared community vision for the Town of Gawler's Rural Zone remains lacking Requests to speak
4	CR22/43102	Tony Piccolo	E-mail	Y	Council has not been listening. Stated SGRAC want to work with the local Member and Minister for Planning to achieve a Code Amendment. Jensen Report No. 2 is "as a good starting point" Wishes to be notified of meeting
5	CR22/43336	GEHA - Gawler Environment & Heritage Association	E-mail	Y	Supports area to be used for horticulture. However, the area needs quality water. Seeks the area to be recognised as Environment and Food PA status Is interested in being informed of future meetings.
6	CR22/43324 CR22/43047	Barry Flaherty and Beverley Gidman	E-mail		Area zoned as rural are no longer viable for horticulture. Water not suitable
7	CR22/43114 CR22/43100 CR22/42339	Graham Brookman	E-mail		Support policy such as Green Belt Act in Ontario Canada. Notes that the area has been part of SA's rural history.
8	PR22/2571	Arthur & Robyn Christou	E-mail		Growing Roses in Kudla. However no longer viable
9	CR22/43059	Domenic Cavallaro	E-mail	Y	Area no longer viable for horticulture. Seek Council to engage with residents Wishes to be heard at council to express his views further
10	CR22/42985	Nick Pezzaniti	E-mail Your Voice (website)		Comment on around economic viability of primary production on small acreages in the area. Some of the tables and information provided are quite erroneous and out of date. Properties are too small for economies of scale.
11	CR22/42983	Marie and Tony Fahey	E-mail		Owner of Northern Trade Centre. Has previoulsy sought the rural area is rezoned to industrial
12	CR22/42980	Brenton Williams	E-mail		Area zoned as rural are no longer viable for horticulture production
13	CR22/42940	Karen Brunt	E-mail Your Voice (website)		Land size is too small for viable primary production for the majority of activities . There is no further clarity required from my perspective the land use discussions have been in consultation for more than 10 years
14	PR22/2559	Dr Stephen and Thea Whittle	E-mail Your Voice (website)		Not viable for Primary Production and different land usage should be investigated in consultation with land owners
15	PR22/2558	Anne Wilkinson & Noel Gerlach	E-mail	Y	Lack of affordable water and small allotment sizes main reason for lack of viability - seeking greater level of consultation Looks forward to council annoucning a community meeting to hear views prior to decisions being made.
16	PR22/2549	Rae and Steven McMillan	E-mail		Yes the land is suitable for that use but not at all viable for horticulture. Seek a greater level of consultation.
17	CR2242483	Innocent Munyantwali	E-mail		Request a removal of the rural zone area for Kudla and allow Kudla to be a residential zone
18	CR22/42227	Alisonia Ille	E-mail Your Voice (website)		Report is clear that the areas zoned as rural are no longer viable for primary production. Need egagement from the council rather than to waste rate payers money procuring large reports.
19	CR22/42223	Mia Dinca	E-mail Your Voice (website)		Clear that the areas zoned as rural are no longer viable for primary production. People living in these areas are no longer interested in primary production.
20	CR22/41640 CR22/41639	Tony Forgione	E-mail Your Voice (website)		Primary production in Kudla is not viable - due to lack of affordable water and small allotment sizes. I urge the council to engage actively with the land owners
21	CR22/40076 CR22/36968 CR22/36967	Frank Grillo	E-mail		Ridiculous notion that gawler wants a buffer from the metro zone
22	CR22/45101	Francisco Grillo	Your Voice (website)		I do not believe that primary production is viable in this area. The previous Jensen Report is a far better report to commence negotiations from
23	CR22/45101	Cornell Smith	Your Voice (website)		Great merit to having a green belt separating Gawler & City of Playford. Request that council commits to retaining the rural zone
24	CR22/45101	Andrea Burke	Your Voice (website) multiple		Over 90% of the people in Kudla are wanting further subdivision. Land parcels that are in Kudla are just a drop in the ocean compared to nearby Virginia. Please start listening to the people of the actual community.
25	CR22/45101	Bill Lediaev	Your Voice (website)		The area is not primary production. The capital investment for the size of land areas is not commercially viable. Due to scale and lack of water. Too much money has been spent on reports and consultations.
26	CR22/45101	Jane Bagshaw	Your Voice (website)		Very difficult process for council and the people who live in the area and for others that live close by. Noted that there are many different views . Likes open space in this Rural Zone supports ope space and greenbelt.
27	CR22/45101	Vicki Payne	Your Voice (website)		If people in this area wanted to grow produce then they would be be growing it already.Council needs to listen to constituents.
28	CR22/45101	Carlie Troup	Your Voice (website)		Conclusion to be unviable in my situation. Flood risk is another significant reason to avoid small scale farming on the rest of the property.
29	CR22/45101	Nick Geracitano	Your Voice (website) Multiple	Y	Comment on the two questions asked: 1. What is the land capable and suitable for growing. 2. What factors impact on the commercial viability. Factors Impacted : - Mains Water not Viable due to the cost of the Water. Wishes to be notified when all submissions are presented to council.
30	CR22/45101	Bruno Capogreco	Your Voice (website)		Irrigation water has never been and is still not currently available. Even with water not be commercially viable due to land sizes being too small. Area suit those seeking a larger house lot / semi-rural lifestyle.
31	CR22/45101	Stephen Dichiera	Your Voice (website)		The Land in the Kudla area is not suitable for Primary Production to small and too expensive. Reclaim Water is very marginal water
32	CR22/45101	Roque Grillo	Your Voice (website)		Opposition of many land owners to the views expressed in the Report. Primary production is in any way a feasible for the area
33	CR22/45101	Peter Power	Your Voice (website)		Advise you I do not recommend our land be changed to Primary Production. Due to the land size packages this is not viable due to the cost. I am hoping the council will discuss this with the people who are paying Rates.
34	CR22/45101	Vince Maiolo	Your Voice (website)		Gawler Council to push their agenda for the South Rural area by not consulting with property owners (rate payers) is appalling.
35	CR22/45101	Susan Lewis	Your Voice (website)	Y	The report is based on primary production stats in this area. A report that factors on inaccurate infrastructure can not be a means for determining an effective outcome. Wishes to be notified of the outcome with regards to this matter.
36	CR22/45101	Thea Whittle	Your Voice (website)		I do not believe my property at [redacted] is viable for Primary Production
37	CR22/45101	Joseph East	Your Voice (website) Multiple	Y	I have no interest in utilising my land for commercial cropping. Wishes to be informed of any future public sessions regarding the tabling of submissions regarding the Arris report.
38	CR22/45101	Peter Sarunic	Your Voice (website)		The land in question is not suitable for viable primary production. The blocks of land in the area are too small to be viable. There is not an adequate supply of water

39	CR22/45101	Andrea Brunt	Your Voice (website)		The land in the rural zone is not capable nor suitable for viable primary production. Block sizes are too small to be competitive with producing areas such as Virginia.	
40	CR22/45101	Michael Dimuccio	Your Voice (website)		The rural zone is not viable for primary production. As a third generation market gardener I can confidently advise council these land holdings are not viable are not the primary production no water and no hope.	
41	CR22/45101	Helen Power	Your Voice (website)	Y	Gawler Rural Zone is neither conducive or suitable for supporting commercial primary production - lack of water. We would like to see Gawler Council genuinely consult. Like opportunity to speak	
42	CR22/45101	Kat Pjevac	Your Voice (Website)		Report states that 90% of properties are under 5Ha is unusable to grow produce/crops. Alternative land zoning uses should be explored	
43	CR22/45101	Marie Ishimwe	Your Voice (Website)		I think the land of Gawler rural area is not suitable for primary production as we do not have available water to use	
44	CR22/45101	Theogene Kayigamba	Your Voice (Website)		Gawler Rural area is not suitable for primary production due to the following reasons: Water limitation, Poor soils, quality Land size	
45	CR22/45101	Ben Maiolo	Your Voice (Website)		To keep this entire area zoned as primary production is holding back the Town of Gawler. Gawler could have the best of town and country. Seek development of smaller rural living allotments	
46	CR22/45101	Adam Turrell	Your Voice (Website)		I do NOT agree that the areas of Hillier and Kudla are viable for primary production. Primary production this issue needs to be finally put to bed	Submission sent through twice
47	CR22/45101	Martin Banham	Your Voice (Website)		It is disappointing that Council has elected to commission yet another consultants report. Don't have sufficient good quality water supply at a reasonable price to be economic.	
48	CR22/45101	Kathleen Slape	Your Voice (Website)		Land is not viable for primary production in the rural zones. Would like to engage with council to explore other options which may be available.	

#1

From: Rich, Dearnne (DEW) [redacted]
Sent: Friday, 01 July 2022 04:39 PM
To: Jack Darzanos
Subject: DEW submission on the draft Gawler Rural Areas Land Capability Assessment
Attachments: Submission on Draft Gawler Rural Areas Land Capability Assessment_01072022.docx

OFFICIAL

Hi Jack

Thanks for the discussion today regarding the section of land along Smith Road, that is owned by the Minister for Climate, Environment and Water and is set aside as open space.

Please see attached a submission on the Draft Gawler Rural Areas Land Capability Assessment | Town of Gawler Council

I wasn't able to get in touch with Planning SA as planned, but I didn't have a look around at some mapping of MOSS.

There are defiantly still SA Gov active databases showing the land referred to in my submission as MOSS.

The Greater Plan for Adelaide does identify the Gawler Buffer Green Belt as MOSS and so does the Town of Gawler's own draft Open Space Strategy.

I will continue to seek clarity on the recent changes to SAPPA mapping, but please see below also.

Metropolitan Open Space System Study Area (MOSS) - Dataset - data.sa.gov.au – status is active dataset

Also see p.29 of the draft Town of Gawler Open Space Guideline
draft-open-space-guideline-combined-document-revision-j-consultant-document-reference-18.006_190521_osguideline.pdf.pdf (gawler.sa.gov.au)

I'll be in touch again soon.

Kind Regards

Dearnne Rich
Senior Project Manager – Public Land Stewardship

Adelaide & Mount Lofty Ranges | National Parks and Wildlife Service South Australia
Department for Environment and Water
| M [redacted]
Black Hill Conservation Park, 115 Maryvale Rd, Athelstone 5076 SA
environment.sa.gov.au | **parks.sa.gov.au**

Government of South Australia
Department for Environment and Water

Helping South Australians conserve, sustain and prosper

Submission on Draft Gawler Rural Areas Land Capability Assessment

Background

National Parks and Wildlife (AMLR) and Crown Lands (Central) of Department for Environment and Water (DEW) is managing the Crown Land owned by the Minister for Climate, Environment and Water at Evanston South and includes the following land parcels, H105400 S3187, D24726 A1, D24726 A2, D6328 A85.

The land was identified as strategically important for creating a green buffer between Gawler and Munno Para and to create a green corridor link to Playford Hills. It is categorised as Metropolitan Open Space by Planning SA. Gawler Buffer covers 250 hectares and is one of the largest remaining urban park developments in Adelaide metropolitan area that has been restored from degraded farming land to a revegetated green buffer to encroaching urban development - creating a strategic link with nearby remnant vegetation and nearby revegetation sites.

Important patches of remnant vegetation have been identified in the area including species such as Eucalyptus Porosa, Acaena echinata (Sheep's burr), Boerhavia dominie, Calocephalus citreus (Lemon beauty heads), Calostemma purpureum (Garland Lilly), Cyperus gymnocaulos (Spiny flat sedge), Cyperus vaginatus (Flat sedge), Dianella revolute (Spreading Fax Lily, Black anther Flax-lily), Enneapogon nigricans (Black heads), Lomandra densiflora (Pointed matt rush), Lomandra effuse (Scented matt rush), Poa labillardieri (Tussock grass), Ptilotus spathulatus forma spathulatus (Pussy tails), Sida currugata, Themeda triandra (Kangaroo Grass).

Prior to 2007 the area was used for intensive grazing and cropping. The area was once heavily wooded but significant clearing by 1849 left the landscape without trees. From this time, until 2007 it was used for intensive grazing and cropping which almost totally removed the shrub strata. When restoration efforts began the site was highly degraded.

Since March, 2007, revegetation has been carryout at the Gawler Buffer Zone on land adjacent Dalkeith, Main North Road and Smith Road near the Smithfield Memorial Park. The revegetation has been planned as a grassy open woodland - with herbaceous species and grasses more recently introduced into the landscape to improve the grassy aspect of the woodland. Regionally threatened species have recently been planted at the site to provide additional ecosystem functionality. The revegetation efforts have greatly enhanced the native flora in the area with excellent environmental outcomes being observed, including the return of native flora and fauna species to the area including rare and vulnerable species.

The Gawler Buffer makes a significant contribution to Adelaide's green open space, encouraging the return of a variety of birds and other wildlife to the area. The revegetation is now at a stage where the area can be made more accessible to local residents to enjoy and provide opportunities for passive recreation and relaxation while ensuring continued environmental protection, restoration and interpretation. The area also provides an important dark habitat in an urban setting which suits bats and other fauna in an otherwise well-lit urban setting with developments approaching.

Future Plans

DEW is considering some small-scale development of the site, namely the installation of trails and interpretive signage about the natural landscape, flora and fauna local to the area. Trails could potentially be shared with both walkers and cyclists to make the area more accessible for a range of recreation activities.

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In October 2021, the Department partnered with the University of South Australia to undertake an early consultation aimed to engage with residents who live nearby the Gawler Buffer Open Space Zone ("Gawler Buffer Zone") in order to understand their views on potential small scale development in the area. The consultation gathered ideas and input from the local community about what they would like to see at Gawler Buffer Zone in the future.

Forty-seven people responded to a survey to contribute their ideas and express their values to the project team.

The engagement process attracted feedback from several members of the Gawler Buffer Zone community and indicated that the community was largely interested in creating walking trails, cycling trails (including mountain biking trails), and a nature or adventure play space for families. Practical considerations like the provision of toilet and rubbish facilities, benches and seating, and picnic and BBQ areas were also important.

Other important themes that the community identified were revegetation and preservation of native species, allowing space for people to connect with nature, nature education and interpretation, maintaining open space, access to outdoor exercise, and consultation with traditional owners.

Figure 6-1 of the Town of Gawler's Land Capability Assessment - Gawler Rural Zone includes DEW managed land (H105400 S3187, D24726 A1, D24726 A2, D6328 A85) in it's study area and is included in the 'SMI' Land System Category. Section 6.2.1. of the Assessment describes the SMI Category to be 'Smithfiled SMI – land system that contains soils derived from alluvial clays from the ranges to the east and incorporates Aeolian (wind Blown) carbonate – outwash fans with very gentle slopes from 2%-10% with well-defined watercourses. The information presented in the assessment is primarily focused on soil suitability for varying primary production purposes. Although the assessment finds the soils of the Gawler Rural Zone to, in general, not be limiting for primary production, it does not appear to take into account land tenure, current land use, environmental impacts or discuss the broader environment planning policies that applies to the area. The land parcels mentioned above are currently set aside as metropolitan open space to contribute to **The 30 Year Plan for Greater Adelaide** Plan Policies 48-50, and in particular Target 5 – Biodiversity:

"Valuing our natural environment and enhancing biodiversity Adelaide is rare in world terms because it is a capital city in the middle of a biologically diverse area. However, our patterns of consumption and development have fragmented and disrupted natural systems, resulting in a significant loss of biodiversity. Protecting and re-establishing this biodiversity is important to restoring and maintaining our functioning ecosystems – particularly in key areas such as the Mount Lofty Ranges – and making our environment more resilient against the anticipated impacts of climate change. Protecting and improving biodiversity within our urban environments is also important. Maintaining a healthy, biologically diverse environment will help make Greater Adelaide a better and more productive place to live. It will provide us with premium food and wine for exporting, clean air and water, building materials, recreational opportunities and increased tourism opportunities" Policy 90 (P90) recommends, 'Delineate and maintain areas with significant environmental values to protect landscape health; conserve biodiversity; and improve development certainty and transparency (represented in Map 10). On map 10 – the Gawler Buffer Green Belt is represented as Metropolitan Open Space.

P. 105 of the 30 Year Plan for Greater Adelaide recognises that, "the role and value of public open spaces is becoming increasingly important as living patterns within Greater Adelaide continue to change. An increasing number of people are choosing apartments rather than houses, with many new houses having small backyards. Greater emphasis must be placed on quality public open spaces within our communities that can support a diverse range of activities. Quality green spaces will provide a focus for social interaction between neighbours and help support safe, healthy and connected

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communities. Parks and other areas of public open space will provide physical activity levels, which improves the overall mental and physical health of the community and its liveability. Access to nature and green spaces also helps promote positive health and wellbeing".

Section 8 of the Gawler Rural Capability Assessment identifies options for maintaining Gawler Rural Zone green belt, with the number 1 option being Small Allotment Horticulture Potential and refers to soil based poly-houses as a viable option for the area due to low capital investment and reduced labour costs, carbon offset tree planting as the second option and development of Open Sport and Recreation uses which could include:

1. large sporting hubs, BMX, road and track cycling, dog training and equestrian centres
2. an increase in nature based recreational areas, trail linkages with existing trails and enhancement of the Gawler River and Smith Creek catchments (including walking, cycling and horse riding)
3. protecting and enhancing the nature environment
4. improve the quality and viability of indoor facilities such as the swimming pool

National Parks and Wildlife and Crown Lands position

For the reasons outlined above regarding the original intended purpose of the setting aside of Gawler Buffer as open space and a Green Belt, National Parks and Wildlife AMLR and Crown Lands would not be supportive of the development of any of its managed Gawler Buffer land parcels within the SMI study area being considered for primary production uses including the polyhouses stated in Option 1.

In regards to Option 2 - Carbon Offset Tree Planting – although the Department is generally supportive of this type of land use and the environmental benefits it provides, however it is not considered necessary for parcels H105400 S3187, D24726 A1, D24726 A2, D6328 A85.

In regards to Option 3, the Department would be supportive of 'an increase in nature based recreational areas, trail linkages with existing trails and enhancement of the Gawler River and Smith Creek catchments (including walking, cycling and horse riding)' and 'protecting and enhancing the nature environment', but not supportive of large sporting hubs, motor cross or BMX pump tracks, dog training facilities or equestrian centres or swimming pools/centres being developed on parcels H105400 S3187, D24726 A1, D24726 A2, D6328 A85) due to the environmental impacts this would cause to the restored and regenerated green belt area and impacts to previous investments in biodiversity and revegetation by both Federal and State Governments.

Finally, the Department wishes to be consulted directly on any proposed planning processes or changes relating to zoning changes, land divisions or proposed land transfers or proposed agreements arising from the recommendations from this Land Capability Assessment on the contact details provided with this submission.

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#2

Adrian Shackley
[redacted]
30 June 2022

Submission on Rural Zone Land Capability Assessment Report

I have a background of growing up on a family farm and working on farms for majority of my life. That experience has included irrigation and horticultural activities on the Adelaide Plains. My qualifications include a Bachelor of Rural Science and tertiary study in economics and accounting.

The Assessment Report provides useful input and is a good summary of the technical issues to do with soils and land use in the Rural Zone. Clearly it doesn't deal with all the issues involved.

Landscape, rural land used and vistas

One of the major issues is retaining the open space character of the rural area. This issue was highlighted in the 1970s with creation of the MOSS scheme and creation of the Hills Face Zone. MOSS included a connection from the Hills Face Zone to the Gawler River through land now comprising Gawler's Rural Zone. These schemes did not create parks or public ownership of most of the land, but rather provided for retention of open space and vistas.

The feeling of open space and vistas of the Adelaide Hills and the River Red Gums along the Gawler River are key features. Gawler Council adopted a very good" Rural Open Space" policy some years ago. The Council's 2019 Biodiversity Management Plan sets out well the open character of the landscape now comprising the Rural Zone – essentially open native grassland with scattered areas of woodland on the hill slopes and a riverine corridor of Red Gums and River Box dominating along the Gawler River.

What we don't need is planting like the State Government undertook along Main North Road about 30 years ago which removed the historic vistas. Compare this with the visual impact now experienced by people using the new elevated section of South Road which has restored vistas to the Adelaide Hills, long lost with urban development. We also don't need massive industrial scale horticultural facilities such as at Lewiston. Low scale impacts of farming and horticulture are the best uses to maintain viable activities and landscape values. European countries have implemented successful policies that provide these outcomes. We need to use similar planning policies and incentives to achieve outcomes which benefit both the Rural Zone community and the broader town and state community.

Rural Zone public meeting

Earlier this week I attended a public meeting organised by Light MP Tony Piccolo. About 80 people attended. Unfortunately, I would summarise the meeting as not providing significant assessment of the issues involved but rather a continuation of some historic themes. In particular, the discussion about whether primary production is viable in the Rural Zone was very confusing. A majority of the people present voting that primary production is not viable in the area without even having any clear wording of the proposal was not good process.

Clearly for many landholders in the Rural Zone it is not a particularly relevant question as they have bought properties with the intention of using the land for rural lifestyle outcomes. That is not the issue – primary production is clearly being carried out on the majority of land in the Zone. Primary production does not require individual land units to be viable. Like most areas with smaller lots, activities will occur over multiple lots. An example discussed of one landholder growing field crops and producing hay over many smaller lots was not given the significance it demonstrates. Similarly an example of a landholder having off property income but developing an small scale organic production activity. These are typical activities that need to be encouraged and facilitated if the lifestyle of the area is to continue longer term. Given that it is not necessary for landholders to undertake primary production activities, and quite a few landholders undertake other commercial activities, it is also essential to realise that having larger lots is also important for some of these activities, which might otherwise be in conflict with adjoining activities.

A second suggestion by MP Piccolo for the State Government to be asked to take charge of discussions on the future of the Rural Zone was also not good process. There was no discussion of this suggestion until right near the end of the meeting. Given the history of suggestions about subdivision for the area which have been promoted over the years, it was not surprising that people present who have looked to this as a way of increasing the value of their properties, would support such a suggestion. The history of the introduction of the 0.9ha area in Kudla some years ago had a similar appearance during the late stages of a process – being put into a DPA after public discussion on other issues with the DPA had been undertaken. The issues involved need to be clear for the whole community.

I look forward to further Council and community discussion of the issues.

Yours faithfully

Adrian Shackley

#3

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Ref: 22ADL-0425

30 June 2022

Henry Inat
Chief Executive Officer
Town of Gawler
43 High Street
Gawler East SA 5118

Email to: jack.darzanos@gawler.sa.gov.au

Dear Mr Inat,

Submission - Rural Areas Land Capability Assessment

URPS is acting on behalf of Andrea Gonis, the registered owner of [redacted].

Thank you for the opportunity to provide feedback on the draft Rural Areas Land Capability Assessment recently commissioned by the Town of Gawler.

Overview

We contend that the land is not suitable for viable primary production and should ultimately be utilised to support a future environmentally sustainable and affordable residential / rural living community.

In respect to the Rural Zone and Rural Areas Land Capability Assessment we contend:

- For the reasons, outlined in this submission, the majority of the land is not suitable for viable primary production.
- The provision of "affordable" irrigated water is unlikely to be provided and taken up.
- In the improbable event that affordable water was provided, the majority of existing landowners have no desire to farm their small land holdings.
- The land value of the small lots discourages primary produces to purchasing the land. Rural living / lifestyle purchases are attracted to the area that results in land been unaffordable for primary producers.
- In the unlikely event that affordable water was provided, land could be purchased by primary producers at rural living rates and non-conventional crops were grown

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(as suggested by the commissioned report), such activity could lead to the development of intensive greenhouses and associated logistics. It is unclear if this visual impact is desired by Council and the community.

Unfortunately, the Council's consultation process is focused on questions such as:

- *What is the land capable and suitable for growing across the Rural Zone?*
- *What factors impact on the commercial viability of primary production in the Rural Zone?*

These questions are framed in a manner that suggests Council is not considering alternative land use zones for the area. The project appears to fail to acknowledge the significant fundamental problems of continuing to promote viable primary production within the area.

We believe there are alternative solutions available to Council and its community to achieve better quality infrastructure and a greening of the locality.

Subject Land – [redacted] and Locality

The allotment is illustrated in Figure 1.

The allotment is approximately 30 hectares in size and is located in the Planning and Design Code's Rural Zone. Given the limited land use activities available to the landowner, the owner is leasing the land for cropping. This is not a long-term viable position.

The land abuts the Orleana Waters development, located to the north of Gordon Road. This development is well progressed and as shown in Figure 2 will ultimately result in allotments extending to Gordon Road. The development has experienced strong demand in recent times, with stage eight currently selling.

Renewal SA owns the land abutting Orleana Waters to the east. This land is largely zoned 'Master Planned Neighbourhood' and will eventually be developed for residential purposes. The Main North Road frontage of the Renewal SA land is zoned Open Space. There is a small portion of land zoned Employment on the corner of Gordon Road and Main North Road.

Our client is an experienced wheat farming family and have firsthand knowledge of the challenges associated and costs required to establish land for cropping. Our client informs us that wheat farming is only profitable on very large broadacres, not on the size of the subject land. Farmers are dealing with challenges associated with high machinery, fuel and fertilizers costs making small scale farming unviable. In the last year alone the cost of fertilizers have increased from $330 to $1200 a tonne.

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Figure 1: Aerial Image of [redacted]

Figure 2: Existing Zoning and Lodged Land Division Map

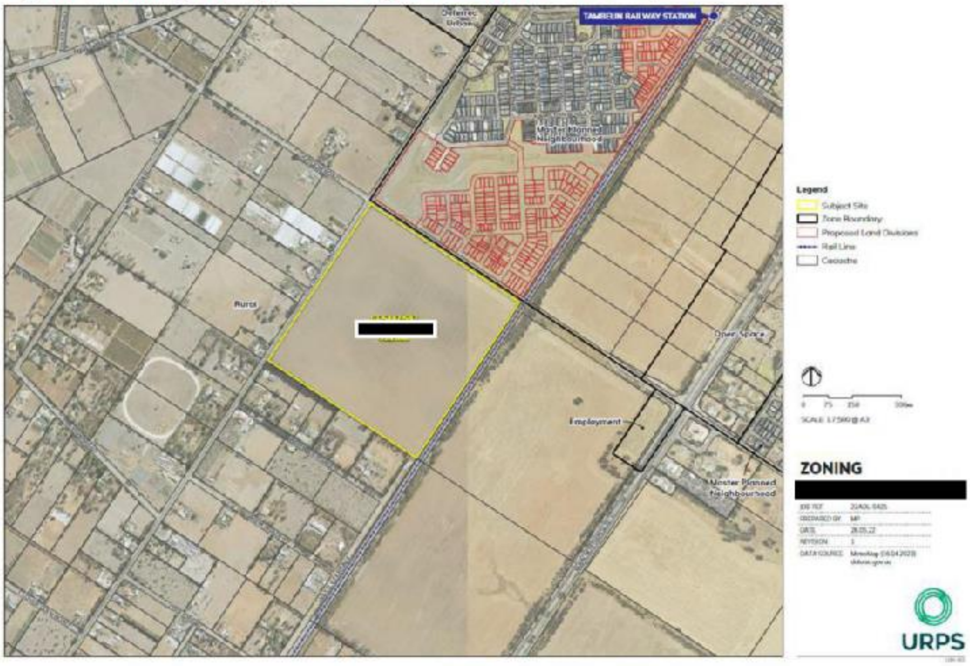

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Figure 3 highlights the majority of land in the locality is utilised for Rural Living (Rural Residential) purposes. The existing well-established rural living activities significantly detract from the opportunity of the area being convert back to primary production. Issues that hinder the use of the locality for primary production include:

- Fragmented primary production land into generally small unviable lots.
- Rural living lots command higher land values that often results in the land being unaffordable to be purchased for horticultural ventures.
- Interface conflict issues between existing residential land uses and intense surrounding primary production operations (e.g. chemical spraying, early and late harvesting).
- Lack of access to a quality and affordable water supply (as acknowledged in the Council commissioned land capability assessment).

These matters have been previously raised by the local community and are impacting on the area's viability for primary production.

Figure 3: Generalised Land Use Map

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Reason for the Rural Areas Land Capability Assessment

We understand that the Rural Areas Land Capability Assessment was prepared because of advice received from the (former) Minister for Planning, in light of Council's desire to undertake a Development Plan Amendment via the now superseded *Development Act 1993*.

The desire to undertake a Development Plan Amendment was an acknowledgement from Council that existing Development Plan policy does not necessarily align with existing land uses and some community feedback. Council acknowledged that a review of planning policy was necessary.

The Statement of Intent prepared by Council and lodged with the then Minister established Council's vision for the area.

We understand that Council is currently working through an extensive list of investigations recommended by the former Minister in preparation for undertaking an amendment to the Planning and Design Code. The capability assessment was considered the most pressing and was therefore undertaking first.

Previous Concept of Rural Buffer / Greenbelt

A clear shared community vision for the Town of Gawler's Rural Zone remains lacking. However, we note that some Town of Gawler Elected Members desire a buffer / green belt between the urban areas of the City of Playford and the Town of Gawler.

The notion of a green belt seems to date back to the Playford / Dunstan Governments era when a plan was developed to have a one-mile-wide buffer around numerous townships to the north of Adelaide. This concept was loosely incorporated into the Metropolitan Open Space System (MOSS)[1]. The rezoning of land from Rural to MOSS was never undertaken.

In terms of state strategic policy, there is a lack of specific detail for the area, however Gawler's Rural Zone is located outside of the Environment and Food Production Areas

[1] Gawler (CT) Development Plan consolidated on 18 July 2019, incorporates MOSS Map Ga/1 (Overlay 2) and the following note "*This Map is indicative only. The State Government and Councils will undertake studies of each area resulting in detailed zoning maps to designate the boundary of MOSS and the policies relating o various areas. (The inclusion of private land in MOSS does not indicate an intention to purchase that land)*". Reference to Development Plan Zone Map Ga/10 illustrates the Kudla area within a Rural Zone.

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(EFPAs)[2]. This highlights the area is not considered to be a state significance food production area.

Alignment with State Planning Policies

State Planning Policies represent the highest level of policy in the planning system, and address the economic, environmental and social planning priorities for South Australia. The integrated development of our client's land for residential purposes is considered to align with numerous strategic planning outcomes as follows:

State Planning Policy (SPP)	Code Amendment Alignment with SPPs
State Planning Policy 1 – Integrated Planning To apply the principles of integrated planning to shape cities and regions in a way that enhances our liveability, economic prosperity and sustainable future. 1.1 An adequate supply of land (well serviced by infrastructure) is available that can accommodate housing and employment growth over the relevant forecast period. 1.3 Plan growth in areas of the state that is connected to and integrated with, existing and proposed public transport routes, infrastructure, services and employment lands.	The development of this land would provide for the logical expansion of residential lands within the existing urban area. The land is connected to and integrated with existing transport infrastructure, services and other economic activities in the locality.
State Planning Policy 6 – Housing Supply & Diversity Housing is an essential part of people's health and wellbeing. With the changing composition of our community and our	The development of this land would integrate with existing residential and commercial development. Furthermore, it could bolster infrastructure investments. Like the abutting

[2] Under the Planning, Development and Infrastructure Act 2016 (SA), EFPAs have been introduced to: (i) protect food producing and rural areas, including conservation of natural landscapes and environmental resources, (ii) support sustainable growth of residential development in existing urban areas to maximise use of existing infrastructure and public spaces; and (iii) provide greater certainty for both food and wine producers and residential developers on the future of urban development in metropolitan Adelaide.

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State Planning Policy (SPP)	Code Amendment Alignment with SPPs
desire to live more sustainably, our housing supply needs to become more diverse in both metropolitan Adelaide and regional township locations. 6.1 A well-designed, diverse and affordable housing supply that responds to population growth and projections and the evolving demographic, social, cultural and lifestyle needs of our current and future communities. 6.2 The timely supply of land for housing that is integrated with, and connected to, the range of services, facilities, public transport and infrastructure needed to support livable and walkable neighbourhoods. 6.3 Develop healthy neighbourhoods that include diverse housing options; enable access to local shops, community facilities and infrastructure; promote active travel and public transport use; and provide quality open space, recreation and sporting facilities. 6.6 A diverse range of housing types within residential areas that provide choice for different household types, life stages and lifestyle choices. 6.7 Facilitate the provision of Affordable Housing through incentives such as planning policy bonuses or concessions (e.g. where major re-zonings are undertaken that increase development opportunities).	greenfield sites, a varied range of houses would be anticipated to provide choice for a diverse community.

The Rural Areas Lands Capability Assessment

Several points of interest have been made within the Rural Areas Land Capability Assessment, including:

- The analysis identifies that primary production in Council's Rural Zone is financially unviable mostly due to a lack of affordable water or in the instance of field cropping the average allotment size is too small.

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- Any notion of primary production becoming economically viable in this area, is on the basis that an affordable, quality water supply becomes available and there will be landowner desire to farm the land.
- Although the 'Barossa New Water' project has been identified as a potential source for recycled water, investigations remain in the conceptual phase and infrastructure constraints are not fully understood.
- While Council has continued to investigate options relative to recycled water, this has largely been focussed on securing and utilising recycled water to irrigate Council reserves. It is our understanding that there has been no commitment from Council (financial or otherwise) for securing recycled water for third parties relative to agricultural purposes within the Rural Zone.
- In the instance recycled water was to be secured for agriculture purposes, salinity levels are likely to remain high and require local customers to implement onsite desalination technologies. The potential costs associated with this requires further consideration, as the provision of such infrastructure as well as the supply of power to run such systems is likely to be high.

This assessment also sought to offer greater clarity relative to the terms 'Capability' and 'Suitability'. This clarity was to assist in determining if the area is suitable for primary production.

In relation to determining suitability for primary production, the report's adopted approach was based on the proviso that the final land suitability will depend on the risk a landholder is prepared to absorb to farm a specific non-typical horticultural produce (e.g. bush tomatoes as opposed to conventional tomatoes or cucumbers). However, we have little confidence that most of these rural living landowners have the risk profile to accept such financial risks.

There is no discussion in the Rural Areas Land Capability Assessment regarding the feasibility and interface pressures facing rural business ventures within an existing rural living and residential locality.

In respect to [redacted], the land abouts an existing Master Plan Neighbourhood zone and medium density greenfield residential development. In the unlikely event that intensive framing of this site was financially viable, such farming located near the medium density residential area is likely to be associated with farming – residential interface issues.

Operating a farm in proximity to residential development is difficult due to challenges associated with impacts upon amenity through spray drift, noise and hours of operation etc.

The Rural Areas Land Capability Assessment concludes that with the provision of affordable quality recycled water, annual horticulture and the utilisation of low-tech poly houses for non-conventional crops would be the most financially viable primary

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production outcome. However, from a visual impact perspective, this outcome can hinder the concept of a "rural buffer / green belt". Such an approach may have the following unintended impacts:

- Promote large scale imposing greenhouse buildings / structures that erode the open rural landscape amenity.
- These built form facilities can be associated with increased noise and traffic generation.
- Increase traffic generation triggers increased hard paved areas for manoeuvring and parking of large commercial vehicles and increase impacts on Council's road infrastructure.

These impacts potentially contract the notion of a rural buffer and greenbelt. This matter requires further consideration from the Council.

Recycled Water Issues

We have sought to meet with representatives of the Barossa New Water Scheme. However, at this stage, they have been unwilling to meet. They have referred us to the website - https://www.pir.sa.gov.au/major_programs/new_water_infrastructure_for_the_barossa. In addition, they have informed URPS that they are progressing with the development of a detailed business case which is expected to be finalised in the coming months and will provide an evidence base for future investment decisions. URPS understands that the business case will include industry demand analysis for the Barossa Valley and Eden Valley.

Two rounds of community engagement seeking to better understand industry demands has occurred, with the most recent presentation to a public forum held on 5 February 2022. 195 responses from primary industry were received for consideration of access to recycled water. We are not aware if any significant number of landowners from the Kudla area have expressed interest in securing additional water via the scheme.

Alternative Land Use Options

Given the high proportion of rural living land uses within Kudla, we have little confidence that most of the landowners will accept the financial risks associated with at this stage, a speculative water supply and intensive non-conventional horticultural production.

The existing under investment in the area as a result of outdated planning policy and long-term uncertainty is having a detriment impact on the area.

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Council should consider, in our opinion, a more practical approach that includes the evolution of the current zoning policies to facilitate:

- Well landscaped smaller rural living allotments, potentially linked to infrastructure agreements that contribute to a greenbelt.
- Permitting existing broadacre land to be converted to environmentally sustainable residential development with potential infrastructure agreements that results in infrastructure upgrades and planting of a greenbelt along Main North Road.

We content that the existing broadacre land is suitable for residential development for the following reasons:

- Proximity to the Adelaide to Gawler rail line.
- Integration with the New Southern Urban Areas directly to the north.
- Access to adjacent service infrastructure.
- The likelihood of an integrated approach to development with infrastructure agreements to be secured over the entire site.
- Proximity to the district service centre of Gawler.
- An increase in population, further supporting Council's investment in Karbeethan Reserve and the Evanston Gardens Community Centre

Conclusion

Council's Rural Zone is unlikely to become a hub for primary production. The notion of a greenbelt has proved to be ineffective and land use policy has struggled to encourage this vision. Today the area is largely utilised for rural living purposes which further creates difficulties relative to promoting primary production activities.

An alternative planning policy approach is required that can assist in "greening" the area. The area is suitable for small rural living lots and residential development that could provide an integrated solution that promotes landscaped rural settings, improved infrastructure, environmentally designed residential areas (on existing broadacre land) and a greenbelt frontage along Main North Road.

I look forward to Council's response to our submission and will be pleased to meet with staff to discuss this matter further.

I request to speak to this submission at the relevant Council meeting.

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Yours sincerely

Grazio Maiorano
Director

Enc: A3 images of Figures/Maps

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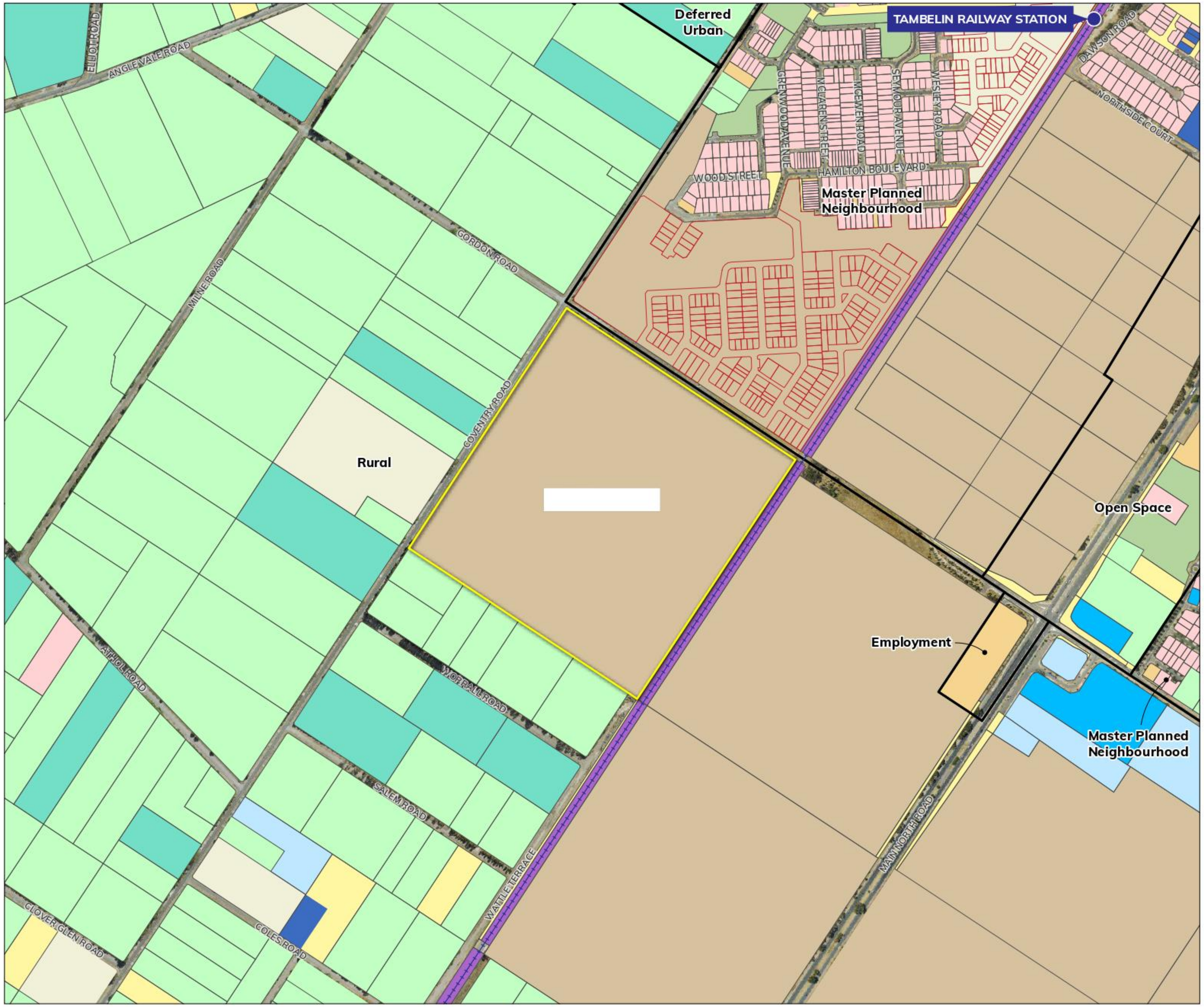

0 75 150 300m

SCALE: 1:7,500 @ A3

LOCALITY

JOB REF.	22ADL-0425
PREPARED BY.	MP
DATE.	28.05.22
REVISION.	1
DATA SOURCE.	MetroMap (16.04.2022) data.sa.gov.au

Legend

- Subject Site
- Zone Boundary
- Proposed Land Divisions
- Rail Line
- Cadastre

0 75 150 300m

SCALE: 1:7,500 @ A3

ZONING

[redacted]

JOB REF.	22ADL-0425
PREPARED BY.	MP
DATE.	26.05.22
REVISION.	1
DATA SOURCE.	MetroMap (16.04.2022) data.sa.gov.au

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