Agrology

PRODUCTION POSSIBILITIES

WESTERN SYDNEY AIRPORT AGRIBUSINESS PRECINCT

OCTOBER 2018

This report was commissioned by NSW Department of Primary Industries to support the development of the Western Sydney Airport Agribusiness Precinct.

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CONTENTS

1.	**Executive Summary**	5
2.	**Introduction**	7
3.	**Site Description and Overview**	9
3.1.	Location and Layout	11
4.	**Current Agricultural Land Use**	13
4.1.	Current Land Use Introduction	16
4.2.	SA2 Geographical Regions	16
4.3.	Value of Agricultural Production in Selected SA2 Regions	18
4.4.	Consideration of Current Land Use	18
4.5.	Future Land Use Opportunities	20
5.	**Climatological Review**	21
5.1.	Climatological Analysis Introduction	24
5.2.	Sunlight	22
5.2.1.	Annual Light	
5.2.2.	Seasonal Light Levels	
5.3.	Temperature	27
5.3.1.	Seasonal Temperature Overview	
5.3.2.	Minimum Temperature	
5.3.3.	Maximum Temperatures	
5.4.	Rainfall	30
5.4.1.	Mean and Median Monthly Rainfall	
5.4.2.	Maximum Rainfall Events	
5.4.3.	Annual Rainfall Comparison	
5.5.	Relative Humidity	31
5.6.	Windspeed and Direction	33
6.	**Production Possibility Analysis**	34
6.1.	Production Possibility Introduction	36
6.2.	Poultry – Meat Production	37
6.2.1.	Sector Overview	
6.2.2.	Technical Viability	
6.2.3.	Areas for Further Attention	
6.3.	Intensive Horticulture – Vegetables	39
6.3.1.	Sector Overview	
6.3.2.	High-tech Tomato Production	
6.3.3.	Key Industry Players	
6.3.4.	Technical Viability	
6.3.5.	Areas for Further Attention	
6.4.	Intensive Horticulture – Berries	43
6.4.1.	Category Overview	
6.4.2.	Blueberries and Rubus	
6.4.3.	Technical Viability	
6.4.4.	Areas for Further Attention	
6.5.	Aquaculture	45
6.5.1.	Sector Overview	
6.5.2.	Technical Viability	
6.5.3.	Areas for Further Attention	
7.	**Economic Assessment of Industry Sectors**	49
7.1.	The Economic Analysis Process	51
7.1.1.	Data Collection Process	
7.1.2.	Core Assumptions	
7.1.3.	How to Interpret the Analysis	
7.2.	Economic Analysis by Sector	53
7.2.1.	Livestock Production	
7.2.1.1.	Economic Model Output – Chickens	
7.2.2.	Intensive Horticulture Production	
7.2.2.1.	Economic Model Output – Tomatoes	
7.2.3.	Intensive Horticulture Production	
7.2.3.1.	Economic Model Output – Blueberries	
7.2.4.	Recirculating Aquaculture Production	
	Figures and tables	59
	References	61

EXECUTIVE SUMMARY

This Production Possibility Report was commissioned by the New South Wales Department of Primary Industries (NSW DPI) to assist with concept development of a world class Agribusiness Precinct adjacent to Western Sydney Airport (WSA). The study was tasked with investigating what forms of primary production are technically feasible and economically viable for inclusion. This was not to be an exhaustive list of infinite possibilities, rather an identification of exemplary sectors to begin shaping the concept.

The process was undertaken in the following four major steps (for detailed information please refer to the respective sections within this report).

1. Investigation of Existing Land Use to better understand the industries that will be impacted upon by the development of the broader Aerotropolis.

2. Climatological Analysis to enable the technical assessment of current and future land use opportunities and to help shape the technology utilised within these production systems.

3. Identification of Production Systems that are technical viable and from sectors with high-growth.

4. Economic Analysis of the selected sectors to ascertain their financial viability.

KEY FINDINGS

Controlled climate glasshouse vegetables production is one of the most attractive propositions. The financial yields are significantly higher than most other options considered and their high-tech componentry allows more resilience to environmental fluctuations. The truly intensive nature of these systems enables high revenue generation per given production area making them a viable option for limited-high value land. If integration with onsite energy generation can be achieved they will become more attractive and could also offer significant benefits to local energy networks.

Blueberry/Berry production offers an interesting investment opportunity beyond the financial yield in the domestic market. It is a category with growing global demand for what is a highly perishable product; a production facility in close proximity to the airport could open up substantial export opportunities.

The established sector of poultry broiler production is subject to a number of key influences. The challenges of urban encroachment, concerns regarding aircraft noise and pressure on financial returns provided indicate that this is a sector requiring support to ensure its future position or eventual transition. This report signals to government and industry to develop a strategy for industry that may otherwise disappear from the region.

High intensity land based recirculating aquaculture is an oddity in the assortment that deserves further thoughtful investigation, particularly looking outside of Australia at what is occurring at a global level. Although the precinct is potentially not the ideal location, the enormous market opportunity warrants further investigation.

The true value of this work and the opportunity presented can be realised via the creation of an Intensive Integrated Production Hub (IIPH) that is greater than the sum of its parts. With enormous potential to employ principles of circular economies, the outcome should be a Precinct that interlinks diverse primary production systems and enables external integration with alternate industries and the community.

It is intended to undertake a detailed investigation into the development of an IIPH including some of the identified production possibilities and integration beyond the individual businesses. It should address the questions surrounding land value, appropriate zoning for agricultural purposes and connectivity to energy and water networks. Parallel work should commence regarding trade agreements and workable biosecurity protocols to leverage the ambitions of servicing the international market via the Precinct.

There are numerous global examples that can form the basis for initial case studies, however there are arguably none that have an opportunity as great as this. The potential of a greenfield site adjacent to a curfew free international airport on the doorstep of Australia's largest city is most certainly a once in a generation opportunity that should be capitalised on.

INTRODUCTION

"A world leading Agribusiness Precinct for the production of value added high-quality produce and pre-prepared consumer foods. Sustainability will be driven through circular economies integrating food production, industry, energy and water. Linked directly to the freight and logistic hub it will enable delivery from farm gate to international consumer plate within 36 hours."

WESTERN SYDNEY OVERVIEW

Western Sydney is a dynamic, multicultural region home to almost half of Sydney's population of 4.7 million and is Australia's third largest economy. The newest, and arguably greatest opportunity for this region is now underway – the creation of the Western Sydney Aerotropolis.

This Aerotropolis will create a once-in-a-generation economic boom, bringing infrastructure, businesses and knowledge-intensive hubs to Western Sydney. It is strategically located on more than 11,000 hectares of land surrounding WSA and will be connected through rail, road and rapid bus links (Department of Planning and Environment, 2018).

The Aerotropolis and the region surrounding WSA is a priority for all levels of government. The landmark Western Sydney City Deal announced in March 2018 will deliver investment, transport and jobs for Western Sydney over the next 20 years. The City Deal has already driven public investment of more than $20 billion across transport, health, education and infrastructure, with an expected 200,000 jobs to be created as a result (Department of Planning and Environment 2018).

The airport will open in 2026 as a curfew-free, 24-hour a day international airport.

THE WESTERN SYDNEY AEROTROPOLIS

As one of Australia's only Greenfield metropolitan airports in the last 50 years, the $5.3 billion WSA is a transformational project for NSW offering a competitive location and access to global opportunities for economic growth (Department of Planning and Environment, 2018). For investors, it is a positive indicator of the Government's long-term commitment to major infrastructure developments, which will yield attractive domestic and foreign investment opportunities.

Surrounding the airport will be a vibrant, fully integrated, world-class economic precinct that will target industries such as smart cities, defence, aerospace, advanced manufacturing, freight and logistics, agribusiness, health, education and tourism. This will be tied together though digital and logistical connectivity to form the Aerotropolis and auxiliary precincts.

A key enabler in securing investment is The NSW Governments recently released Land Use and Infrastructure Plan – Stage 1 (LUIIP). This plan outlines the key precincts and major infrastructure planned for the WSA. It outlines the priorities for the planning, inclusive of a feasibility study by NSW DPI into the development of the Agribusiness Precinct.

WSA AGRIBUSINESS PRECINCT

"A world leading Agribusiness Precinct for the production of value added high-quality produce and pre-prepared consumer foods. Sustainability will be driven through circular economies integrating food production, industry, energy and water. Linked directly to the freight and logistic hub it will enable delivery from farm gate to international consumer plate within 36 hours."

Part of the focus on the development of Western Sydney is the NSW Government is vision of creation of a world-class Agribusiness Precinct. The LUIIP has this Precinct situated adjacent to the WSA on the south-west border adjoining the Freight and Logistics Precinct (see figure 1 and 2).

The precincts will be interconnected to the entire Aerotropolis and will enable a curfew-free, 24-hour export opportunity. This uninterrupted connectivity will be a key enabler and competitive advantage to the success of the agribusiness precinct, it will enable the development of new markets and enhance export capability for farmers within the precinct and from connected regional areas.

Beyond the obvious export opportunities, the Precinct will also service the food demands of the Sydney region via an increase in locally produced food. This approach should afford a reduction in costs associated with freight and also offer consumers a fresher product that is grown on the city doorstep.

The Precinct will create a multitude of skilled and unskilled jobs as a direct result of its development. This will be a bi-directional opportunity enabling employment near major living centres so people can work where they live, conversely the cities will provide a workforce to an industry that is facing challenges securing labour in regional areas.

This Production Possibility Report was commissioned by the NSW DPI to assist with determining the feasability of developing a world class Agribusiness Precinct adjacent to WSA.

SITE DESCRIPTION & OVERVIEW

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Location of the agribusiness precinct.
The agribusiness precinct will be located adjacent to and directly West of the new Western Sydney Airport.

Source: Google Earth

FIGURE 1

3.1 LOCATION AND LAYOUT

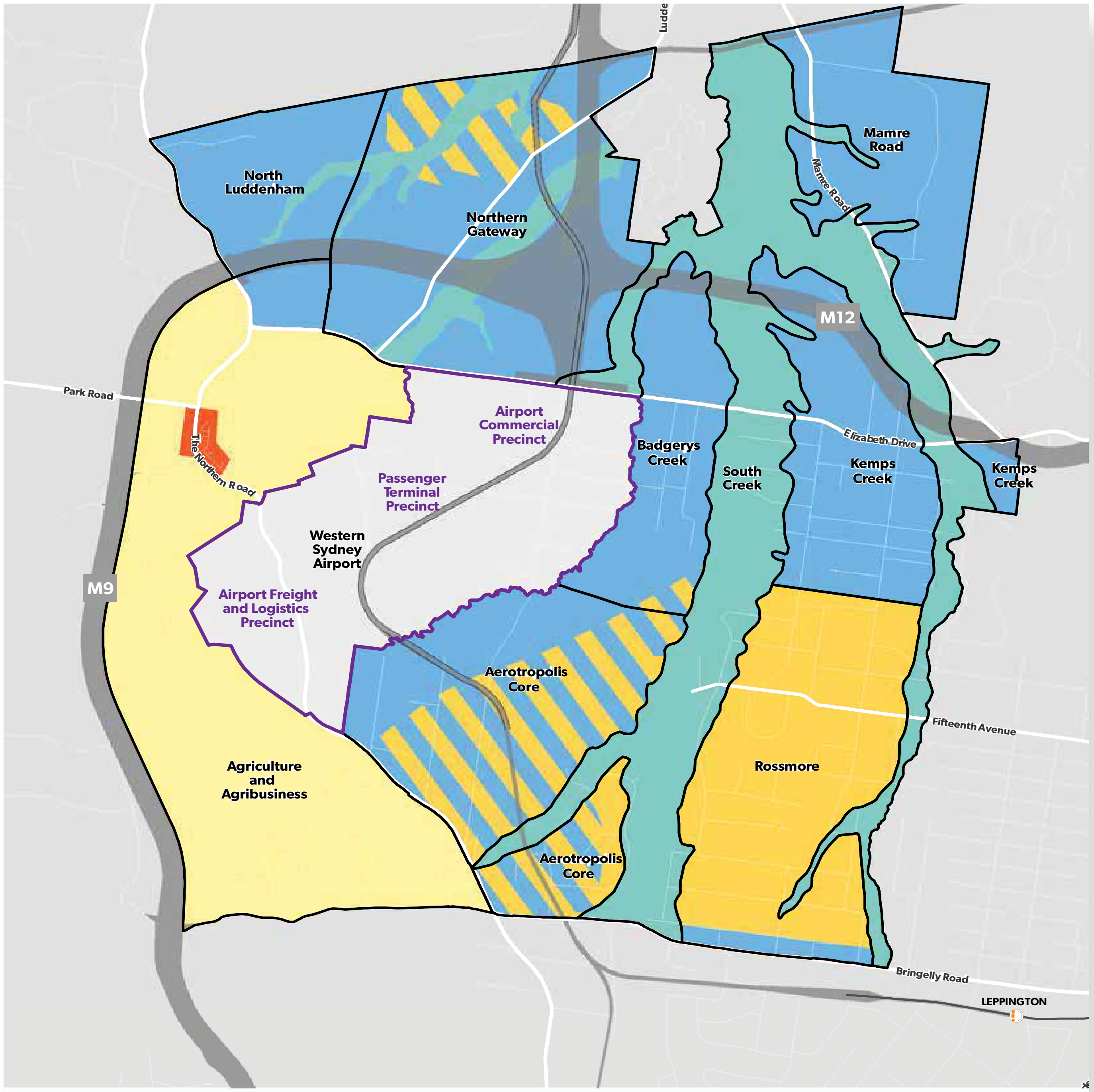
The LUIIP shows 2,400 hectares of land allocated for use as an Agribusiness Precinct. This Precinct will skirt the western edge of the Airport and is directly linked the transport and logistic hub. The site is Approximately 45km inland with elevation ranging from ~80 to ~100m above sea level.

The areas surrounding the Precinct will be well connect by road and rail systems, as identified in the recently announced Western Sydney Corridors. These investments in transport will help to enable connectivity between the Precinct and other production areas, along with enabling workforce access.

Some of the more significant investments include:

- Outer Sydney Orbital (M9) linking Western Sydney to the Central Coast and Illawarra
- North–South Rail Link between St Marys, Macarthur and Leppington
- Western Sydney Freight Line linking the Outer Sydney Orbital and the Main West Line to Port Botany

Today, the Precinct is little more than a concept and an area defined on a map, but this is evolving rapidly and is being led by the NSW DPI. This Production Possibilities Report serves to begin the development of land utilisation concepts that will help drive the planning and design phase of the Precinct.



Structure Plan
Western Sydney Aerotropolis

- Precinct Boundary
- Western Sydney Airport
- Proposed Transport Corridors
- Agricultural
- Luddenham Village
- Flexible Employment
- Urban Land
- Non Urban Land
- Mixed Flexible Employment & Urban Land

0 0.5 1 2 Kilometres N

Source: Department of Planning and Environment, 2018.

Initial precinct planning

FIGURE 2

CURRENT AGRICULTURAL LAND USE

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THE WESTERN SYDNEY AEROTROPOLIS REGION

SA2 regions used in the analysis
(Note: the Aerotropolis land is outlined in white).

FIGURE 3

The current Gross Value of Production (GVP) of the broader Aerotropolis region is $169 million representing 25.7% of the greater Sydney total (1.3% of the state total). The main region is Badgerys Creek – Greendale with a value of $83 million (49% of the study area).

Over 50% of the GVP of the selected region is derived from Poultry meat production with a value of $86 million. Other notable sectors include vegetable production $33 million (20%), Eggs $22 million (13%), Nursery, Flowers and Turf $13.5 million (8%) and Dairy $7 million (4%).

4.1 CURRENT LAND USE INTRODUCTION

Although the intent of this report is to identify future production possibilities that will maximise the agricultural output of the agribusiness precinct, it is also important we take into account current land use in regards to agricultural production practices.

The current and historic agricultural land use is important for many reasons, though in an attempt at brevity we have summarised this into two core factors:

1. It gives an indication of what is technically viable and potentially suited to the region; and

2. It identifies the sectors of significance that we have to be cognisant of when developing land use plans and zoning proposals.

Data for the majority of this analysis was derived from the Australian Bureau of Statistics (ABS) Agriculture Census, which is run every 5 years. In this instance the latest available data was the 2015-16 census data published in 2017. (ABS, 2017).

4.2 SA2 GEOGRAPHICAL REGIONS

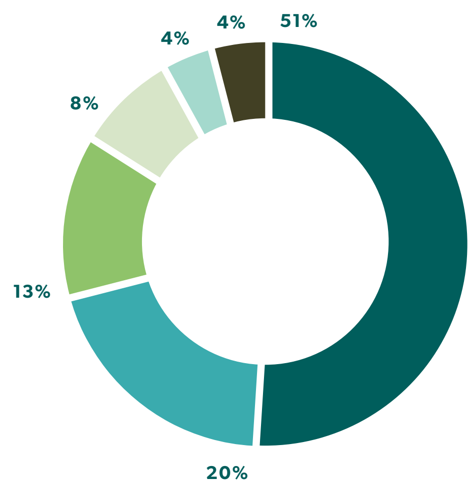
The greater Sydney region generates around $658 million in Gross Value of Agriculture Production (GVP) or around 5% of the total state value of $13 billion. Whilst this is an important figure, is not wholly representative of the Aerotropolis and its surrounding precincts, for this we must dive a little deeper.

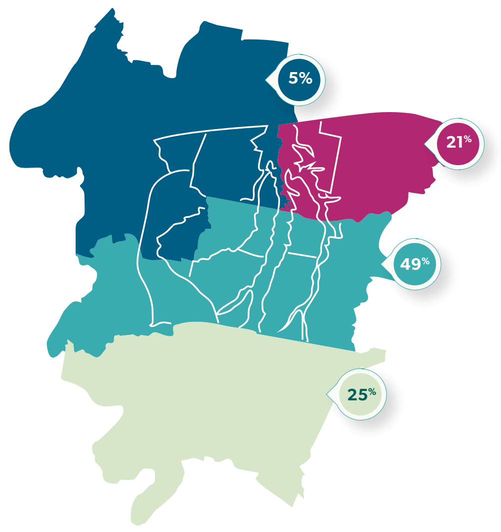
To allow a more granular analysis of current land use along with the sectors that will be impacted upon by the development of the Aerotropolis we analysed ABS data at a SA2 regional level. We identified three SA2 regions (figure 3) that make up the broader Aerotropolis and its surrounding precincts. Whilst not entirely confined within the borders of the Aerotropolis, these regions are quite representative to the value and type production be being carried out.

We also identified a fourth region deemed relevant to the analysis – the Cobbitty – Leppington SA2 region (figure 3), which forms the southern border of the Aerotropolis. Whilst not strictly within the Aerotropolis, the fact that it has a shared border and significant agricultural production determined that it was an appropriate inclusion. The analysis table does allow the reader to break this out if required (table 1).

The SA2 regions identified:

1. Mulgoa – Luddenham – Orchard Hills (SA2 124031463)
2. Horsley Park – Kemps Creek (SA2 127021518)
3. Badgerys Creek – Greendale (SA2 127011505)
4. Cobbitty – Leppington (SA2 127011506)





GVP by commodity type

FIGURE 4

- **51%** Livestock & Poultry
- **20%** Vegetables
- **13%** Eggs
- **8%** Nurseries, cut flowers and cultivated turf
- **4%** Livestock products – Milk
- **4%** Other

GVP by SA2 region

FIGURE 5

- **49%** Badgerys Creek – Greendale
- **25%** Cobbitty – Leppington
- **21%** Horsley Park – Kemps Creek
- **5%** Mulgoa Luddenham – Orchard Hills

GVP by SA2 region and community type

TABLE 1

COMMODITY DESCRIPTION	BADGERYS CREEK GREENDALE	COBBITTY LEPPINGTON	HORSLEY PARK KEMPS CREEK	MULGOA LUDDENHAM	TOTAL VALUE
Livestock & poultry	$48,008,476	$23,440,461	$9,771,954	$4,480,420	$85,701,311
Vegetables	$20,576,333	$6,247,814	$4,882,143	$1,431,631	$33,137,921
Eggs	$1,644,306	$6.851,777	$13,134,914	$632,426	$22,263,423
Nurseries	$3,398,762	$2,990,981	$6,829,671	309,557	$13,528,972
Milk	$7,132,214	–	–	–	$7,132,214
Other	$2,421,002	$1,883,996	$1,087,572	$1,749,491	$7,142,060
GRAND TOTAL	$83,181,094	$41,415,028	$35,706,254	$8,603,524	$168,905,901

4.3 VALUE OF AGRICULTURAL PRODUCTION IN SELECTED SA2 REGIONS

The GVP of the selected SA2 regions is $169 million or 25.7% of the greater Sydney region (~1.3% of the total state value).

The largest SA2 region by value is Badgerys Creek – Greendale area with an GVAP of $82.5 million or 49% of the total value of the study area. Cobbitty – Leppington was second with a value of $41.4 million (25%), Horsley Park – Kemps Creek is third with a value of $35.4 million (21%) with Mulgoa – Luddenham – Orchard Hills forth and a value of $7.1 million (5%).

The largest sector by far is livestock slaughtered and other disposals – poultry, which represents around 51% of the value of the GVAP for the selected region at $85.7 million. Other notable sectors include vegetables for human consumption with a GVAP of $33.1 million (20%), livestock products – eggs at $22.3 million (13%), nursery cut flower cultivated turf at $13.5 million (8%) and livestock products milk at $7.1 million (4%).

4.4 CONSIDERATION OF CURRENT LAND USE

Before we consider new and innovative solutions for the development of the agribusiness precinct we must acknowledge and remain cognisant of the current land use practices along with their associated value they provide – both economically and socially.

Existing agricultural operations may be adversely impacted upon by rezoning and the additional land use conflicts which will accompany an increase in residential dwellings and commercial activities surrounding the Aerotropolis. There are already multiple cases of conflict with farmland situated in urban / peri-urban areas and this issue is only likely to increase without appropriate planning.

The LUIIP states that land planning will support the long-term retention and growth of agriculture and agribusiness in the Western City. The agribusiness precinct should support the transition of existing agriculture in the area, as well as the development of new agricultural opportunities (Department of Planning and Environment, 2018). This is an important statement that must be supported by action; without appropriate zoning measures land value will inevitably increase bringing with it industries that are not agriculturally based.

Beyond the Aerotropolis there is the overarching consideration of the impact of urbanisation on lands and its effects on the right to farm and conflicts with urban residencies. Overall this is a broad policy issue that needs to be addressed, inclusive of consideration of the impact the Aerotropolis and its surrounding precincts may have.

Whilst all agricultural production should be considered, it is clear that there are five main industries that must be communicated with further:

- Poultry – meat production;
- Vegetables;
- Poultry – egg production;
- Nursery cut flower and turf; and
- Dairy

The poultry sector is a key concern due to both its size and that it contains complex vertically integrated businesses who create significant value and jobs beyond the gross farm gate figures. They are also incredibly sensitive in regard to farm proximity to processing plants and it is generally considered the maximum distance should be around 2hours / 200km (due to concerns for animal welfare and transportation costs).

Planning and Zoning preferences should be put in place to ensure that agricultural enterprises have a place within the precinct and adjoining lands. Policymakers and government should look towards developing solutions which can maintain existing industries and increase their value as a benefit of the Aerotropolis rather than pushing them further away. Where maintaining the business is not possible there must be support to transition, in so allowing continued investment by these industries.

4.5 FUTURE LAND USE OPPORTUNITIES

Whilst it is acknowledged that historic and current land use is a good indicator of viable production technologies, this is not necessarily the best future utilisation of the land. This report is pragmatic in the recommendations provided, remaining aware of the fact that we are dealing with limited high-value land and therefore highly intensive production systems will inevitably be the best fit.

To determine the optimal use of the limited land and resources that will be available in the agribusiness precinct we will next investigate the regions environmental conditions via a detailed climatological analysis. This analysis will help highlight local conditions and give an indication of technically viable agricultural production opportunities and appropriate application of technology within them.

We will then consider both the technical and economic viability of a select number of case studies for consideration, inclusive of current practices and future alternative solutions.

It is acknowledged that this cannot be an exhaustive list and accordingly will select some of the most appropriate category sectors to give indications of what might be possible within the Precinct. Whilst there are categories may not be mentioned, this does not mean they should not be included within the Precinct.


CLIMATOLOGICAL REVIEW
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The region experiences an extreme temperature range with lows to -4.9°C and highs of over 45°C. A positive is the fact that the occurrence of high temperatures coincides with moderate to low relative humidity affording the opportunity for cost-effective options such as evaporative cooling. Winter time lows highlight the need for heating in most intensive production systems, and from a positive standpoint it allows consideration of species that may benefit from chilling (e.g. berries).

Light levels for the region are good with annual averages of 565,769 J/cm2. The light is sufficient for 12month cropping of glasshouse vegetable production when one takes an assiduous approach during the winter months. Artificial light would not be needed though could increase yields, the economics of this in the current market is arguable.

The region experiences a summer dominant rainfall pattern receiving around 677mm annually. Even with a modern catchment solution supplementary water sources will be required for all of the options investigated.

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5.1 CLIMATOLOGICAL ANALYSIS INTRODUCTION

One of the first steps in determining the technical viability of various forms of primary production is a comprehensive understanding of the local climatic conditions. This section of the report serves to enable consideration of appropriate production systems based on the local climate.

This data can be utilised in the analysis of each sector in consideration of their appropriateness for the region (beyond historical uses), and also forms a significant influencer in the financial models, this is particularly important for energy costs (heating/cooling) and seasonal price estimates of produce.

A detailed climatological assessment was carried out for the area around the proposed location of the WSA Agribusiness Precinct. The following sources were utilised:

- Light data was sourced via the Badgerys Creek weather station (BOM site# 67108) with data ranging back to 1990.
- Temperature was sourced via the Badgerys Creek weather station (BOM site# 67108) with data ranging back to 1995.
- Rainfall data was sourced via the Badgerys Creek weather station (BOM site# 67108) with data ranging back to 1995.
- General Climatic data (Month by month statistics) was sourced via the Badgerys Creek weather station (BOM site# 67108) with data ranging back to 1995.
- Monthly relative humidity (RH) and general climatic data was sourced via the Badgerys Creek weather station (BOM site# 67108) with data ranging back to 1995.

All data was analysed for the purpose of consideration of appropriate primary production systems and to highlight any major risks or areas of concern. Tables and graphics are displayed in months and also day number of year whereby day = 1 would be the 1st of January of any given year ranging up to day 365 being the 31st of December.

5.2 SUNLIGHT

Data for the years 1990 and 2018 were not included in this analysis due to incomplete data sets which would have affected the accuracy of the analysis.

Sunlight levels are particularly important in modern intensive horticulture, with every joule of energy accounted for the growers will attempt to maximise output based on sunlight energy input. This particular aspect of the analysis will be most important for modern intensive protected cropping consideration.

5.2.1. Annual Light

The total average annual light received for the years 1991 through 2017 is 565,769 J/cm2. Annual light sum shows a variation from the mean of up to 13%. This data shows a low in 1995 of 492,530 through to high of 621,400 experienced in 2004.

5.2.2. Seasonal Light Levels

Typical average summer light levels are 2-2,250J/cm2/day, with peak levels reaching around 3,500 J/cm2/day in December and January. The sunniest month on average is December with an average daily joule count of 2,263J/cm2.

Winter time light will be at its lowest in the months of June and July with averages of around 870-1,000 J/cm2/day to be expected. The darkest month is June with an average daily joule count of 868 J/cm2. This period would be the most difficult for modern glasshouse production systems as the low light coincides high rainfall and high humidity.

There is a relatively large degree of variability between the daily minimum, mean and maximum values. This observation indicates a relatively broad variability day by day on any given year with an average maximum variation above the mean of around 40%, and the average minimum variation below the mean of around 76%. The highest variability occurs in the summer months.

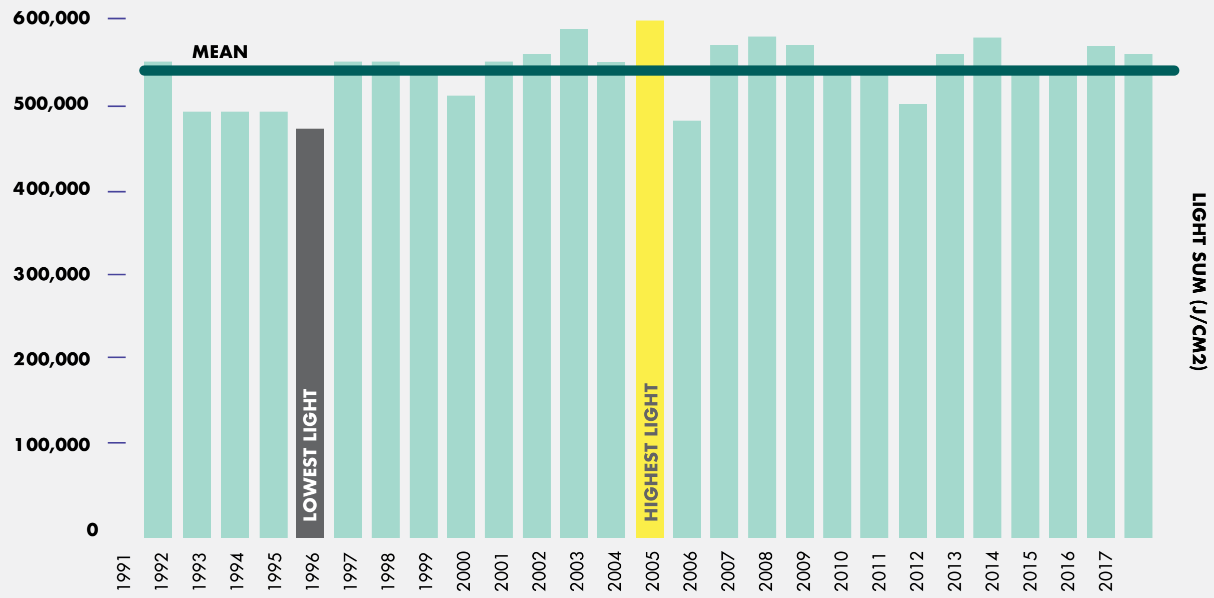
Climatological analysis by month

TABLE 2

MONTHLY LIGHT (J/cm2)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Min daily light	70	50	30	80	40	40	50	60	130	40	120	30	62
Mean daily light	2,225	1,902	1,646	1,372	1,056	868	996	1,327	1,687	1,986	2,102	2,262	1,619
Max daily light	3,570	3,250	2,830	2,200	1,600	1,230	1,460	1,920	2,550	3,030	3,400	3,490	2,544
MONTHLY RAINFALL (mm)													
Mean rainfall	82	106	84	52	41	66	24	39	34	54	74	61	717
Median rainfall	55	86	56	29	18	52	20	20	28	43	51	47	42
Lowest rainfall	14	13	21	2	2	2	0	1	1	0	8	0	5
Highest rainfall	192	342	285	253	156	250	72	231	82	182	173	131	196
MONTHLY HUMIDITY – RH (%)													
Mean min RH	45	50	50	50	48	57	46	42	38	35	39	40	45
Mean max RH	96	96	95	95	96	96	96	94	94	93	94	95	95
Mean 9am RH	73	80	83	76	80	84	81	72	66	62	69	69	75
Mean 3pm RH	49	55	55	52	53	56	50	44	44	45	50	48	50
MONTHLY WINDSPEED – km/h													
Mean 9am wind speed	9.4	8.7	8.4	9.8	9.6	9.1	9.6	10.6	11.7	11.8	11.0	9.8	10.0
Mean 3pm wind speed	17.9	15.9	14.5	14.4	13.9	13.7	15.4	17.8	19.2	19.9	18.9	18.5	16.7
Max wind gust speed	98	113	152	91	98	102	100	118	126	121	135	106	
Date of max wind gust	19.1 2017	16.2 1983	2.3 1983	2.4 2008	26.5 1987	27.6 1980	7.7 1993	12.8 1992	3.9 1973	29.10 1992	14.11 1979	6.12 1986	

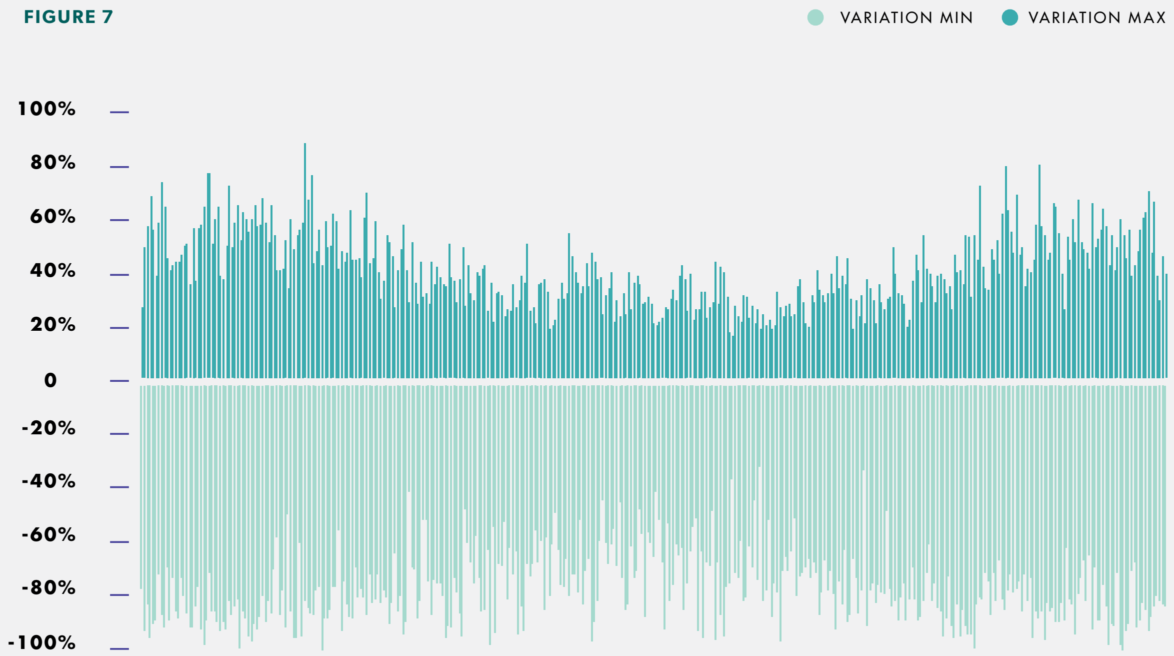
Historical annual light figures

FIGURE 6



Daily variation from the mean light value (%)

FIGURE 7



5.3 TEMPERATURE

Data for the years 1990 and 2018 were not included in some of this analysis due to incomplete data sets which would have affected the accuracy of the analysis.

5.3.1. Seasonal Temperature Overview

Analysis of temperature data shows a wide range of values. With winter time lows going well below zero and summer highs of over 45°C this is an expected temperature range of over 50°C.

Seasonal mean monthly minimum temperatures range from around 4°C in the winter months up to around 17°C in the summer months. Seasonal mean monthly maximum temperatures range from around 17°C in the winter months up to around 30°C in the summer months.

This is quite an extreme climate and bolsters the argument for primary production systems that afford some form of weather protection and/or climate control systems.

5.3.2 Minimum Temperature

The coolest month on average is July with a mean minimum temperature of 3.97°C and mean maximum temperature of 17.5°C. The coldest day in the last 23 years occurred on 12th July 2002 with a temperature of -4.5 degrees Celsius.

Based on the last 23 years of data sub-zero temperatures can occur at any time through the months of April through until September inclusive.

In terms of low-temperature events we can expect the following based on annual averages:

Mean number of days < 0°C = 7

Mean number of days < 5°C = 64

Mean number of days < 10°C = 151

5.3.3. Maximum Temperatures

The warmest month on average is January with a mean minimum temperature of 17.1°C and mean maximum temperature of 31°C. The hottest day in the last 23 years occurred on 11th February 2017 with a temperature of 46.4°C.

Based on the last 23 years data temperatures in excess of 30°C can occur in the months of September through to April inclusive, whilst temperatures of over 40°C can occur in the months of November through to March inclusive.

In terms of high-temperature events we can expect the following based on annual averages:

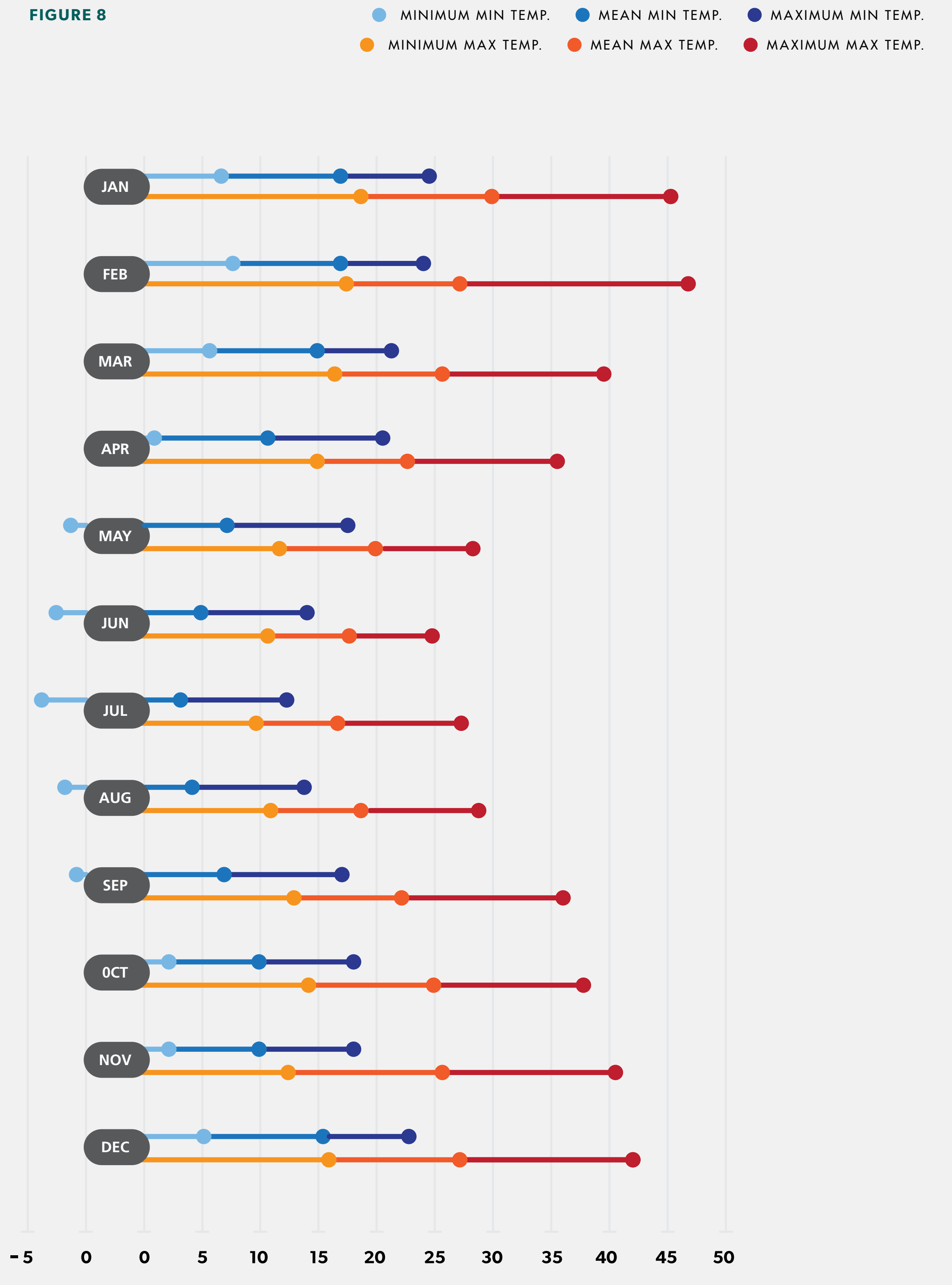
Mean number of days > 40°C = 3

Mean number of days > 35°C = 15

Mean number of days > 30°C = 55

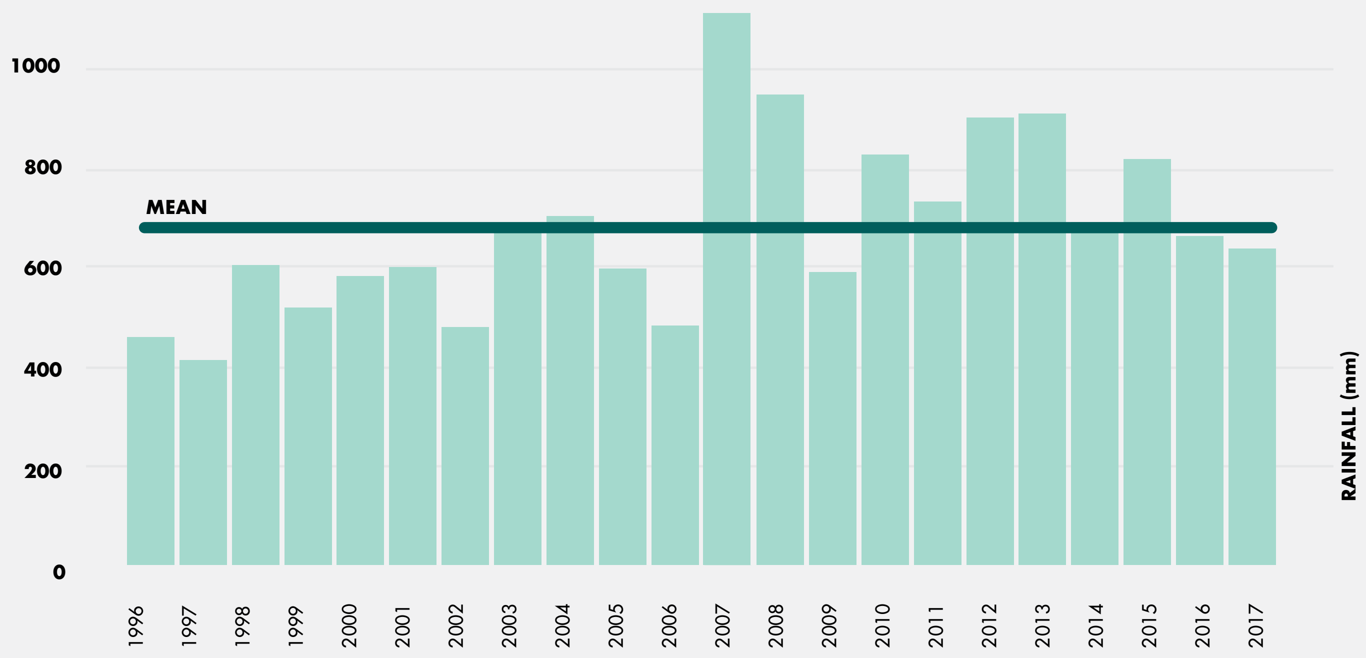
Minimum and maximum temperatures by month

FIGURE 8



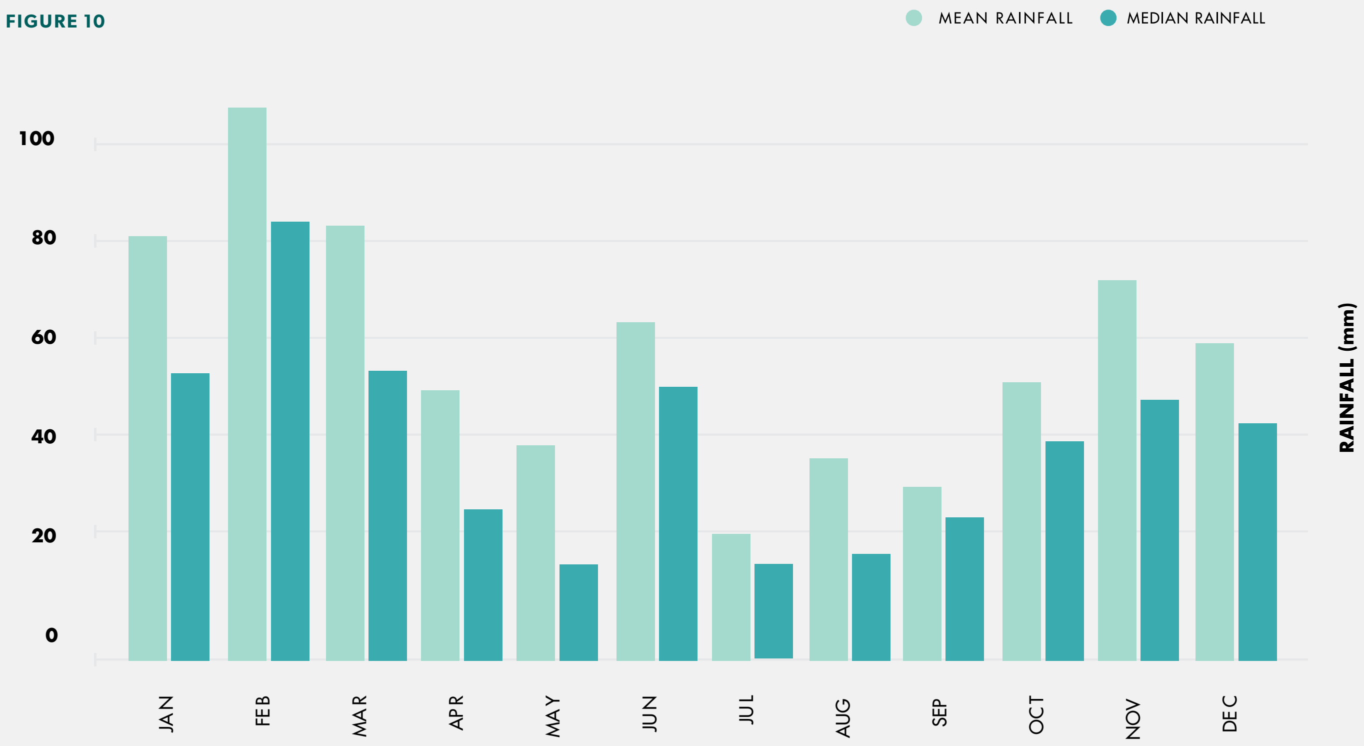
Comparison of annual rainfall

FIGURE 9



Mean and median monthly rainfall

FIGURE 10



5.4 RAINFALL

Rainfall data was analysed for the period between 1996 and 2017. The years 1995 and 2018 are omitted due to incomplete datasets.

The region experiences a summer dominant rainfall pattern in general, and the wettest month is February receiving on average 106mm, whilst July would be considered the driest month receiving only around 24mm. Although the winter period is in general receiving lower rainfall it should be noted that historically June does receive high rainfall events with mean rainfall expected to be around 66mm.

5.4.1. Mean and Median Monthly Rainfall

Both the mean and median monthly rainfall values are worth considering. If the mean and median are close together this indicates there are not many significant outliers influencing the mean rainfall data. If there are large variations between the mean and median this indicates that there are likely a large number of outlier values (high or low) and seasonal variation can be significant. In this instance we conceded the median and mean values are generally following a similar trend and not too dissimilar.

5.4.2 Maximum Rainfall Events

The highest recorded single day rainfall event observed in the data was 138mm reported 31st of January 2001, and on average the region can expect around six days per year with a rainfall exceeding 25mm.

5.4.3. Annual Rainfall Comparison

Consideration of annual variations will help primary producers plan for both wet and dry years and month by month variation. These patterns can influence the availability of water (if the producer relies on rainwater), and adverse impacts on crop and livestock.

The mean annual rainfall is 677mm, whilst the calculated annual rainfall based on monthly means is 717mm. The region shows a large variation between years and total annual rainfall varied from a low of 414mm in 1997 to a peak of 1,041mm in 2007.

The significant variation in annual rainfall is likely due to large-scale climate variation resulting from factors such as the El Niño/La Niña cycles. Any investment in this region that is solely reliant on rainfall should be cognisant of the large variations and in general would be well placed to have access to alternate sources.

5.5 RELATIVE HUMIDITY

The humidity varies quite broadly throughout any given day with average maximum humidity of over 90% occurring every month of the year and average minimum humidity dropping to 50% or below for every month with the exception of June (57%).

The overall humidity profile is relatively flat and generally quite stable throughout the entire year.

The mean monthly 3pm RH is between 44% and 56% throughout the entire year (average 50%), whilst the 9am RH is generally between 60% and 80% (average 75%).

Due to the occurrence of relatively low humidity in the hotter periods this climate presents a good opportunity for consideration of the use of evaporative cooling solutions such as those provided in modern glasshouse production systems along with poultry and piggery production.

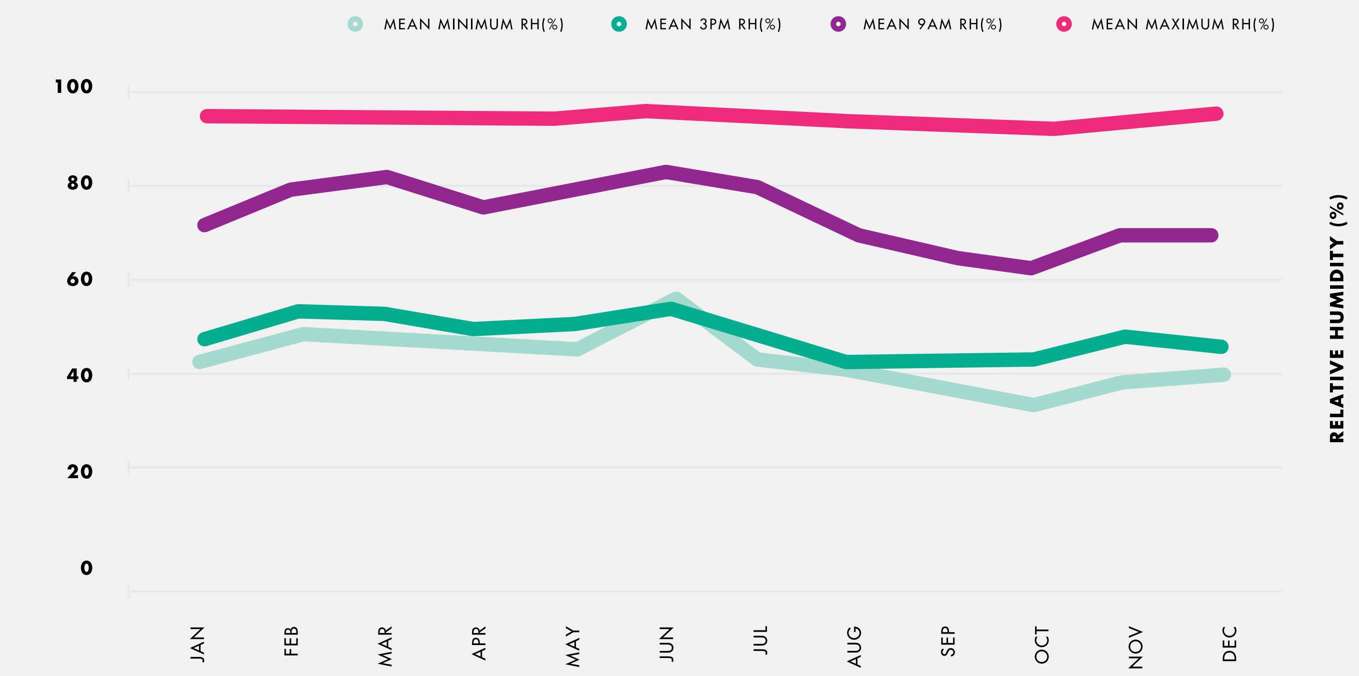
5.6 WINDSPEED AND DIRECTION

The dominant wind direction at Badgerys Creek is south westerly in all seasons. Wind direction is more constant in autumn and winter than in spring and summer. Mean windspeed is a relatively consistent ranging from between 9 to 19 km/h, with a general increase from a low in June through to a peak in October.

Occurrences of strong wind gusts can occur throughout the entire year reaching almost 100 km an hour in all months. The highest recorded wind gust in the data obtained was 152km an hour recorded in March 1983.

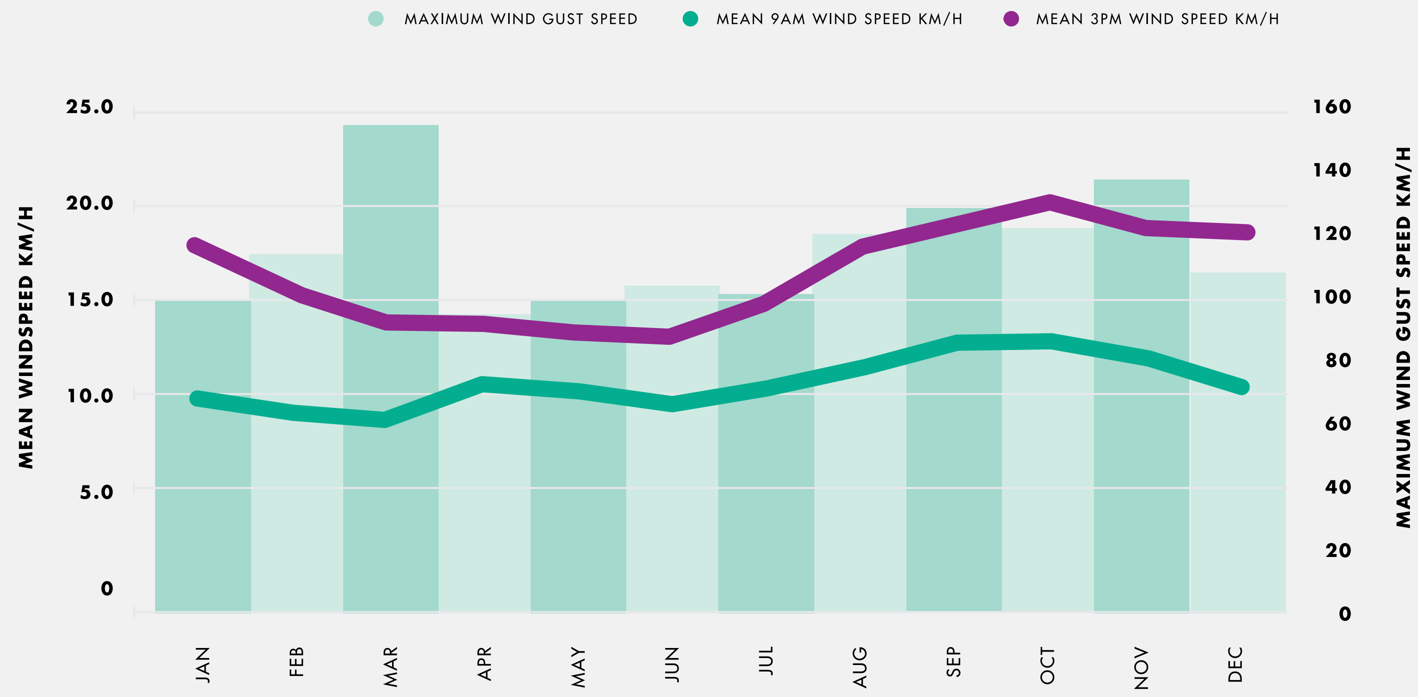
Monthly average relative humidity levels

FIGURE 11



Monthly wind speed statistic

FIGURE 12



PRODUCTION POSSIBILITY ANALYSIS

There is an almost infinite number of possibilities we could consider, though to keep a concise and accurate report a select few were included as exemplary case studies. All sectors identified are technically viable for inclusion within the precinct when given due consideration of appropriate application of technology. All sectors displayed potential for domestic growth and /or global export possibilities.

6.1 PRODUCTION POSSIBILITY INTRODUCTION

Based on the analysis of current agricultural land use, climatological analysis and engagement with industry stakeholders we have derived a select number of industry sectors to form our detailed analysis. These include:

1. Livestock production – Poultry meat production (Chickens)
2. Intensive horticulture production – Vegetables (Tomatoes)
3. Intensive horticulture production – Berries (Blueberry)
4. Recirculating aquaculture production – Fin Fish

We acknowledge that there are many other sectors (and variants of the above) that may be viable for inclusion within the precinct, but it is impossible to assess all of these in one report. The purpose of the selected sectors is to show indicative categories that will be technically viable and consider their economic feasibility for inclusion within the precinct.

There were a number of other sectors identified of interest that could not be analysed in this report due to either a lack of data and time or the fact that the industries are highly complex and variable meaning a 'standardised economic model' is not appropriate to include. These sectors are highlighted below and are worth further investigation:

1. Nursery and Garden
2. Floriculture
3. Poultry – Egg production
4. Mushrooms

Dairy production in the region is a sector highlighted in section 4 and must also be considered. In this particular case we note that the entire ~$7m of production is controlled mostly by a single entity – Leppington Pastoral Company (LPC). Direct discussions with LPC about the future of this industry in the region is most appropriate and is therefore not addressed specifically within this report.

6.1.1. Value Adding Opportunities

This report was tasked with identifying a variety of production possibilities for consideration within the proposed agribusiness precinct. Beyond production there is inevitably enormous potential for value adding facilities to be included that go above and beyond any local production. This would include opportunities such as consumer ready meals, pre-packed salads, and healthy snack options just to name a few.

By furthering vertical integration into the value-added category producers would likely be able to generate significant returns beyond the 'farm gate' and enable better economic yields. This will be particularly important when we consider export opportunities where verified food provenance is needed (such as targeting higher price points in markets like China). More detailed work is required in this space and should be included in future planning considerations for the development of the Precinct beyond production possibilities.

6.2 POULTRY MEAT PRODUCTION

6.2.1. Sector Overview

The NSW Poultry industry had an estimated GVP of $912 million in 2016-17 (NSW DPI, 2017), up around 4% from the 2015-16 ABS figures of $875 million where it represented around 32% of the national Poultry production of $2.75 billion. Poultry production is a significant contributor in terms of the NSW GVP representing around 7% of the states total GVP (ABS, 2017). With a 2015-16 value of $85.6 million the region we are investigating accounts for around 10% of the New South Wales total production (ABS, 2017).

The fact that the sector is such a significant contributor to the states GVP and the selected region represents around 10% of the state's production, this is clearly a category that must be considered in terms of both current production and for its continued modernisation. The region of focus is almost wholly controlled by two large processors (Cordina Chickens and Pepe's Ducks) and further engagement with these parties will help shape the local future of this sector.

The industry has experienced strong growth in the last forty years and is expected to continue in the long term with 3 – 4% year-on-year forecasted (NSW DPI, 2015).

Above and beyond the farm gate GVP, this sector has a significant multiplier effect post farm gate. It is estimated that the NSW poultry meat industry supports around 6,000 jobs directly, but a further 39,000 jobs downstream (NSW DPI, 2015) – a 6.5 times multiplier.

The poultry meat industry is distinctively different to many other primary production sectors. It is a truly vertically integrated sector whereby a single entity usually owns and controls multiple stages of the value chain including:

- Breeder flocks
- Hatcheries
- Grow-out flocks
- Processing plant
- Feed mill
- Transport; and
- Marketing

This incredibly high level of vertical integration allows the processor to reduce production cost through purchasing power and economies of scale. By controlling the entire value chain, they are able to minimise individual profit centres and can negotiate input supply contracts based on large volumes that bring economies of scale.

This model uses a contract production system whereby the producer (an independent farmer) grows the processors birds out under a contractual arrangement. The farmer provides all the necessary infrastructure and day-to-day animal husbandry, whilst the processor takes care of the majority of other inputs including supply of birds, feed, harvest labour and freight, along with veterinary support and technical assistance when required. At no point in time does the contracted farmer own the birds.

Under the aforementioned model the farmer is paid a growing fee per bird. Typically, in broiler production this fee is around $0.70/bird, however if a farmer is more efficient through the measures of better food conversion rates (FCR's) and lower mortalities they are paid a premium of up to around $0.80/ bird. Conversely, if they are a less efficient with a higher FCR and higher mortality rate they are penalised and paid a lower fee down to around $0.65/bird.

In this production possibility report we classify production as the grow out phase of the process and this will be our focus.

6.2.2. Technical Viability

The sector has clearly been viable in the region, so from a technical point of view we do not need to investigate the climatological aspects in detail, other than noting it is within the acceptable ranges given due consideration to heating in winter and cooling (evaporative) in summer – which all modern enterprises employ.

Poultry farms are incredibly sensitive in regard to their proximity to processing plants. Due to concerns for animal welfare and transportation costs it is generally considered the maximum distance from farm to plant should be around two hours or <200km (NSW DPI, 2015). This is a primary driver for the consolidation of enterprises in this region and the broader Sydney area. Relocating these enterprises further afield would be a significant challenge, and if forced to move then it is likely that localised processing plants would also close. It important that the planning and zoning allows for their continued existence or a unified transition.

Odour is an important issue associated with meat chicken farms, as is noise. The latter especially at night where pick-ups occur and when the noise tends to travel farther. Increasing urbanisation of regions around these farming enterprises will continue to put pressure on their existence, and the agribusiness precinct may offer the ability to buffer some of these incursions.

6.2.3. Areas for further attention

Engagement with industry bodies and producers has highlighted a number of areas of concern regarding the technical viability and long-term sustainability of the sector in the region. There were 3 key areas we took note of for inclusion in this report that should be further investigated and further industry engagement is needed on these topics to better understand the identified risks.

Urbanisation:

Urban encroachment can lead to clashes with industry, particularly around the perception of odour and dust issues. Proximity to urban dwellings and sensitive industries will need to be managed carefully.

Noise:

Poultry can be quite sensitive to noise. Producers interviewed noted that the disturbance to birds caused by the harvesting in neighbouring sheds often results in short period of downturn in produce performance. This raises the question of what impact the noise of aircraft operating twenty four hours a day may have on the birds and subsequently the viability of farm operations in the Precinct.

Diseases:

The region does have a number of endemic diseases that can cause challenges for the industry, for example: Infectious Laryngotracheitis (ILT). It is noted that some producers that decided to leave the region claimed these issues as a concern that influenced their decision. It also highlights the importance of farm biosecurity in any planning process.

6.3 INTENSIVE HORTICULTURE: GREENHOUSE VEGETABLES

Protected cropping (greenhouse) production is already carried out in the region, though is a sector that has not had much investment into modernisation, unlike other regions around Australia. Anecdotally, this is driven by farmers looking to realise land value for urban development rather than further investing in their farming businesses.

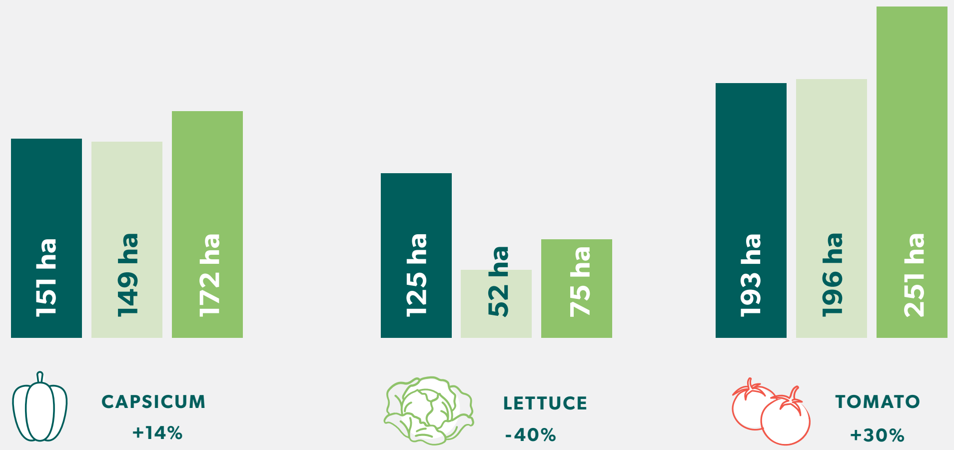
Cropping carried out in controlled environments is less dependent on weather conditions and seasonal changes than field-grown production systems. Controlled environments have allowed producers to greatly increase yields, whilst reducing risk of crop failure and ensuring consistent product quality. Accordingly, these producers have become a preferential supplier of retailers.

As a result, the Australian protected cropping vegetable industry has thrived, particularly in the last 10 years where the industry has seen significant investment from both corporate and medium-large private entities alike. It is not an increase in the number of growers / entities, but rather significant increase in the size of operations and the technology incorporated.

Accurately quantifying the exact size and nature of the market is a difficult task. The detail and accuracy of data available on the sector can be considered variable at best. The following points give some quantification to this:

- 2017 publication on international greenhouse vegetable production by the consultancy firm Cuesta Roble Greenhouse Vegetable Consulting listed the Australian area at 498ha (Hickman, 2017).
- Protected Cropping Australia publications list the total Area at 1,341ha and a farm gate value of $1.3billion (Smith, 2016).
- Ibisworld quotes the sector at $576million, but included mushrooms (Mullaby, 2017).
- ABS data for 2015-16 indicates an area of only 388ha with only 3 species recorded in production-capsicum, lettuce, and tomato – omitting crops like cucumber that were previously published up until 2009. (Agricultural Commodities, Australia and state/territory, 2015-16).

It is possible that the subjective interpretation of the definition of protected or undercover cropping does influence the analysis, with a vast array styles ranging from extremely low-tech 'tunnel production' right through to high-tech, automated climate-controlled facilities. Regardless, the data is not consistent enough to be relied upon.



Data for the main vegetable crops grown under protected cropping in Australia from 2008-2016. (Hickman, 2016).

FIGURE 13

● 2007-8 DATA ● 2014-15 DATA ● 2015-16 DATA

Given our experience and observation in the industry, we would consider the higher estimates as most accurate when considering the full category (>1,000ha in total). This evaluation is inclusive of new, modern climate-controlled structures which consist of ~250-300ha. The category as whole is growing and becoming more competitive, and technologically advanced.

6.3.1. Sector Overview

There are four main vegetable species in the protected cropping sector, which are spread across all technology fronts:

1. Tomatoes:

Range from low-tech tunnel to ultra-modern semi-closed glasshouse production.

2. Cucumber:

Typically low-tech poly tunnels and medium tech structures. There is an emerging presence of high-tech structures producing cucumbers, though still a small representation of the high-tech category.

3. Capsicum:

Typically low-tech poly tunnel, a multitude of smaller growers with dominant production out of SA and Victoria. High-tech facilities exist but are generally limited to a select few growers in Tasmania and Victoria.

4. Leafy Greens (lettuce and herbs):

A mixture of production systems. A lot of low tech with a few small to medium high-tech facilities.

Whilst all crops occupy a presence in the low-tech echelons, the high-tech is almost completely dominated by tomatoes, with a smaller, but increasing presence of the other cropping species. Even the arguably inaccurate data in the reports all indicate a similar story of decreasing number of growers and an increase in the size of entities and total category. Fruiting crop production is increasing and tomatoes leads the way.

6.3.2. High-tech Tomato Production

The majority of new high-tech farms / expansions have focused on tomato production. Our estimates suggest that there is presently 200–250 hectares of high-tech (actively heated and climate controlled) facilities dedicated to tomato production.

Twenty years ago, the average tomato producer had a small plastic house occupying a couple of thousand meters square, a simple owner operator farm. Now, the majority of the market is supplied by large farms over 200,000m2 (20ha), and even middle tier farmers have sites over 10,000m2 (1ha). These businesses are technologically sophisticated enterprises, highly productive and complex. It is important to consider these facts when looking to their inclusion within a Precinct.

Technology development and breeding programs have seen a rapid increase in yield potential. In the late 90's tomato growers might have been yielding 40kg/m2, now the most modern sites lay claim to figures above 80kg/m2.

The trend of both category growth and increased production potential can continue, and it is replacing a decrease in field production.

6.3.3. Key Industry Players

The tomato category has been dominated by 3-4 main companies over the past years, all of which are Vertically Integrated Producers (VIP's) who maintain the entire value chain from production to retailers. These entities have significant production facilities of their own and handle large portions of satellite (semi-independent) growers.

In the past 5 years there has been some change in this category. The 3 main producers (being Costa Group, Perfection Fresh and Flavourite Tomatoes) have solidified their positions as market leaders. Moraitis Group left the market and Sundrop farms entered it as a new player. The Ibisworld report recently listed the Australian undercover vegetable category being dominated by these 4 key players:

1. Costa Group (42.3%)
2. Perfection Fresh Australia (10.7%)
3. Flavourite Tomatoes (8.5%)
4. Sundrop Farms (4.9%)

It should be noted these figures are significantly skewed by the inclusion of mushrooms, which Costa Group is a very significant player. If mushrooms would not be included the market share would be more comparable.

Perfection Fresh currently holds the title of the largest single site with over 35ha of glass in Two Wells, South Australia and will expand beyond 45 hectares by the end of 2019. Costa Group has 30 hectares located in Guyra on the NSW tablelands with a further 10 hectares planned for construction in 2019, and the family owned business Flavourite Tomatoes around 29 hectares in Warragul Victoria (~30% of their crop is now dedicated to capsicum, cucumber and eggplant). All three also manage product supplied by satellite growers and deliver this to their retail customers.

The newest entity to join the 'mega-farm' category Sundrop Farms has ~20 hectares located in Port Lincoln, South Australia. This company is attempting to integrate new technology platforms such as desalination via solar energy capture.

6.3.4. Technical Viability

The region has a good light profile for year-round production, and even mid-winter crops could be sustained with appropriate management practices. A fully loaded plant could go through winters allowing for 12-month supply of crops such as tomatoes, cucumber, capsicum and egg plant, though maximum yields would be obtained via a traditional winter planting date and summer cropping strategy.

Given the relatively extreme climatic variation of the region, a modern climate-controlled greenhouse production would be a good option. With wintertime temperatures expected to drop below 0°C and with anticipated 151 days<10°C a modern heating system such as the traditional hydronic pipe heating would be a must for year-round production. Conversely, the extreme summer heat (maximums above 45°C and 55 days> 30°C) indicates some form of cooling should be implemented. When we consider that the higher temperatures generally coincide with RH levels <50% this offers the opportunity for evaporative cooling.

Our evaluation of the region leads us to suggest two obvious solutions:

1. Conventional Dutch Venlo style glasshouse with heating, shade/thermal curtains and high-pressure misting
2. Modern Semi-closed glasshouse utilising evaporative cooling and positive pressurisation vis induction fans

Whilst both solutions are technically viable, there are pros and cons to each. Option two will afford the grower maximum control giving incredibly stable summer production and reduced pest and disease pressure, however it will cost significantly more in capital expenditure as well as ongoing running costs (electricity). The economic analysis will therefore be carried out for each option.

Beyond the two noted exampled evolving systems worth investigating further include modern retractable roof structures currently being deployed around the globe. As these are not yet standardised economic modelling of these solutions has not been carried out, though they are noted for future consideration.

6.3.5. Areas for further attention

Reflectivity

Reflectivity of glasshouses is an important consideration as it has the potential to distract pilots in flight. This is an issue for the Civil Aviation Safety Authority and further engagement is required in this area to determine the suitability of glasshouses positioned around the designated flight paths. Further work is required to identify areas suitable for their development that will not impact airline safety.

Resource Availability

The intensive nature of these systems requires significant inputs of high quality water and reliable, affordable energy. The next step planning will need to take this as a holistic figure for the total Precinct planning.

6.4 INTENSIVE HORTICULTURE: BERRIES

6.4.1. Category Overview

Australia produced over 106 thousand tonnes of berries in 2017 delivering a GVP of $866 million (Hort Innovation, 2018). Production is dominated by strawberries (86%), followed by Blueberries (9%) and an evolving market of rubus berries (5%). There is already a minor export market established with around 4,244 tonnes (4%) of production exported in 2017 (Hort Innovation, 2018).

Whilst Strawberries are easily the largest category in the berry sector NSW is not a major growing region generating only ~1% of the national production. The vast majority is produced in Queensland-46% and Victoria-36% (Hort Innovation, 2018). Furthermore, the majority of farms are relatively large-scale open field production (Strawberries Australia, 2018) and not what we would define as 'intensive'. Accordingly, the most viable fit for consideration in the agribusiness precinct is that of intensive protected cropping, and thus blueberries and rubus berries.

All berries are considered highly perishable, with rubus species the most sensitive – this challenge is so notable that there are currently no fresh imports (Hort Innovation, 2018). Any export opportunity would require rapid freight opportunities and minimised post-harvest handling, this highlights the opportunity for considering production in close proximity to the airport. Given the increasing domestic demand, current farm expansions underway and forecasted increased global demand it is definitely a worthy contender for production within the Precinct.

6.4.2. Blueberries and Rubus

Blueberries

Blueberries are the fastest growing fresh produce category globally (ABGA, 2018). Australian production is now year-round with commercial production in New South Wales, Victoria, Tasmania, Queensland, South Australia, and Western Australia (Hort Innovation, 2018). The industry has over 250 growers (ABGA, 2018) and is diverse in nature with a mix of small family farms through to large agribusinesses run by VIP companies such as Costa Group / Drisdol's Australia and Perfection Fresh Australia.

The industry continues to grow rapidly with production volumes of blueberry increasing by 25% from 2016 to 2017 (Hort Innovation, 2018), and significant future growth expected in the coming years.

Rubus Berries

Rubus Berries (such as raspberry and blackberry) are a minor sector in the total berry category (5% of production) yet is experiencing rapid growth with a 57% increase from 2015 to 2016 and a further 20% growth to 2017 (Hort Innovation, 2018). Production occurs in the same states as that of blue-berries with the larger VIP's noted above often producing both rubus sp. and blueberries. Raspberries dominate this sector accounting for around 85% of production. The growing systems are an evolving science and it is safe to say it is not yet standardised in Australia.

6.4.3. Technical Viability

Given the relatively new production of rubus species and the lack of comprehensive production data we have decided to focus on blueberries as the primary opportunity, whilst acknowledging that rubus production would be possible, it does require further investigation and research.

Blueberries are incredibly adaptable with a vast array of cultivars offering an enormous range of climatic conditions suitable for growth. There are five main types of blueberries (Source: Mann, 2015)

1. Lowbush Blueberries (Vaccinium angustifolium) – Grown wild on the prairies of Canada and North America; grown solely for processing; machine harvested; low inputs.
2. Rabbiteyes Blueberries (Vaccinium ashei & V. virgatum) – High yielding smaller sized fruit but very vigorous and grown mainly because they can be harvested on the shoulders of the season.
3. Northern Highbush Blueberries (Vaccinium corymbosum) – Grown in the cooler climates, these bushes are deciduous and require chill to initiate flowering.
4. Southern Highbush Blueberries (Hybrids of Vaccinium corymbosum x Vaccinium darrowii x Vaccinium angusti-folium). Grown in the warmer climates, these bushes are kept evergreen and growers try to keep them fruiting for longer periods and two harvest per season; require little to no chill.
5. Half-Highbush Blueberries (Hybrid of the Highbush x Lowbush) – These compact bushes can be very high yield-ing to their proportional size and show potential for being grown on raised benches in greenhouses.

The Badgerys Creek region would have climatic conditions that would suit Southern Highbush cultivars. The relatively cool winter periods would enable a reasonable degree of chilling hours enabling a broader selection of cultivars than more moderate (warm) regions. The summer temperatures are a little on the high side and some form of plant protection should be considered. The industry has now shifted to the majority of new plantings being in hydroponic substrates and this is what we recommend for the region.

It is our conclusion that two main cropping systems would be worthy of consideration:

1. Poly-tunnel production
2. Retractable roof production

Due to the availability of data and standardisation of the industry to date we will focus on category 1 above when carrying out the financial modelling.

6.4.4. Areas for further attention

1. Birds

Berry production has the potential to attract foraging birds which could increase the risk of bird-strike with aircraft. This type of production maybe considered a wildlife attracting land use and requires further investigation (Department of Infrastructure, regional development and Cities, 2108)

2. Summer Temperatures

High summer temperature will require the selection of suitable cultivars. Growers will also benefit from climate management solutions such as misting or fogging to take advantage of the low relative humidity's and the potential evaporative cooling effect. We have factored this into our capex estimates though highlight this as an area of note for potential investors.

6.5 AQUACULTURE

6.5.1. Sector Overview

Worldwide, food sourced from aquaculture has grown from 7% of total seafood consumed in 1971 to 44% in 2014 and had an estimated global value of US$160 billion (commonwealth of Australia, 2017). Global growth of the aquaculture sector is expected to continue and it is forecasted to account for more than half the world's fish production by 2020–21 (FAO, 2016).

Australia has a reputation for producing safe, sustainable, high-quality and high-value aquaculture products, yet with a value of only $1.31 billion in 2015-16 it accounts for less than 1% of global production (ABARES, 2017a). This affords a great opportunity for an increase in supply from Australia, in fact The National Aquaculture Strategy aims to double the current value of Australia's aquaculture industry to $2 billion by 2027. (Commonwealth of Australia, 2017).

Currently the vast majority of aquaculture production comes from Tasmania $731 million (56%) and SA $252 million (19%), while NSW represents only $65 million (5%) (ABARES, 2017a). Enabling NSW to be a larger contributor would have significant economic and social benefits for the state.

Given the obvious limitation that the precinct is land-locked with effectively no obvious access to major water ways suitable for production, one must ask the question what fit does aquaculture have within the precinct? In this instance we see the primary opportunity as intensive land-based systems such as Recirculating Aquaculture Systems (RAS).

6.5.2. Technical Viability

RAS allows high intensity production to be carried out with limited land and water input. They are typically technologically advanced systems with computer aided control systems to maintain the health of the organisms via correct water quality management (such as temperature, solids removal, oxygenation etc). Importantly, they are also carried out indoors meaning the risk of attracting birds is negated, a major issue for any consideration given the proximity to the airport.

Via industry consultation regarding suitable species with established production techniques we have identified two initial systems worth further investigation.

<u>Cold-water Finfish – Salmonid Species</u>

Salmonid species (such as trout and salmon) must be one of the first opportunities to investigate due to their economic significance. In 2015-16 the value of aquaculture production of salmonid species in Australia was $718 million (ABARES, 2017a) representing some 23% of the $3.03 billion national GVP of the fisheries sector.

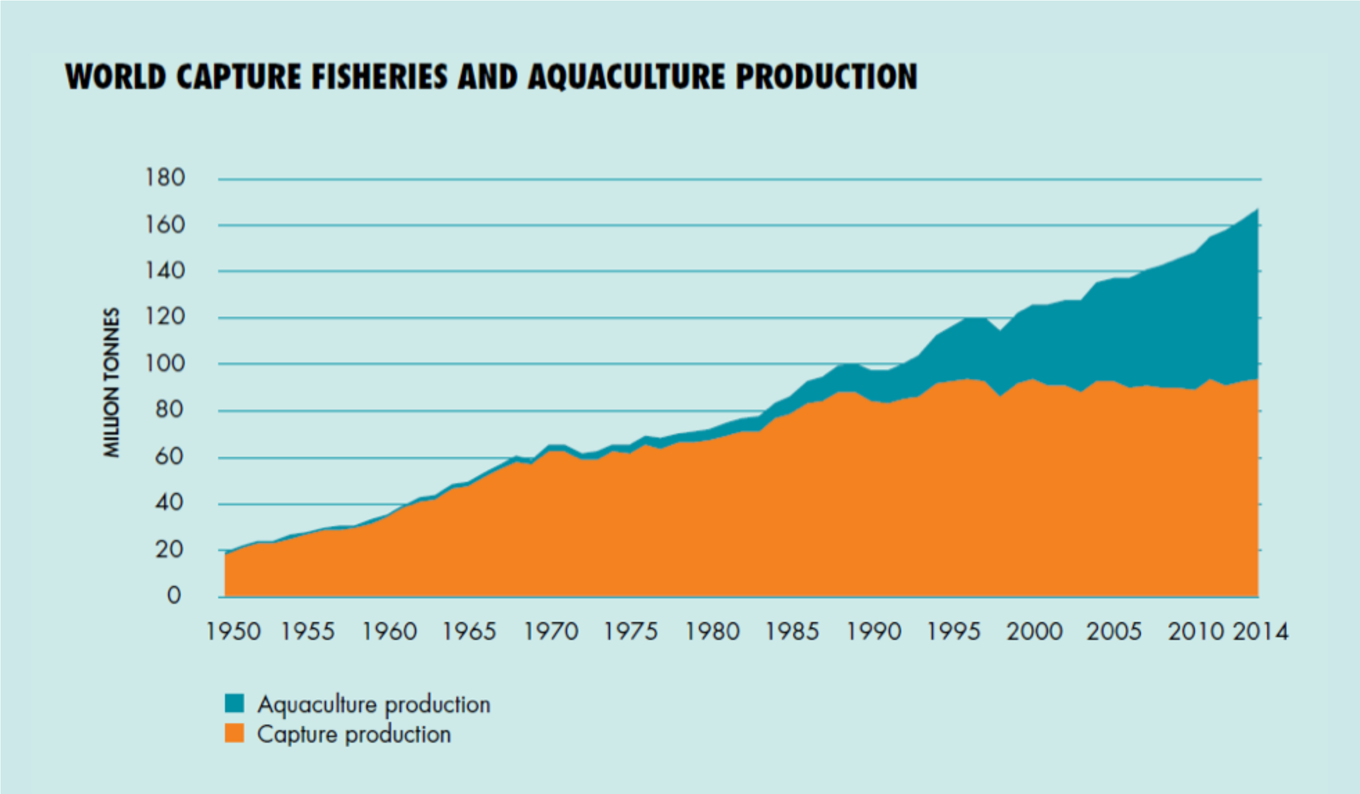
Currently the majority of production is done in sea pens – clearly not a possibility within the proposed agribusiness precinct. RAS tank production is an alternative solution to consider and there is a precedence for this, albeit not common in Australia. Specific technical factors that must be considered include the imbalance between the fish's temperature range and the local climatic conditions. For a system such as this to be implemented the technical requirements would have to focus heavily on the ability to supply high quality chilled water in a cost effective manner.

Engagement with industry specialists confirms that this is technically viable already and there is substantial evidence to suggest it is also economically viable. A report prepared by DNB Denmark in 2017 carried out IRR analysis comparing sea pen production with land-based systems for Salmon and determined that it was a viable and attractive proposition (Hanstad, 2017).

Global growth in aquaculture production

FIGURE 14

Source: FAO. 2016.



RAS production units have seen significant technological improvements over the past five to 10 years, and there are an estimated 150,000 tonnes of modern land-based systems in the pipeline by 2020 (Hanstad, 2017). An example of a modern farm of this nature is the Sapphire Atlantic Salmon Farm in Miami Florida (Atlantic Sapphire, 2018). This system is currently being developed at 10,000tonne per annum capacity for Atlantic Salmon – a true cold-water land-based RAS in a tropical climate – much warmer than that of the proposed agribusiness precinct.

Warm water Finfish – Barramundi and Murray Cod

Currently both Barramundi and Murray Cod are already being produced in NSW in this manner and combined have a modest GVP of $5 million (NSW DPI, 2018) though is growing rapidly from a base of just $2 million in 2014 (a ~250% increase). Both of these species currently achieve a relatively high value at farm gate when sold live $14-17/kg (NSW DPI, 2018), whilst chilled fish sold to Sydney fish markets typically net lower returns in the range of $9-$13kg (Sydney Fish Markets, 2018).

Both of these species can be grown in fresh / brackish water so being distant from the coast if of little concern. They are also considered a warm water species meaning the higher summer temps will not be a worry, and heating during winter should be viable via traditional methods.

Unlike the evolving Murray Cod category, farmed Barramundi is an established sector. It commenced in the mid 1980's and is now farmed in all mainland states along with the Northern Territory (ABFA, 2018). Australia currently produces around 7,000tonnes per annum of farmed barramundi, with 95% of this supplied by just nine producers (ABFA, 2018). The market is growing and production levels by 2020 are expected to reach 10,000tonnes with a 2025 target of 20,000tonnes (ABFA, 2018).

The major concern for these species is the absorption of large volumes into a relatively small market (domestic). Typical commercial RAS units are now in the vicinity of 2,000tonne/annum. This sizing helps enable economic viability due to scale, however in such a small market would create large gluts and drive price down resulting in a poor opportunity for return.

6.5.3. Areas for Further Attention

Water

A key area that would need to be considered for this is water, both incoming and waste output.

A reliable source of high quality water suited to the production system would be required in relatively large volumes to accommodate this type of production. Our initial investigation suggests that there will likely be a viable supply of high quality recycled water available to the precinct should the demand be significant enough. In this case we think that the source water solution can be adequately solved from a technical perspective.

A requirement for salt in many of the systems would also need to be addressed from a technical and economic stand point. Given the distance from the coast (45km) access to sea water is not a viable proposition and onsite blending would likely be required.

Outgoing waste water must be managed to avoid entry into local waterways. A good approach to this would be to enable the waste water as a resource for neighbouring agricultural enterprises. This could be in a relatively low-tech manner such as irrigation pasture, or more high-tech such a systems commonly termed aquaponics or adaptations thereof. At the very least a solution of some description would need to be developed to allow the required licencing to be gained.

Market Size

The Salmonid market would be an ideal opportunity, both domestically and globally. However, the technology required for its viability is relatively new and still only a few examples are underway globally. It is not as yet a truly proven opportunity here in Australia and a detailed site-specific business case would need to be developed. This may determine that the Precinct is not a suitable location for such an enterprise, yet it does warrant further consideration.

Barramundi and Murray cod production whilst technically viable only offer small market opportunities and any large volume producer in Australia would need to ensure they have prospects to move this fish either domestically or as exports. Even with the domestic sectors anticipated growth, the economics of large scale intensive warm-water fin fish would need to have a strong market offtake agreement to be considered.

The first three options of Poultry Broilers, Greenhouse vegetables and hydroponic blueberries are relatively mature segments with standardised production systems enabling us to verify their potential and carry out detailed financial modelling. The fourth option of intensive land based recirculating aquaculture is an evolving industry that shows strong future potential and warrants further assessment regarding the technical and economic viability of such a venture.

The process took into account the anticipated total capital outlay to develop a comparable greenfield site for each of option (excluding land purchase) giving us a range of $10.5 million for blueberry up to $90 million for semi-closed greenhouse vegetable production.

Utilising an aggressive discount rate of 10% all options generated a positive Net Present Value (NPV) over a 10 year comparison period, ranging from $270 thousand for Broiler chickens to $75.5 million for semi-closed glasshouse snacking tomatoes. The Internal rate of return (IRR) ranged from 10.2% for Broiler chickens to 26% for conventional glasshouse snacking tomatoes. We reiterate that these figures excluded land costs and more work is required here.

7 ECONOMIC ASSESSMENT OF INDUSTRY SECTORS

7.1 BACKGROUND ON ECONOMIC ANALYSIS PROCESS

The analysis was tasked with assessing the economic viability of various production systems as a standalone entity and for comparison between sectors. The goal is to highlight those business types that have the best fit within the precinct and can enable the optimisation of land use. It identifies some of the sectors that would be economically sustainable business enterprises.

The values provided are indicative in nature and a sensitivity analysis should be performed in regards to core items such as but not limited to yield, produce prices and major input costs (especially energy).

7.1.1. Data Collection Process

Data for the economic analysis was obtained from a variety of sources including direct consultation with producer's and industry bodies representative of each sector. Publicly available data from published reports was also taken into account along with experience from within the data sets from Agrology Pty Ltd and NSW DPI.

All data collected via industry consultation was verified across multiple sources and then adapted to be representative of true industry metrics which are verifiable and useable for developing economic models. These models then formed the foundation of the analysis that follows.

Due to the sensitive nature of commercial terms supplied by business this report has kept the sources of data as anonymous. The validity of any data used is representative of businesses operating in the fields of concern.

7.1.2. Core Assumptions

Site Assumptions

Each site was considered as a standalone greenfield site and assumes access roads, water and power to site entrance / boundary. All works to service site internal connectivity are captured in the Capex component. We have allowed reasonable estimates for development application processes, earth works, civil works, and all auxiliary facilities required to develop the sites into operational businesses.

The analysis compared relatively like for like land use parcels. All business assumed a useable land area requirement of around 25-30 hectares (total), this would be the minimum size of a modern enterprise of this type, with ~40 hectares and above becoming increasingly common and larger sites would bring further economies of scale.

The land size used is representative of the minimum requirements to attract appropriate investors. There would be further economies of scale on larger sites which would accordingly increase the financial yields.

Land Values

Occupancy rates and land values have not been included in this analysis, all comparisons are compared equally and fairly without speculation on land values. When approaching farming as a business there are many methods and strategies towards land evaluation and cost, and this process was not within the scope of this report, though is required in the next steps planning for the precinct.

Pricing

All produce pricing is based on current and recent historic domestic figures reflective of the intended products and production windows. We assume direct supply to retail where appropriate (no middle man) and have applied industry-based rebate structures. We acknowledge that export opportunities may offer a further premium that would enable a more lucrative financial return, but as this is speculative it is not include in the analysis.

We have not taken into account inflation or anticipated market price variation on any inputs or sales.

Production Yields

All yield data was derived from actual figures prepared in consultation with industry leading producers and /or industry validated bench marks. We have specifically targeted the better operators yet have taken median yields for them rather than upper or lower years.

Energy, Water and Gas

Energy and water have been estimated based on data obtained for the region and utilises the same figures for each financial model. We have assumed use of high quality recycled water servicing the precinct and electrical supply from the grid. The latter could be serviced from localised generation (such as combined heat and power generators or photovoltaics) and would significantly reduce the cost of power.

Currently there is no gas pipeline to site so we have assumed the use of tanker delivered LPG using current price estimates for agricultural production in the region. The development of alternate heat fuel stocks or the installation of gas lines could enable further financial gains.

Timelines and ROI

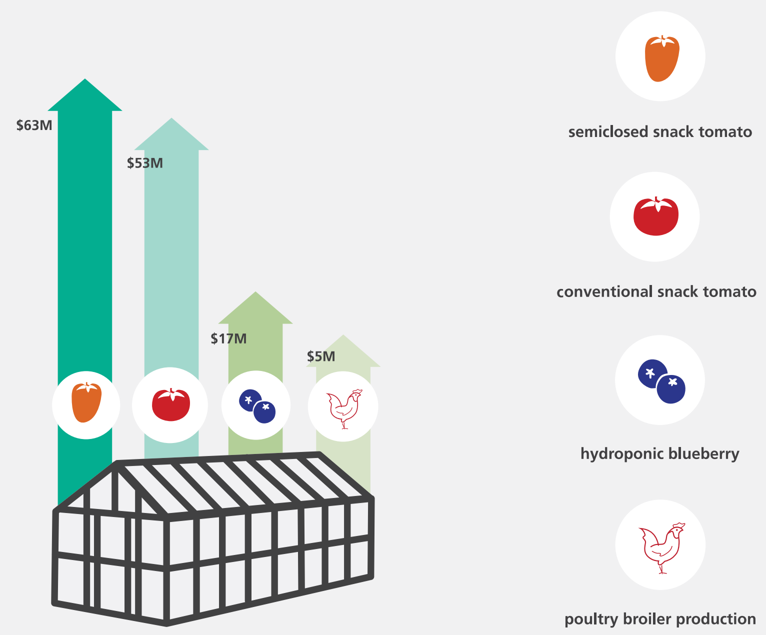
We have assessed each business over a 10-year period to allow comparisons of crops and businesses that take longer to reach optimal production (e.g. Blueberries) but not to adversely impact the remainder. At the 10-year end we have included a reasonable assessment on the residual capital investment on infrastructure base on typical depreciation rates for each sector.

7.1.3. How to Interpret the Analysis

To enable analysis of the profitability of the individual capital investments over time we have displayed both a Net Present Value (NPV) and Internal Rate of Return (IRR) for each business option over the same 10-year horizon. All parties we spoke to acknowledged in the current climate this is the maximum timeframe they would look at to assess a return on investment for large capital outlay. It was also deemed the minimum time period over which all systems could be fairly compared. As noted above, the residual value of the assets based on reasonable industry specific depreciation rates are included in the year 10 cashflow.

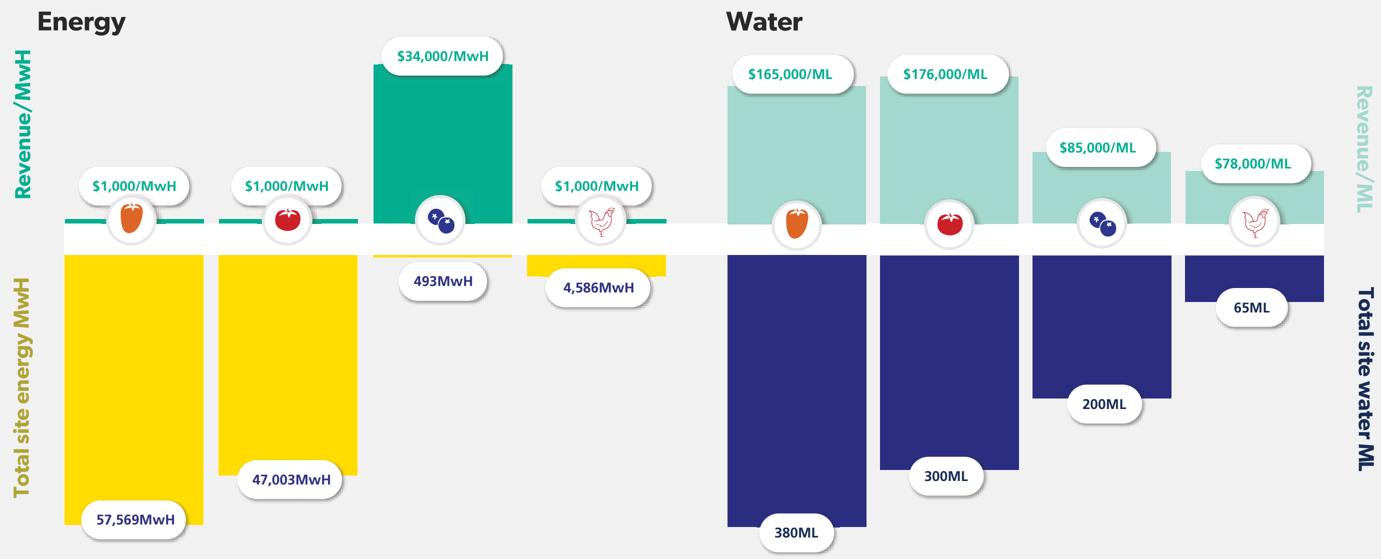
The discount Rate applied to the NPV is quite aggressive at 10%. Again, this was derived via consultation with leading industry players based on their return expectations in the current climate.

Due the amount of intellectual property contained within the financial models, along with the sensitive nature of the sources, only the final output is presented in this report.



Peak annual production per 20ha production area

FIGURE 15



Energy and water use per commodity

FIGURE 16

7.2 ECONOMIC ANALYSIS BY SECTOR

Detailed economic modelling was carried out for the first of three of the four identified sectors (outlined below). Detailed modelling on the aquaculture component was not possible in the timeframe of this report, however we note global examples that indicate viability and warrant further investigation in section 7.4.1.

1. Livestock production – Poultry meat production (Chickens)
2. Intensive horticulture production – Vegetables (Tomatoes)
3. Intensive horticulture production – Berries (Blueberry)
4. Recirculating aquaculture production – Fin Fish

We acknowledge there are potentially many more opportunities for consideration but given the time constraints these examples were identified as key exemplary options to begin shaping the image of primary production possibilities.

All models are based on a comparable foot-print of around 25-30 hectares of total land area, the minimum size that would create economic interest to large investors. The metrics presented below could be extrapolated with yields increasing proportionally with production area, but a slight decrease in the capital expenditure per hectare and a reduction in operating cost, particularly management overheads.

For each sector we have highlighted a table of key metrics for the reader to better understand the size and type of operations.

Figure 16 shows the economic intensity of the comparative production options and will add some context to the systems being assessed in the following sections. Even at a cursory glance it is abundantly clear that glasshouse vegetable production is truly intensive, both terms of inputs and outputs. For these reasons it presents a very interesting option for the limited land area within the Precinct. It also enables the reader to visualise the Resource Availability discussion noted in section 6.3.

7.2.1. Livestock Production – Poultry Meat Production (Broiler Chickens)

Poultry meat production is currently undergoing a change much like that discussed for greenhouse production – overall production is increasing, but the number of farmers / enterprises is decreasing. Farms of six to eight sheds are considered the absolute minimum for cash-flow positive status and even these are regarded as negligible.

The 26-shed model we have described below is still relatively small compared to modern operators who may share resources across four or more similar sized sites. We have taken this into consideration when carrying out the financial modelling and acknowledge that a larger four site farm would generate a slightly higher financial yield.

7.2.1.1. Economic Model Output – Broiler Production

The financial modelling of broiler chicken production assumed a site development capex of $21.55 million with a useable life of 25years. Modelling was carried out over a 10year period. With an applied discount rate of 10% the NPV is $271,767. The IRR for this system is estimated at 10.2%.

7.2.2. Intensive Horticulture Production – Vegetables (Tomatoes)

Most greenfield investment sites would look to a minimum production area of around 20hectares, preferably with the opportunity to expand beyond this to 40hectares plus. A 20hectare site can easily operate as a stand-alone business model, but larger sites would afford economies of scale and accordingly generate better financial yields. It is likely most investors would look favourably to larger land parcels.

Energy is becoming an increasing burden on modern systems. In a semi-closed house, the energy cost (heating and electrical) is estimated to be ~20% of the total cost of production – second only to labour. Localised energy generation on site is becoming more and more common. This is often via the utilisation of combined heat and power (CHP) generators which also provide carbon dioxide that optimises photosynthesis and increase crop yields.

These power generation solutions can also be incorporated into supplying residential or commercial neighbours in so reducing operating cost for the business and generating benefits to constrained local networks. Opportunities in this space must be considered for the broader precinct and could increase the financial yields of these business enterprises above the modelled figures presented.

The analysis presented utilised the benchmark (and market dominant) crop of tomatoes and selected the two major categories; Truss and Snacking. The economics of other fruiting crops species such as Cucumber and Capsicum would fall within a similar range as that presented, though of course a detailed economic analysis is recommended along with assessment of sales options proportionate to production volumes.

7.2.2.1. Economic Model Output – Tomatoes

The financial modelling of glasshouse tomato production was carried out with four scenarios, testing two different production systems across the two major categories:

1. Conventional venlo glasshouse – Truss Tomato
2. Modern semi-closed glasshouse – Truss Tomato
3. Conventional venlo glasshouse – Snack Tomato
4. Modern semi-closed glasshouse – Snack Tomato

Key metrics used for the economic analysis of Poultry, Tomatoes and Blueberries

TABLE 3

CATEGORY	BROILER PRODUCTION	CONVENTIONAL TRUSS TOMATO	SEMI-CLOSED TRUSS TOMATO	CONVENTIONAL SNACKING TOMATO	SEMI-CLOSED SNACK TOMATO	BLUEBERRY
PRODUCTION TECHNOLOGY	Tunnel ventilated shed	Conventional venlo glasshouse – hydroponic	Conventional venlo glasshouse – hydroponic	Conventional venlo glasshouse – hydroponic	Conventional venlo glasshouse – hydroponic	Polyhouse / Tunnel production – hydroponic
SHED SIZE	2,736m²	200,000m²	200,000m²	200,000m²	200,000m²	200,000m²
NUMBER OF SHEDS	26	NA	NA	NA	NA	NA
ESTIMATED SITE DEVELOPMENT CAPEX	$21.55 million	$70 million	$90 million	$70 million	$90 million	$10.47 million
TOTAL PRODUCTION AREA	71,136m²	200,000m²	200,000m²	200,000m²	200,000m²	200,000m²
ESTIMATED ANNUAL PRODUCTION	7,275,840 birds	13,000,000kg	15,000,000kg	5,200,000kg	6,200,000kg	1,040,000kg (during peak prod)

The resulting output from the financial models showed an interesting assessment. In both categories the models anticipate a better IRR for conventional glasshouses with a range from 15.1% for semi-closed truss through to 26% for conventional snacking tomatoes. The NVP for truss tomato production was almost identical across both production systems at around $24million, whilst snacking tomatoes in conventional production outshone all options with a NPV of $61.4 million.

7.2.3. Intensive Horticulture Production – Blueberries

Again, in a similar theme to the other industries a 20hectare production area of modern hydroponic berries would be on the minimum side of investment interest, with typical producers looking to have the ability to expand this out beyond the 40-50hectare range in future developments.

Whilst all yields utilised were verified with domestic producers, data we have acquired over global visits suggest much higher yields are possible with further breeding and crop husbandry practice. This opportunity could elevate the financial returns significantly above those modelled, though this is not verifiable for inclusion within the report.

7.2.3.1. Economic Model Output – Blueberries

The financial modelling of blueberry production assumed a site development capex of $10.47 million with a useable life of 20years, and a crop life of 10years. Modelling was carried out over a 10year period (assuming a replant would occur in year 11). With an applied discount rate of 10% the NPV is $6.77 million. The IRR for this system is estimated at 18.2%.

7.2.4. Recirculating Aquaculture Production – Fin Fish

Large scale land-based RAS is not what can be described as a conventional investment strategy today, though this is changing. Investment and operational costs of traditional aquaculture are rising rapidly, whilst land-based technology has moved in the opposite direction. Add to this the high levels of control and mitigated risk of environmental influence and we see a new focal point for future investment opportunities. Could this be the Greenhouse of the Aquaculture world and parallel the shifts we see vegetables production towards protected environment production?

Unlike their more standardised horticulture comparative (Greenhouses), controlled environment land-based RAS systems are an evolving science and still not what can be deemed as standardised / mature. Furthermore, the world leaders in this space are not always willing to share sensitive data to potential competitors. Whilst we have identified avenues to develop detailed financial models for the production in the region, this could not be completed within the scope of this report. For now, we must draw our analysis from the limited data currently available.

A Report carried out by the Danish Bank DNB (Hanstad, 2017) shows examples of the possibilities of land bases RAS from an economic investment point of view. A key factor highlighted the potential transport advantage afforded by the site selection possibilities of a land-based system, in particular locating near direct demand (cities) or international airports with fit-for-purpose cool chain capacity. Something only too obvious when we consider the WSA agribusiness precinct opportunity- with not only a huge domestic supply on your door step (Sydney) but a whole world that is less than 36hours away.

Financial models are only as good as the data entered and accordingly we acknowledge the report focused on a completely different continent, so must not be taken out of context. It does however highlight the possibilities and flag the opportunity for further investigation. Data output from the DNB report showing a land-based system with transport advantage (setting up a land-based facility in or close to an end market) makes sense offering a favourable IRR of 23% when compared against traditional sea pen systems at only 15% (Hanstad, 2017).

The investment by Sapphire Atlantic into a Stage 1 facility producing 10,000 tonnes per annum of land based Atlantic Salmon in Miami Florida is driven by an intent to bring production closer to the end point consumer (Atlantic Sapphire, 2018). This is taking into action the aforementioned model of transport advantage. Their intent to continue development to 90,000tonnes per annum highlights the market potential of such operations, even in what would traditionally appear as nonconventional climate.

Whilst all of these observations must be taken in context, it still highlights the potential opportunity and the need for more detailed works to be carried out if it is to be considered for the Precinct.

10year cash flow forecast – Broiler production, Tomatoes & Blueberries

TABLE 4

YEAR	0	1	2	3	4	5	6	7	8	9	10
BROILER PRODUCTION											
Residual Value of Capex $											12,240,000
Cash Flow $	21,550,000	2,783,388	2,783,388	2,783,388	2,783,388	2,783,388	2,783,388	2,783,388	2,783,388	2,783,388	15,023,388
Cummulative Cash Flow $	21,550,000	18,766,612	15,983,223	13,199,835	10,416,446	7,633,058	4,849,669	2,066,281	717,107	3,500,496	18,523,844
CONVENTIONAL TRUSS TOMATO											
Residual Value of Capex $											35,000,000
Cash Flow $	70,000,000	13,095,378	13,095,378	13,095,378	13,095,378	13,095,378	13,095,378	13,095,378	13,095,378	13,095,378	48,095,378
Cummulative Cash Flow $	70,000,000	56,904,622	43,809,244	30,713,866	17,618,488	4,523,110	8,572,268	21,667,656	34,763,024	47,858,402	95,953,780
SEMI-CLOSED TRUSS TOMATO											
Residual Value of Capex $											45,000,000
Cash Flow $	90,000,000	15,759,452	15,759,452	15,759,452	15,759,452	15,759,452	15,759,452	15,759,452	15,759,452	15,759,452	60,759,452
Cummulative Cash Flow $	90,000,000	74,240,548	58,481,096	42,721,644	26,962,192	11,202,740	4,556,712	20,316,164	36,075,616	51,835,068	112,594,520
CONVENTIONAL SNACK TOMATO											
Residual Value of Capex $											
Cash Flow $	70,000,000	19,189,560	19,189,560	19,189,560	19,189,560	19,189,560	19,189,560	19,189,560	19,189,560	19,189,560	54,189,560
Cummulative Cash Flow $	70,000,000	50,810,440	31,620,881	12,431,321	6,758,239	25,947,798	45,137,358	64,326,918	83,516,477	102,706,037	156,895,597
SEMI-CLOSED SNACK TOMATO											
Residual Value of Capex $											
Cash Flow $	90,000,000	24,108,381	24,108,381	24,108,381	24,108,381	24,108,381	24,108,381	24,108,381	24,108,381	24,108,381	69,108,381
Cummulative Cash Flow $	90,000,000	65,891,619	41,783,237	17,674,856	6,433,525	30,541,906	54,650,288	78,758,669	102,867,050	126,975,431	196,083,813
BLUEBERRY											
Residual Value of Capex $											3,427,417
Cash Flow $	10,471,500	3,027,713	1,058,595	2,825,062	3,808,295	4,791,528	4,791,528	4,791,528	4,791,528	3,808,295	6,252,478
Cummulative Cash Flow $	10,471,500	13,499,213	12,440,618	9,615,556	5,807,261	1,1015,733	3,775,796	8,567,324	13,358,853	17,167,148	23,419,626

Discount Rate	10%
NPV	$271,767
IRR	10.2%
Peak Capital	$21,550,000

Discount Rate	10%
NPV	$23,959,444
IRR	16.4%
Peak Capital	$70,000,000

Discount Rate	10%
NPV	$24,184,459
IRR	15.1%
Peak Capital	$90,000,000

Discount Rate	10%
NPV	$61,405,552
IRR	26%
Peak Capital	$70,000,000

Discount Rate	10%
NPV	$75,485,014
IRR	25.3%
Peak Capital	$90,000,000

Discount Rate	10%
NPV	$6,774,173
IRR	18.2%
Peak Capital	$13,499,213

LIST OF FIGURES

Figure 1. Location of the new agribusiness precinct 11
Figure 2. Initial precinct planning 12
Figure 3. SA2 regions used in the analysis 15
Figure 4. GVP by commodity type 17
Figure 5. GVP by SA2 region 17
Figure 6. Historical annual light figures 26
Figure 7. Daily variation from the mean light value 26
Figure 8. Minimum and maximum temperatures by month 28
Figure 9. Comparison of annual rainfall 29
Figure 10. Mean and median monthly rainfall 29
Figure 11. Monthly average relative humidity levels 32
Figure 12. Monthly windspeed statistic 32
Figure 13. Data for the main vegetable crops grown in Australia 40
Figure 14. Global growth in aquaculture production 47
Figure 15. Peak annual production 53
Figure 16. Energy and water use per commodity 54

LIST OF TABLES

Table 1. GVP by SA2 region and commodity type 18
Table 2. Climatological analysis by month 25
Table 3. Key metrics used in economic analysis 55
Table 4. 10 year cash flow forecast 57

REFERENCES

ABARES 2017a. Australian fisheries and aquaculture statistics 2016. Australian Bureau of Agricultural and Resource Economics and Sciences.

ABARES 2017b. Agricultural Commodities, Australia and state/territory, 2015-16.

ABFA 2018. Australian Barramundi Farmers Association. https://www.abfa.org.au/

ABGA 2018. Australian Blueberry Growers Association. https://abga.com.au

ABS 2017. 7530 Value of Agricultural Commodities Produced, Australia, 2015-16 State & SA2 Region

Atlantic Sapphire 2018. Atlantic Sapphire. http://atlanticsapphire.com/

Australian government bureau of meteorology 2015. Western Sydney Airport climatological review.

Commonwealth of Australia 2017. National Aquaculture Strategy. September 2017. Department of Agriculture and Water Resources. Canberra

Department of Infrastructure, regional development and Cities 2018. National Airports Safeguarding Framework Principles and Guidelines. Guideline C: Managing the Risk of Wildlife Strikes in the Vicinity of Airports. Australian Government. https://infrastructure.gov.au/aviation/environmental/airport_safeguarding/nasf/nasf_principles_guidelines.aspx

Department of Planning and Environment 2018. Western Sydney Aerotropolis, land use and infrastructure implementation plan. August 2018

FAO 2016. The state of world fisheries and aquaculture 2016. Contributing to food security and nutrition for all, Food and Agriculture Organization of the United Nations, Rome.

Hanstad, Tone Bjørnstad 2017. DNB Markets Seafood – Special Report. Equity research. Research report prepared by DNB Markets, a division of DNB Bank ASA.

Hickman, Gary W. 2017. International Greenhouse Vegetable Production – Statistics 2017 Edition. Cuesta Roble Greenhouse Consultants.

Hort Innovation 2018. Australian Horticulture Statistics Handbook. Fruit. 2016/17

Mann, Nicky 2015. Nuffield Scholarship paper: Intensive Berry Production Using Greenhouses, Substrates and Hydroponics. Is this the Way Forward?

Mullaby, James 2017. IBISWorld Industry Report. Under Cover Vegetable Growing - Australia Market Research Report.

NSW DPI 2017. Performance, Data and Insights 2017. New South Wales Department of Primary Industries

Smith, G. 2016. Overview of the Australian Protected Cropping Industry. Protected Cropping Australia. Protected Cropping Australia. https://www.protectedcroppingaustralia.com/wp-content/uploads/2016/06/National-Training-Centre-for-Controlled-Environment-Horticulture-PART-1.pdf

Strawberries Australia 2018. Strawberries Australia Inc. http://www.strawberriesaustralia.com.au

Sydney Fish Markets 2018. https://www.sydneyfishmarket.com.au/seafood-trading/fish-prices

Transport for NSW 2018. Western Sydney Freight Line recommended corridor. NSW Government

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