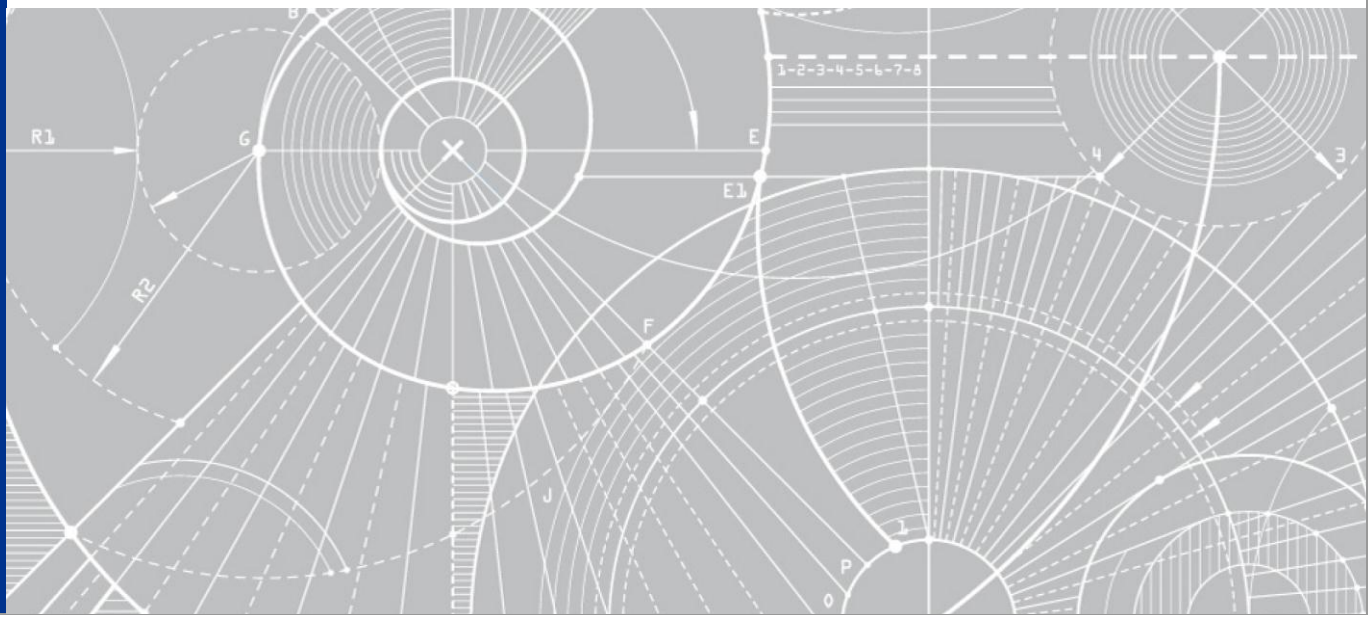
Mount Emerald Wind Farm Economic Impact Assessment

RATCH-AUSTRALIA CORPORATION

Final 30 October 2014



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Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to provide an economic impact assessment and response to submissions in accordance with the scope of services set out in the contract between Jacobs and RATCH-Australia Corporation (RATCH-Australia). That scope of services, as described in this report, was developed with RATCH-Australia.

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1. Introduction

RATCH-Australia Corporation (RATCH-Australia) is proposing to develop the Mount Emerald Wind Farm (MEWF) (the project). The project will involve the construction of approximately 63 wind turbines on a rough plateau near Mount Emerald west of the Kennedy Highway between Atherton and Mareeba in Far North Queensland.

The project was referred under the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) to the Minister for Sustainability, Environment, Water, Population and Communities on 21 December 2011. A delegate of the Minister determined on 24 January 2012 that the proposed development was a controlled action under the provisions of the EPBC Act and would require an Environmental Impact Study (EIS).

The EIS for the project underwent public notification from 28 May 2014 to 2 July 2014. A total of 26 questions relating to socio-economic matters were raised in submissions during the public notification period.

1.1 Purpose of the report

The purpose of this report is to:

- Provide a complete and independent Economic Impact Assessment for the project.
- Respond to the socio-economic issues raised in the public submissions.

1.2 Report structure

This report is structured as follows:

1) Introduction, providing an overview of the report purpose and structure.
2) Policy and strategic context, providing an overview of relevant strategic policy and context.
3) Existing socio-economic environment, providing demographic and economic data.
4) Economic impact assessment, outlining economic impacts from the construction and operation phases of the project.
5) Economic impacts to local agricultural operations, particularly from changes to bat populations and aerial spraying.
6) Business and social impacts, such as changes to amenity.
7) Tourism impacts, providing an overview of international and national literature on impacts to tourism industry from wind farm development.
8) Property impacts, providing an overview of international and national literature on impacts to property prices from wind farm development.
9) Energy supply impacts, providing an overview of costs and impacts to the supply energy to the market.
10) Summary and conclusion, providing a brief summary of the key findings of this report.

2. Policy/strategy context

This section provides an overview of the broader economic policies and strategies relevant to the project and the study area.

Tropical North Queensland Renewable Energy Industry Development Plan

The Tropical North Queensland Renewable Energy Industry Development Plan (the Plan) was published by the Queensland Government Department of Energy and Water Supply in July 2012. The Plan provides a pathway for co-ordinated development of the renewable energy industry in the Tropical North Queensland region, being the four LGAs of Cairns Regional Council, Cassowary Coast Regional Council, the Cook Shire Council and the Tablelands Regional Council. However, the Plan also acknowledges and integrates the economic links which extend beyond these LGAs. These economic links extend to areas such as the Cape York Peninsula and the Torres Strait, the Gulf of Carpentaria, and Hinchinbrook.

The Plan is based on findings from a survey conducted in 2012 of local industry participants located in the four LGAs listed above. The survey identified a number of key strengths for these LGAs, namely photovoltaic solar, large scale wind generation, bagasse and biodiesel production. An analysis of these capabilities has resulted in the formulation of a vision for the region for the development of the renewable energy industry. The vision is “to enhance and diversify the economy of Tropical North Queensland through the support, development and deployment of renewable energy technologies that deliver industry growth through increased revenue, jobs and renewable energy capacity” (page 3). Four strategies were developed to support the implementation of this vision and these strategies are, as outlined on page 35 of the Plan:

1) To facilitate Tropical North Queensland renewable energy projects.
2) Foster renewable energy innovation.
3) Focus on areas of expertise.
4) Increase local manufacturing.

The Plan acknowledges that a key area of wind resource in the region is located on the Atherton Tableland, between Atherton and Mareeba, around the location of the Mt Emerald Windfarm Project. The project aligns with the vision and objectives of the Plan to grow the renewable energy industry in the Tropical North Queensland LGAs through the construction and operation of a viable renewable energy project.

Tablelands Futures Corporation Strategic Plan 2012 – 2017

The Tablelands Futures Corporation Strategic Plan (the Strategic Plan) was published by the Tablelands Futures Corporation, a peak regional development body in the Tablelands region, in August 2012. The Strategic Plan outlines the vision for the Tablelands region from 2012 to 2017 and sets the strategic and operational priorities for the Tablelands Futures Corporation until 2017. The aim of the Strategic Plan is to identify and pursue opportunities for development, enhancement and diversification across the Tablelands region, as identified during the course of consultation with business, local government and community organisations. The overall strategic goal is for the Tablelands region to have a thriving and sustainable economy. The strategic objectives include:

1) Greater economic return on the region’s assets.
2) Increased business and industry growth and diversification.
3) Increased employment and training opportunities (quantity and range).

The project aligns with the vision articulated in the Strategic plan as it would contribute and improve the sustainability of the region’s economy by offering employment opportunities for the local population and by providing a cost-effective and renewable electricity source.

Far North Queensland Regional Plan 2009-2031

The Far North Queensland Regional Plan 2009-2031 (Regional Plan) (Department of State Development, Infrastructure and Planning, 2009) is the blueprint that will manage economic growth and guide development in the region until 2031. The Regional Plan applies to the following local government areas:

- Cairns Regional Council.
- Tablelands Regional Council (including Mareeba Shire Council).
- Cassowary Coast Regional Council.
- Yarrabah Aboriginal Council.

The Regional Plan emphasises the need to manage population growth in these LGAs to maximise land use and development outcomes, deliver efficient infrastructure, respond to changing community characteristics and protect natural resources and the environment.

In relation to the Far North Queensland's economy, the vision set out in the Plan is for 'a stronger, more liveable and sustainable community where the economy is vibrant, robust and diverse, firmly based on the principles of ecologically sustainable development'. The project supports this vision by promoting a new, sustainable industry in Far North Queensland, as well as addressing increased demand for energy.

3. Socio-economic baseline

This section describes the existing socio-economic environment of the study area.

3.1 Study area

The study area for the socio-economic baseline was determined based on:

- A review of areas which are likely to experience changes as a result of the project, including the local area where the development is located and areas from which labour and materials for construction and operation are likely to be sourced. For the purposes of this report, it is assumed:
  - Labour and materials in the areas of electrical, transport, machine hire and operation, general labour, quarries, cement and facility maintenance could be sourced from the Tablelands region.
  - Specialist skills, such as technical Wind Farm construction experts, and specialist materials such as turbines would need to be sourced from other national or international locations.
- A review of the *Mount Emerald Windfarm Economic Impact* report (Cummings Economics, 2013), dated April 2013, to generally align with the study area used in this report with that used on the *Mount Emerald Windfarm Economic* Impact report.
- A review of the Information Request issued by the Deputy Premier and Minister for State Development, Infrastructure and Planning under Section 276 of the *Sustainable Planning Act 2009*.

The project is located in Far North Queensland, about 60 kilometres west of Cairns and between Atherton and Mareeba. Atherton is located within the Tablelands Region local government area (LGA) and Mareeba is located within the Mareeba Shire LGA.

The Tablelands Region LGA was formed in March 2008 as a result of amalgamation of the former Atherton, Eacham, Herberton and Mareeba Shires. The Tablelands Region was de-amalgamated in 2013, forming the new Tablelands Region and Mareeba Shire LGAs. The Tablelands Region LGA now comprises the former Atherton, Eacham and Herberton Shires and the former Mareeba Shire now forms its own LGA.

Publicly available demographic data is available from the Australian Bureau of Statistics (ABS) 2011 Census of Population and Housing (Census), at which time the Mareeba Shire LGA was located within the Tablelands Region LGA. As such, data presented at the regional level uses the 2011 LGA boundary of Tablelands Regional Council (Tablelands region), which included the Mareeba Shire LGA, unless otherwise stated.

The study area for the socio-economic baseline comprises the following areas:

- Local study area, comprised of Atherton SA2 located to the south of the project, and Mareeba SA2, located to the north of the project.
- Tablelands region, comprised of the formally amalgamated Tablelands Regional LGA (incorporating Mareeba Shire Council LGA and Tablelands Regional Council LGA).
- Far North Queensland region, comprising data from the Townsville SA4, Cairns SA4, Far North SA3 and Outback North SA3.

In order to provide a baseline for which socio-economic statistics are compared and to provide a context for which expenditure from ‘outside of the region’ is sourced, socio-economic statistics for the State of Queensland are also be provided.

Figure 3.1 provides an overview of the socio-economic study area.

3.2 Regional context and land use pattern

The Tablelands region is an elevated plateau and the hinterland area of the tropical city of Cairns. The Tablelands region covers diverse land uses including national park and state forest, rural areas and growing rural-residential and township areas.

European settlement occurred in the region from the 1880s to develop timber and dairy industries. A railway line was constructed to several townships in the Tablelands region in the 1920s. The primary industries remain important in the Tablelands region, along with a growing tourism industry. Rural land in the region is mainly used for crop farming, cattle grazing, timber production, mining and tourism. The Tablelands region is well recognised for its natural environment such as tropical world heritage rainforests, waterfalls, crater lakes, expansive savannahs and wetlands. The Tablelands region also has a rich Aboriginal heritage.

According to the Tablelands Future Corporation (Tablelands Futures Corporation 2013) the region is a lifestyle destination of choice for many “tree changers” leaving the cities in search of a quieter lifestyle or for those people who are simply attracted to the natural assets, its tropical climate and its relative proximity to Cairns.

The main population centres in the Tablelands region are Mareeba and Atherton, with a number of small rural townships dispersed throughout the region such as Kuranda, Millaa Millaa, Yungaburra and Malanda (Tablelands Futures Corporation 2013). Atherton is the business and commercial centre for the populous southern end of the Tablelands region, and offers primary and secondary education facilities and a Tropical North Institute of TAFE, the Atherton Hospital, accommodation and local businesses and services. Cairns is the closest major service centre to the Tablelands, and provides higher order health and education services, as well as diverse employment and industrial uses.

The townships closest to the project site are Walkamin and Tolga. Walkamin, located in Mareeba Shire Council LGA, is located approximately five kilometres east of the project. Walkamin is a small rural town located on the Kennedy Highway. It had a population of about 450 people at the 2011 Census. Tolga, located in the Tablelands Regional Council LGA, is located approximately eight kilometres south-east of the project on the Kennedy Highway. At the 2011 Census, Tolga had a population of around 878 persons. The range of social infrastructure and community facilities located at Walkamin and Tolga is outlined in **Section 3.6**.

Residential acreage subdivisions offering rural residential and ‘lifestyle’ blocks of land are occurring around the fringe of Mareeba, including the Oaky Creek Estate, Brookland Estate near Chewko Road, Springmount Park Estate near Springmount Road.

Residents of the Tablelands region are serviced by the Kennedy and Palmerston Highways.

FIGURE 1-1 SOCIO-ECONOMIC STUDY AREA

LEGEND

- Project Site
- Town
- Road

ABS Boundary

- Local Study area-Atherton SA2 and Mareeba SA2
- Tablelands Region-Tablelands Regional LGA
- Far North Queensland region - Townsville SA4, Cairns SA4, Far North SA3 and Outback North SA3

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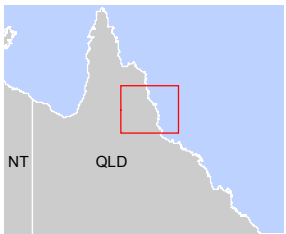

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Document Path: I:\QENV2\Projects\QE06742\Spatial\ArcGIS\Figures\140901_Figure 1-1 Socio-economic study area.mxd

3.3 Population and demography

This section describes the key population, demographic and housing characteristics of the local study area and Tablelands region. The information presented is based on data from the ABS 2011 Census unless otherwise stated.

3.3.1 Population

In June 2013, the local study area had an estimated resident population of 21,618 people, which comprised 46.8 per cent of the Tablelands region (**Table 3-1**).The local study area population grew an average of 1.5 per cent per annum between 2008 and 2013, higher than in the Tablelands region but slower than that recorded for Queensland.

Table 3-1 Estimated Residential Population 2008-2013

Location	Estimated resident population		Population change (2008-2013)	
	2008	2013	Number	Average annual per cent change %
Local study area	20,028	21,618	1,590	1.5
Tablelands region	43,622	46,175	2,553	1.1
Far North Queensland	497,527	541,911	44,384	1.7
Queensland	4,219,505	4,656,803	437,298	2.0

Source: ABS Regional Population Growth, Australia: Estimated Resident Population, NSW Statistical Areas Level 2, 2013

The local study area had a population of 20,965 people at the time of the 2011 Census. This is anticipated to increase to some 27,821 people by 2036, an average annual growth rate of 1.0 per cent (**Table 3-2**). While this is slightly higher than the growth rate expected to occur in the Tablelands region, it is less than the growth rates for the Far North Queensland region and Queensland as a whole over the same period (at 1.6 per cent and 1.9 per cent respectively). In particular, Atherton is anticipating a slow population growth rate, with an average annual growth rate of 0.8 per cent over 25 years from 2011.

Table 3-2 Population projections, 2011-2036

Location	Population		Population change (2011-2036)	
	2011	2036	Number	Average annual per cent change %
Local study area	20,965	27,821	6,856	1.1
Tablelands region	45,117	58,013	12,896	1.0
Far North Queensland	565,658	847,605	281,947	1.6
Queensland	4,476,778	7,095,177	2,618,399	1.9

Source: Queensland Government Statistician, population projections (medium series) by statistical area (2013 edition)

Compared with Far North Queensland as a whole, the local study area and the Tablelands region is generally comprised of an older population. In 2011, around 19.4 per cent of people resident in the local study area and 17.9 per cent resident in the Tablelands region were aged 65 years or older, compared with 11.2 per cent for Far North Queensland as a whole. Atherton recorded a high proportion of people aged 65 years or older, with 20.1 per cent of the population falling into this age group. This indicates there local study area has an ageing population.

The local study area and the Tablelands region generally had a high level of cultural diversity compared with Queensland as a whole, and lower levels of cultural diversity compared with the Far North Queensland region.

About 10.2 per cent of people in the Tablelands region identified as Indigenous in 2011. This is compared with 12.1 per cent in Far North Queensland and 3.6 per cent in Queensland. Mareeba had the highest levels of cultural diversity in the study area, with 13.3 per cent of the population identifying as Indigenous and 12.4 per cent of the population speaking a language other than English at home.

The main countries of birth for residents in the Tablelands region were countries in the United Kingdom, New Zealand, Italy and Germany.

3.3.2 Family and household composition

In 2011, there were 5,531 families in the local study area, comprising 47.3 per cent of the Tablelands region's total families. The local study area and the Tablelands region had the following family and household characteristics:

- A low proportion of couple families with children compared with Far North Queensland. The local study area had 2,018 couple families with children (36.5 per cent of all families), and the Tablelands region had 4,217 couple families with children (36.1 per cent of all families). This is compared with 133,102 couple families with children or 52.9 per cent in Far North Queensland.
- A high proportion of couple families without children compared to Far North Queensland. The local study area had 2,428 couple families with no children (43.9 per cent of all families), and the Tablelands region had 5,370 couple families with no children (45.9 per cent of all families). This is compared with 73,993 couple families with no children or 29.4 per cent in Far North Queensland.
- The local study area and the Tablelands region had a relatively stable population, with lower levels of population mobility. The local study area and the Tablelands region had higher proportions of people who lived at the same address both one year and five years prior to the 2011 Census compared with Far North Queensland and Queensland. This indicates the study area and the Tablelands region is a generally stable community with longer-term residents. Mareeba had the greatest levels of population stability.

3.3.3 Housing

In 2011, there were:

- 7,792 dwellings in the local study area, with an average household size of 2.4 persons.
- 16,235 dwellings in the Tablelands region, with an average household size of 2.4 persons.
- 176,815 dwellings in Far North Queensland, with an average household size of 2.7 persons.

In 2011, a high proportion of houses in the local study area and the Tablelands region were owned outright, compared with Far North Queensland (**Table 3-3**). About 37.6 per cent and 41.1 per cent of houses in the local study area and Tablelands region respectively were owned outright, while 26.7 per cent of houses in Far North Queensland were owned outright. High home ownership may reflect the rural nature of the region, the older population and the stable and settled nature of the community.

In 2011, about 5.2 per cent (402 dwellings) of dwellings in the local study area were being rented from a State housing authority. This is comparable to the level of public rental housing in Far North Queensland (at 5.6 per cent).

Table 3-3 Housing tenure and cost, 2011 (%)

	Tenure type			Housing costs	
Location	Owned outright	Owned with a mortgage	Rented	Median rent per week	Median monthly mortgage repayment
Study area	37.6	24.6	33.1	$200*	$1,550*

	Tenure type			Housing costs	
Location	Owned outright	Owned with a mortgage	Rented	Median rent per week	Median monthly mortgage repayment
Tablelands region	41.1	26.7	28.0	$188	$1,424
Far North Queensland	26.7	31.5	38.1	$181*	$1,680*
Queensland	29.0	34.5	33.2	$300	$1,850

Source: ABS Census of Population and Housing, 2011

**This is the average of median rent and mortgage repayments of the relevant Statistical Areas in the location.*

Households in the local study area generally paid higher rent than those in the Tablelands region and Far North Queensland. In 2011, the average rent in the local study area was about $200 per week, compared with $188 per week and $181 per week for the Tablelands region and Far North Queensland respectively. Atherton had the highest median rent at $210 per week, while Mareeba had a median rent of $190 per week. The higher rental costs in the study area are likely to reflect the relative proximity of these areas to Cairns.

The average monthly mortgage repayment in the study area at the 2011 Census was about $1,550 which is comparable to average repayments recorded for the Tablelands region and Far North Queensland at $1,424 and $1,680 respectively.

There was capacity in the local and regional housing market to absorb population growth. In 2011, about 13.7 per cent of dwellings in the Tablelands region were vacant. At 30 July 2014, there were over 3000 properties on the market in the Tablelands region, including properties for sale in Atherton and Mareeba (realestate.com.au). The houses available for rent included a mix of detached dwellings, urban blocks, acreage and rural properties. An increase in the availability of residential housing has occurred in the Tablelands region since 1997, particularly around Mareeba where several residential subdivisions have developed. These residential subdivisions include Wylandra Estate, Sunbird Park, Amaroo Park and Riverlands Park. Newly released residential lots and new residential homes were available at these residential subdivisions in July 2014. Residential areas around Mareeba and Atherton are generally located within a 30 minute drive to the project site, via the Kennedy Highway.

An average of 156 construction jobs would be created during the construction phase of the project. A proportion of these jobs would be filled by local workers, and the remaining jobs would generally be filled by people moving to the Tablelands region or travelling to the Tablelands region whilst on shift. The housing data indicates there would generally be sufficient availability of local accommodation within an appropriate driving distance for project construction workers during the construction phase.

3.3.4 Socio-economic indices for areas (SEIFA)

A community's level of disadvantage or access to economic resources may influence the ability of that community to cope with changes that arise from the project. The ABS produces a number of socio-economic indices for areas (SEIFA) that identify areas of relative advantage and disadvantage based on Census data, including the index of advantage/disadvantage and the index of economic resources.

The index of advantage/disadvantage considers indicators relating to family income, education, occupation type, wealth and living conditions to determine the relative level of advantage or disadvantage an area may experience relative to all other areas in Australia. Low decile values (ie scores of one to three) generally represent areas of disadvantage while high decile values (ie scores of seven to ten) generally represent areas of greater advantage in general, reflecting many households with high incomes, or many people in skilled occupations and few households with low incomes or few people in unskilled occupations.

In 2011, the Tablelands region had a decile score of three on the index of advantage/disadvantage. This indicates residents in the Tablelands region have a low level of advantage with higher levels of people on low incomes, without qualifications or in lower skilled occupations.

The index of economic resources reflects the economic resources of households in an area, based on indicators such as income, expenditure and assets including wages and rental costs for families, and variables that reflect wealth (eg dwelling size). In 2011, the Tablelands region had a decile score of three on this index, indicated low levels of access to economic resources.

3.3.5 Personal income

The local study area and the Tablelands region both had high proportions of low income households (less than $600 per week) and low proportions of high income households (more than $2,000 per week) compared with Far North Queensland (**Table 3-4**). Median household weekly incomes ranged from $871 per week in Atherton to $900 per week in Mareeba. This is compared with $1,235 per week for Queensland, as a whole. Low household incomes in the region may reflect the low workforce participation rates (see **Section 3.4**) and the relatively older population (see **Section 3.3.2**).

In addition, the local study area and the Tablelands region recorded high proportions of people aged 15 years or older with a low personal income and low proportions of people with a high personal income.

Table 3-4 Personal and household incomes (per week), 2011 (%)

	Personal income		Household income	
Location	Less than $600 per week	More than $2,000 per week	Less than $600 per week	More than $2,000 per week
Study Area	54.2	2.2	28.8	12.9
Tablelands region	54.9	2.5	30.0	12.6
Far North Queensland	45.0	4.5	20.4	22.0
Queensland	46.6	5.5	20.3	24.9

Source: ABS Census of Population and Housing, 2011

3.4 Workforce participation and employment

The following section provides information regarding labour force, employment, and occupation.

3.4.1 Labour force and employment

In 2011, the local study area and the Tablelands region had relatively low rates of labour force participation compared with Far North Queensland. The study area had a working aged population (people aged between 15 years and over) of 16,122 people. This represented about 79 per cent of the total study area population. Approximately 56 per cent of the study area's working aged population participated in the workforce and were either working or looking for work (**Table 3-5**). This is compared with 63.5 per cent in Far North Queensland.

The local study area and the Tablelands region recorded higher levels of unemployment compared with Far North Queensland and Queensland in 2011. About 6.4 per cent of the study area's workforce was unemployed and looking for work in 2011, while the Tablelands region had an unemployment rate of 6.7 per cent. Far North Queensland recorded an unemployment rate of 6.1 per cent, which is in line with the State average. Mareeba recorded a high unemployment rate, with 7.1 per cent of its workforce unemployed at 2011. High unemployment in the study area, Tablelands region and Far North Queensland more generally may reflect the prevalence of the farming operations in the region and also the older population.

Unemployment data from the 2011 Census shows that unemployment rates are comparable to Queensland. However, regional employment data can often hide levels of under employment and hidden unemployment. This can occur when:

- Residents leave the area to work elsewhere but wish to return to the area.
- Farmers do not register as either employed or unemployed or do not list times of underemployment.
- High levels of young people work part time as full time work is unavailable.

As a result, there may be higher levels of unemployment in the Tablelands region than indicated by the ABS data.

The relatively high unemployment rate indicates there is an opportunity for the project to employ local people that had the appropriate skills or underwent training. In addition, there is an opportunity for the project to provide skills development and training to young people, unemployed people and nearby Indigenous communities.

Table 3-5 Labour force, 2011 (%)

Location	Employed	Unemployed	Labour force participation rate
Study Area	93.6	6.4	56.0
Tablelands region	93.3	6.7	54.7
Far North Queensland	93.9	6.1	63.5
Queensland	93.9	6.1	62.8

Source: ABS Census of Population and Housing, 2011

More recent unemployment data is provided from the Small Area Labour Markets (SALM) Australia from the Australian Government Department of Employment (March 2014). The SALM data is based on small geographical units, using a four-quarter average to minimise the variability inherent in the estimates at this level. SALM data relevant to the project has been collected from the following areas:

- Atherton.
- Mareeba.
- The region around the project, including Atherton, Mareeba and Cairns.
- Queensland, as a comparison.

The SALM indicates the unemployment rate in the region around the project has been declining since December 2012 (**Figure 3-2**). However, the region around the project area has a higher unemployment rate compared with Queensland. Mareeba had a particularly high level of unemployment, at 9.6 per cent in December 2013.

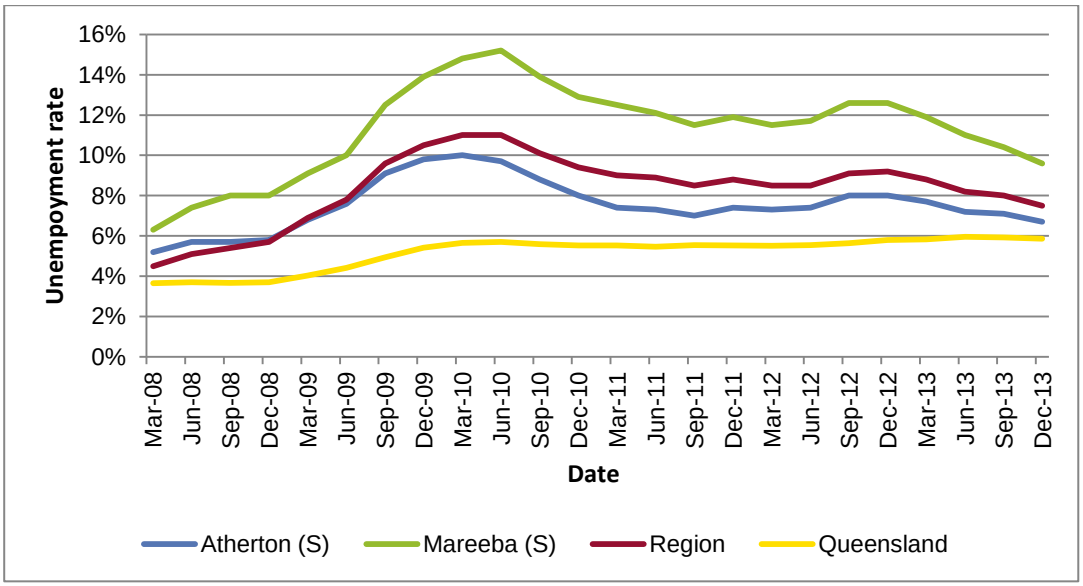

Figure 3-2 Small Area Labour Market Unemployment Data

Source: Department of Employment, 2014

3.4.2 Industries of employment

The following industries were dominant employers in the local study area and the Tablelands region (**Table 3-7**):

- Primary industries (agriculture, forestry and fishing).
- Retail trade.
- Health care and social assistance.

In 2011, 10.8 per cent of workers in the study area were employed in the primary industries, compared with 4.6 per cent for Far North Queensland as a whole. Such a high level of employment in primary industries reflects the rural nature of the area and the high presence of farming operations. Further, approximately 13.3 per cent of workers in the study area were employed in the retail trade industry, compared with 10.6 per cent for Far North Queensland. Atherton, particularly recorded high numbers of people employed in the retail trade industry, with 14.5 per cent of workers employed in this industry in 2011.Such level of employment in the retail reflects the tourist attractions in the area such as the Kuranda Scenic Railway, Skyrail Cableway and Kuranda Markets, as well as the role of Atherton as the main local service centre for the Tablelands LGA. Atherton is also the business and commercial district for the southern populous of the Tablelands region.

Table 3-6 outlines the number of workers in the different sectors, across the regional levels. These numbers are represented in percentage terms in **Table 3-7**.

Table 3-6 Employment by industry

Industry	Local study area	Tablelands region	Far North Queensland
Agriculture, forestry and fishing	740	2,259	10,901
Mining	199	674	10,186
Manufacturing	410	1,034	15,416
Electricity, gas, water and waste services	122	225	3,013
Construction	578	1,558	20,579

Industry	Local study area	Tablelands region	Far North Queensland
Wholesale trade	234	474	6,406
Retail trade	968	2,043	24,999
Accommodation and food services	458	1,092	18,196
Transport, postal and warehousing	261	718	12,521
Information media and telecommunications	58	121	2,289
Financial and insurance services	99	194	3,394
Rental, hiring and real estate services	98	221	3,675
Professional, scientific and technical services	211	690	9,604
Administrative and support services	188	463	7,296
Public administration and safety	597	1,230	22,491
Education and training	539	1,485	18,944
Health care and social assistance	833	1,958	27,736
Arts and recreation services	63	232	3,157
Other services	292	626	9,415
Total	6,948	17,297	230,218

Source: ABS Census of Population and Housing, 2011

The healthcare and social assistance industry was also recorded as a significant industry of employment in the Tablelands region. However, the proportion of workers employed in this industry was in line with state averages (see **Table 3-7**).

Although less dominate in providing employment in the region, there are several important industries of employment that would likely support and benefit from construction and infrastructure projects in the region. The local study area and Tablelands region have significant proportions of residents employed in the manufacturing, electricity, gas, water and waste services, accommodation and food services, construction, and transport, postal and warehousing industries. These sectors are all reasonably well-represented in Tablelands region.

Table 3-7 Key industries of employment, 2011 (%)

Industry	Local study area	Tablelands region	Far North Queensland	Queensland
Agriculture, forestry and fishing	10.8	12.7	4.6	2.7
Mining	2.8	3.8	4.3	2.6
Manufacturing	5.8	5.8	6.5	8.4
Electricity, gas, water and waste services	1.8	1.3	1.3	1.2
Construction	8.3	8.7	8.7	9.0
Wholesale trade	3.3	2.7	2.7	3.6
Retail trade	13.3	11.5	10.6	10.7
Accommodation and food services	6.1	6.1	7.7	7.0
Transport, postal and warehousing	3.7	4.0	5.3	5.3
Information media and telecommunications	0.8	0.7	1.0	1.2

Industry	Local study area	Tablelands region	Far North Queensland	Queensland
Financial and insurance services	1.4	1.1	1.4	2.7
Rental, hiring and real estate services	1.3	1.3	1.6	1.8
Professional, scientific and technical services	3.3	3.9	4.1	6.5
Administrative and support services	2.6	2.6	3.1	3.2
Public administration and safety	8.2	6.9	9.5	6.7
Education and training	7.7	8.3	8.0	7.9
Health care and social assistance	11.2	11.0	11.7	11.9
Arts and recreation services	1.1	1.3	1.3	1.4
Other services	4.0	3.5	4.0	3.9

Source: ABS Census of Population and Housing, 2011

In 2011, the most common occupations in the Tablelands region were:

- Managers.
- Technicians and trades workers.
- Professionals.
- Labourers

Table 3-8 shows the number of workers for each occupation by the regional levels. The table shows that the most populous occupations of the local study area are labourers and technicians and trades workers. The percentage breakdowns are shown in Table 3-9.

Table 3-8 Labour force by occupation, 2011

Occupation	Local study area	Tablelands region	Far North Queensland
Managers	888	2,907	27,853
Professionals	935	2,494	37,536
Technicians and trades workers	1,033	2,648	38,375
Community and personal service workers	811	1,927	26,964
Clerical and administrative workers	861	2,020	31,065
Sales workers	776	1,549	21,894
Machinery operators and drivers	545	1,447	19,910
Labourers	1,148	2,481	27,823
Inadequately described/not stated	140	337	4,632
Total people	7,137	17,810	236,052

Source: ABS Census of Population and Housing, 2011

The local study area had a very high proportion of people working as labourers (**Table 3-9**). The local study area and Tablelands region also had a reasonable proportion of machinery operators and drivers. This indicates workers in the study area would be able to be considered for employment opportunities with the project.

Table 3-9 Labour force by occupation, 2011 (%)

Occupation	Local study area	Tablelands Region	Queensland
Managers	13.4	16.3	12.0
Professionals	13.0	14.0	18.9
Technicians and trades workers	14.7	14.9	14.9
Community and personal service workers	11.2	10.8	10.0
Clerical and administrative workers	12.1	11.3	14.7
Sales workers	10.6	8.7	9.8
Machinery operators and drivers	7.7	8.1	7.3
Labourers	15.3	13.9	10.6
Inadequately described/not stated	2.0	1.9	1.8
Total people	8,447	17,810	2,039,276

Source: ABS Census of Population and Housing, 2011

3.5 Local business and industry

The ABS collects and reports the number and size of businesses annually. Local business and industry data for the Tablelands region, Cairns City SA2 and Gordonvale SA2 follow. These areas have been selected as they are the local areas that would be most likely to provide local resources and materials to the project.

At June 2011, the number of businesses operating in the Tablelands region and Cairns was 6,989 (ABS, 2012) and of these businesses (**Table 3-10**), around 96 per cent were small businesses, each employing less than 20 people.

The greatest number of registered businesses is represented by agriculture, forestry and fishing (about 18 per cent) followed by the construction industry (about 15 per cent) and then by service sectors including retail trade, accommodation and food services and tourism. However, the data suggests there are a number of transport, manufacturing and construction companies of a reasonable size (which employ five or more staff) that may be able to provide skills and equipment relevant to the project.

Table 3-10 Registered businesses and local jobs in key areas of Tablelands and Cairns (2013)

Tablelands region and Cairns business types	Do not employ staff	1-4 staff employed	5-19 staff employed	20-199 staff employed	200+ staff employed	Total
Agriculture, Forestry and Fishing	857	229	115	46	3	1,250
Mining	38	16	6	3	0	63
Manufacturing	129	61	43	9	3	245
Electricity, Gas, Water and Waste Services	9	3	6	0	0	18
Construction	648	294	92	9	0	1,043
Wholesale Trade	64	41	25	9	0	139
Retail Trade	174	192	112	23	0	501

Tablelands region and Cairns business types	Do not employ staff	1-4 staff employed	5-19 staff employed	20-199 staff employed	200+ staff employed	Total
Accommodation and Food Services	139	122	121	34	0	416
Transport, Postal and Warehousing	244	96	22	17	0	379
Information Media and Telecommunications	22	5	4	0	0	31
Financial and Insurance Services	300	68	13	3	0	384
Rental, Hiring and Real Estate Services	618	103	49	6	0	776
Professional, Scientific and Technical Services	265	164	71	14	0	514
Administrative and Support Services	106	94	46	8	0	254
Public Administration and Safety	0	6	0	0	0	6
Education and Training	27	20	9	10	0	66
Health Care and Social Assistance	129	111	35	12	0	287
Arts and Recreation Services	45	22	10	0	0	77
Other Services	155	131	40	3	0	329
Unknown	168	31	12	0	0	211
Total	4,137	1,809	831	206	6	6,989

Source: ABS Counts of Australian Businesses, including Entries and Exits, 2009 to 2013, Cat. No. 8165.0

The Gross Regional Product (GRP) of an area is the equivalent of Gross Domestic Product (GDP), but for a particular region. The GRP is the amount of the nation's wealth which is generated by businesses, organisations and individuals working in the area. The Far North Queensland region had contributed around $12,286 million to GDP in 2010-2011 (**Table 3-11**). The GRP for the Far North Queensland region economy has increased since 2007, and is growing at a slightly slower rate (6.3 per cent growth between 2001 and 2011, compared to 8.8 per cent in Queensland compared with Queensland. Overall, the Tablelands region (including Mareeba Shire LGA) GRP is more volatile than for Queensland (**Table 3-12**). The project provides an opportunity to lift the region's GRP, particularly during the construction phase.

Table 3-11 Composition of gross value added

	$ million			Growth (%)		
Location	2000-01	2006-07	2010-11	2000-01 to 2006-07	2006-07 to 2010-11	2000-01 to 2010-11
Far North Queensland	6,696	10,687	12,286	8.1	3.5	6.3

Location	$ million			Growth (%)		
	2000-01	2006-07	2010-11	2000-01 to 2006-07	2006-07 to 2010-11	2000-01 to 2010-11
Queensland	116,561	212,853	269,866	10.6	6.1	8.8

Source: Experimental Estimates of Gross Regional Product, Queensland Treasury and Trade

Table 3-12 Gross Regional Product

	Tablelands LGA		Mareeba Shire LGA		Queensland	
	GRP $m	% change from previous year	GRP $m	% change from previous year	GRP $m	% change from previous year
2013	1,093	+1.5	905	+2.2	285,149	+3.6
2012	1,077	-0.5	886	+0.2	275,165	+5.6
2011	1,083	-7.8	884	-7.1	260,519	+0.4
2010	1,174	-0.2	951	+0.5	259,529	-0.5
2009	1,176	+7.5	946	+8.3	260,879	+1.2
2008	1,094	+2.7	874	+3.5	257,808	+4.8
2007	1,065	+4.4	845	+4.3	246,062	+5.6
2006	1,020	+7.2	810	+6.5	232,913	+4.8
2005	952	+6.9	761	+6.2	222,174	+6.8
2004	890	+5.1	716	+4.4	207,979	+5.3
2003	848	+1.0	686	+0.4	197,578	+2.6
2002	839	+3.7	683	+3.2	192,454	+5.8

Source: National Institute of Economic and Industry Research, 2014

3.6 Social infrastructure

The local study area accommodates a range of community services and facilities that cater for the needs of both local communities, including education facilities; health, medical and emergency services; sport, recreation and leisure facilities; and community and cultural facilities. Most of these facilities are located in Mareeba and Atherton, approximately 15-20 km from the project site.

A limited number of social infrastructure facilities are located near to the proposal that may experience impacts from the construction and/or operation of the proposal, either directly or indirectly. These are located in the townships of Walkamin and Tolga and are listed in **Table 3-13.**

Table 3-13 Social infrastructure near the project

Location	Facility	Address	Type
Approximately 5kmeast of the proposal at Walkamin	Walkamin Central Van Park	Kennedy Highway, Walkamin	Accommodation
	Australia Post	Kennedy Highway, Walkamin	Service
	Walkamin State School	Wattle Street, Walkamin	School
	Nardellos Lagoon	Hansen Road, Walkamin	Park / recreation
Approximately 10 km south-east of the proposal at Tolga	Rocky Creek War Memorial Hospital Complex and Park (Heritage listed)	Kennedy Highway	Heritage Item
	Tolga Woodworks	Kennedy Highway, Tolga	Tourist attraction

Location	Facility	Address	Type
	Tolga State School	Main Street, Tolga	School
	Tolga Country Lodge	Kennedy Highway, Tolga	Accommodation
	Australia Post	Main Street, Tolga	Service
	Atherton Tablelands Motor Inn	Kennedy Highway	Accommodation
	Atherton Rainforest Motor Inn	Kennedy Highway	Accommodation
	Tolga Racecourse	Racecourse Road	Sporting and recreation

4. Economic Impact Assessment

This section provides an assessment of potential economic impacts from the construction and operation phases of the project, including beneficial as well as any potentially adverse impacts. The impact assessment considers contributions to economic output, gross value added, employment and household income from the construction and operation of the project, assessed quantitatively using Jacobs regional in-house Input Output model. The model is developed to reflect the Far North Queensland region, Queensland and Australia. Where possible, impacts (including employment and source of goods and services) from the local study area (refer **Section 3.1**) are also reported.

4.1 Overview of IO modelling

Input Output (IO) modelling provides an estimate of the economic impact of project expenditure for the domestic economy using a 'multiplier approach'. A multiplier is the proportionate change (increase or decrease) in an economic variable such as output or employment, for a given change in demand for a particular input. The derived multipliers estimate the total impact on all industries in the economy of interest from changes in the demand for inputs in any one industry. In the case of the project, changes in demand for inputs occur as a result of the additional resources required for construction and operation of the project.

The IO model was used to derive estimates of output, value added, employment and household income impacts from construction and operation of the project. **Table 4-1** provides a definition of these impacts.

Table 4-1 Impact types in the IO model

Output	Value added	Employment	Household income
A measure of the market value of goods and services produced by industries in a given economy	Equal to economic output, less the costs of goods and services used by these industries in the production process (intermediate consumption). Total value added within an economy (or by industry) is therefore less than total output	A measure of employment levels (full time equivalents) required to service the demand for economic output	A measure of wages/ salaries earned by employees in a given economy

These impact types, quantified by the use of IO multipliers, can be divided into three impact components:

- Direct (impacts from resources required directly by the project's construction and operation, for instance civil or electrical works).
- Indirect (the subsequent increase in demand for resources by those industries supplying the project, for instance electrical cables required for electrical works).
- Induced (the effects of the increase in expenditure by employees in industries directly or indirectly affected by the project. These impacts occur from increases in wages and salaries earned).

The impacts modelled for this project are direct and indirect effects only. Induced impacts are excluded from this assessment and the total impacts are reported as the sum of direct and indirect impacts. This is adopted as a conservative approach to estimate economic benefits in line with recent technical assessments such as the Economic Impact Assessment completed for the Rolleston Coal Expansion Project in November 2013 (prepared for – Xstrata Coal Queensland).

4.1.1 Limitations

There are a number of limitations which should be considered when interpreting the outputs of the IO model. In particular, limitations of IO tables include the following assumptions:

- Constant prices over the life of the project. Where additional demand may cause a shortage of commodities and labour which would cause prices to increase, the IO model assumes that regardless of the stimulus, the impact on prices is negligible.
- Fixed technology. IO modelling assumes fixed ratios of intermediate inputs to production and outputs from production which implies that technology is fixed. Whilst adjustment in technology is expected in the long run, changes in technology and spending preferences are usually less likely in in the short term. Even if technology changes do occur in the short term, the overall impact would be difficult to estimate given that any improvement in productivity will be partially offset by the a reduction in demand for inputs. The ABS' IO tables (2008-09), may therefore overstate the net benefits from improvement in technology.
- Fixed import shares. The IO model represents a snapshot in the economy in time and the associated linkages between industries which generate direct and indirect impacts. Therefore the impacts are calculated based on the interactions / linkages between industries observed for this snapshot in time. This implies that the share of imports remains constant.
- No supply side constraints. IO assumes unlimited supplies of all resources, including labour and capital. Estimates derived from the IO model represent potential economic impacts rather than generated economic impacts which may be constrained by availability of inputs.

As a result of these assumptions which are inherent to IO modelling, the results involve a certain degree of uncertainty. Therefore, it is important to note that the IO modelling results should not be interpreted as a forecast for economic growth.

4.1.2 Application of the IO model

Although there are a number of limitations associated with IO modelling, IO modelling is commonly used within industry as a tool for estimating economic impacts for projects of this nature, and as part of the EIS process.

The model inputs have been informed by assumptions provided by the proponent. To improve the accuracy of the IO assessment, the following additional key assumptions have been captured in the model:

- Expenditure which is known to be imported has been removed from the estimated expenditure to only capture the impacts on the domestic economy only. In this regard, where industry is allocated to industries with typically high dependencies on imports (such as for example, vehicle manufacturing), the IO model estimates impacts for the domestic economy only.
- Induced Impacts of the IO Model have been removed to mitigate overestimation.
- Royalties and taxes have been excluded from the analysis as they represent a transfer payment.

4.1.3 Modelling assumptions

Economic modelling commonly requires assumptions due to a lack of specific information. The assumptions used in this assessment are outlined in **Table 4-2**.

Table 4-2 Modelling Assumptions

Assumption	Description
Economic multipliers	Multipliers taken from the Jacobs 2014 Far North Queensland calibrated IO Model. The model has 111 different industries. Please refer to Appendix A1.

Assumption	Description
Origin of domestic materials and components	These assumptions are based on Jacobs' industry experience and knowledge, with further explanation provided in Section 4.2. **Construction Phase:** Far North Queensland - 60% Queensland - 100% **Operational Phase:** Far North Queensland - 65% Queensland - 100%
Annual distribution of construction expenditure	Based on RATCH-Australia financial assumptions : Year 1: 53% Year 2: 47%
Industry allocation of expenditure	See tables 4.5 and 4.6.

4.2 Project expenditure

Estimates of domestic construction/ capital expenditure and operational expenditure were provided by RATCH-Australia. The estimated total construction and operational cost (reported in the Mt Emerald Wind Farm EIS 2014 and provided by RATCH-Australia) is $861M over 27 years. This is a combination of domestic expenditure and expenditure on imported goods (turbines). Imported goods and services are excluded from the assessment. **Table 4-3** provides a summary of the total estimated project expenditure for the construction and operation phases of the project provided by RATCH-Australia, compared to the total estimate derived by Jacobs for the economic modelling.

The construction phase is expected to be two years, whilst the operations phase is expected to continue for 25 years. As noted, the Jacobs construction expenditure is less than that listed by RATCH-Australia as Jacobs' estimate excludes wind turbine imports, shipping costs, financing costs and equipment salvage income.

Table 4-3 Summary of project expenditure

	RATCH-Australia estimates	Jacobs domestic estimates	Notes
Total construction	$382M	$188..7	Jacobs' estimate excludes: • 70% of wind turbine component import and transport costs[1] • Shipping costs • Financing costs • Equipment salvage income
Total operation	$479M	$479M	As operational costs all relate to domestic expenditure no costs have been excluded

Figure 4-1 provides an overview of Jacobs' derived expenditure estimate for construction and operation. These findings are based on the assumptions provided by RATCH-Australia and the adjustments outlined above. The highest levels of expenditure occur during the construction phase, which is expected to be two years in duration. Expenditure during the operational phase gradually rises throughout the operational phase of the project (from 2017 onwards). The annual project expenditure is based on RATCH-Australia financial assumptions (see **Table**

[1] This is based on advice from RATCH-Australia that 30% of the wind turbine supply and commissioning costs will be spent within Australia.

4-2). Expenditure rises are due to a scheduled escalation of Warranty Operating and Maintenance Agreement (WOM) related costs.

RATCH's financial assumptions are demonstrated by **Figure 4-1**.

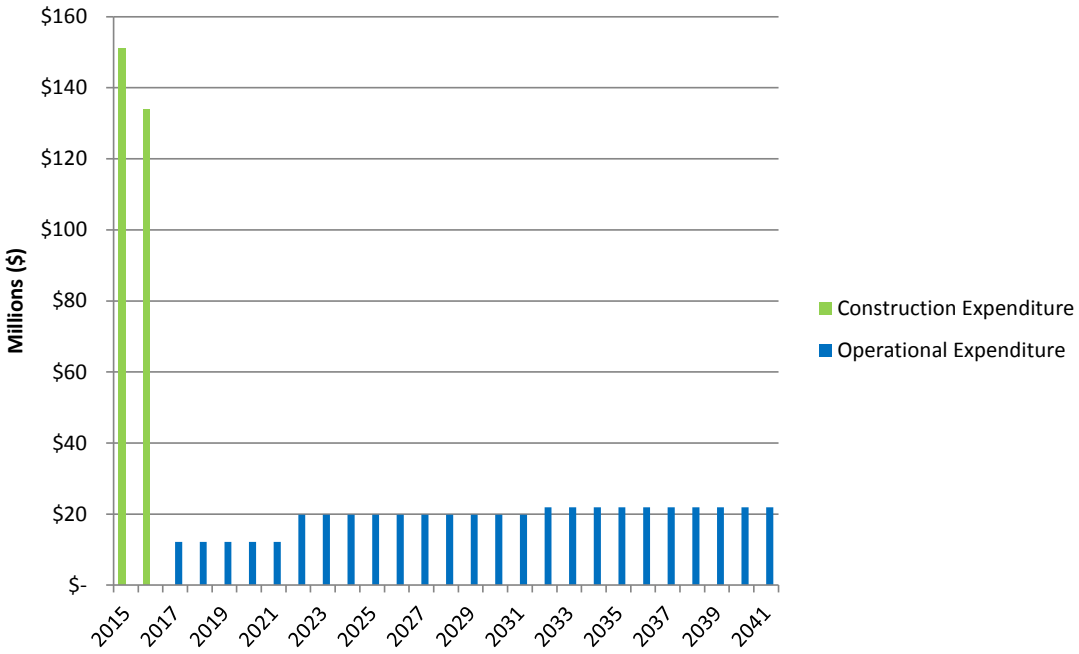

Figure 4-1 Project expenditure profile

Project expenditure has been allocated to Australian industries based on the information on expenditure type provided by the RATCH-Australia. **Table 4-4** and **Table 4-5** provide an outline of the expenditure items and their associated industries.

Table 4-4 Construction Phase Expenditure

Expenditure Item	Industry	Total Expenditure ($M)
Electrical Works	Construction services	$35.7
Civil Works	Heavy and civil engineering construction	$34.1
Road Works	Heavy and civil engineering construction	$11.2
Infrastructure (maintenance and storage compound office, store,)	Construction Services	$0.6
Network Service Provider	Heavy and Civil Engineering Construction	$0.3
RAC project management and Owners Engineering costs	Professional, Scientific and Technical Services	$10.5
RAC Business Integration	Professional, Scientific and Technical Services	$0.5
Other Installation and Commissioning	Heavy and civil engineering construction	$73.3
Transport	Road Transport	8.7
Contingency	Heavy Civil/Construction/Professional	$13.8
Total		$188.7

Table 4-5 Operations Phase Expenditure

Expenditure Item	Industry	Total Expenditure ($M)
Grid connection charges	Heavy and civil engineering construction	117.5
Balance of Plant	Heavy and civil engineering	3.8

Expenditure Item	Industry	Total Expenditure ($M)
Operations and Maintenance (BOP O&M) expenditure	construction	
Community account payments	Public administration and regulatory services	5
Bird/ bat management	Professional scientific and technical services	5
General management	Professional scientific and technical services	18.8
Generation fees	Electricity transmission, distribution, on-selling and electricity market operation	1.3
Contracted and uncontracted WOM costs	Electricity generation	296.3
Sundry costs	Building cleaning, pest control, administrative, and other support services	6.3
Insurance	Insurance & superannuation	25
Total		478.8

In order to assess the economic impacts for Far North Queensland, it is important to derive an estimate of where expenditure is likely to be spent. Estimates on the expenditure sources have been derived from RATCH-Australia's assumption register and Jacobs' technical knowledge and industry experience from other similar wind farm projects. The basis of the assumptions is:

- For the construction phase, much of the cost sourced in Queensland relates to the provision of towers, foundations and the assembly and erection of the wind turbines at the site (i.e. not turbine and associated nacelle, which are likely to be sourced overseas)). Material used (such as concrete) is likely to come from other regions of Queensland. Specialist labour such as crane operators are also likely to be sourced from other regions of Queensland. Other labour required for pouring of foundations, assembly and construction of wind turbines – the major part of construction activities - are likely to be sourced locally. Balance of plant (such as transmission connection) are likely to be completed by labour sourced locally, with management and supervision sourced from other regions.
- During operation, this covers monitoring, repair and maintenance, and operation of the turbines. Operation of the turbines is usually done remotely at a central control facility. Repair and maintenance and monitoring activities are usually done by a combination of regional and out of region workers. The issue here is that a maintenance centre would usually service a number of wind farms so not all maintenance workers would come from areas in close vicinity to the wind farm. However, it is likely that the MEWF and nearby Windy Hill Wind Farm (which is operated by RATCH), would be serviced locally and the region will be the source of labourers for maintenance activities.

Table 4-6 shows the proportion assumed to be spread across the different regions. The table shows that a majority of resources are assumed to be sourced from the regional study area. The sourcing rate of the regional study area is assumed to rise to 65 per cent during the operational phase of the project. The relative size of economic impacts between the different regions will reflect the rate at which materials and labour are procured from the regional study area.

Table 4-6 Assumed regional allocation of domestic project expenditure

Region	Project Expenditure
Construction phase	
Regional study area	60
Remainder of Queensland	40
Total Queensland	100
Interstate	-
Total Australia	100
Operation phase	
Regional study area	65
Remainder of Queensland	35
Total Queensland	100
Interstate	-
Total Australia	100

4.3 Economic impacts

4.3.1 Output impact

The direct output is equal to the estimated expenditure required for the construction and operation of the project (domestic expenditure). **Table 4-7** indicates the total direct output is approximately $667.5M in Australia. Using expenditure sourcing assumptions shown in **Table 4-2,** the regional area is expected to experience around $26.2M of that total. The Indirect Output Impact for the regional study area is anticipated to be around $513.5.9M. The total output impact for the regional study area is estimated at $939.7M. The total output impact for Queensland and Australia for the project is expected to be over $1.43 billion over 27 years. The total output and value added impacts are expected to be the same for Queensland and Australia as the two areas have identical output and value added multipliers for those industries.

Table 4-7 Output impacts

Region	Direct ($M)	Indirect ($M)	Total ($M)
Regional study area	$426.2	$513.5	$939.7
Total Queensland	$ 667.5	$ 762.1	$1,429.5
Total Australia	$ 667.5	$762.1	$1,429.5

4.3.2 Value added impact

Table 4-8 provides the estimated contribution to value added (VA) by region for the construction and operational phases of the project. The direct VA impact for the regional study area is estimated at $161.5M, and the direct VA impact for Queensland is anticipated to be around $252.2M. The total VA impact (direct VA and indirect VA impacts) for the regional study area is expected to be around $386.7M. This reflects the considerable indirect VA impact that would be stimulated by the project.

Table 4-8 Value added impacts

Region	Direct ($M)	Indirect ($M)	Total ($M)
Regional study area	$161.5	$225.2	$386.7
Total Queensland	$252.2	$353.1	$605.2
Total Australia	$ 252.2	$353.1	$605.2

4.3.3 Household income impact

Household income impacts are provided in **Table 4-9** by region. Over the course of the project, the direct income effects in the regional study area are expected to be around $71.3M. It is expected the project would result in a greater direct income impact for Queensland compared to the regional study area, at around $105.3M. The total income impact would be around $177.2Mfor the regional study area. Household income impacts may boost the median income of the regional study area through increased earnings. It should be noted however that household income and employment impacts assume that unemployed labour is available to meet project demands – if this is not the case, these impacts may be reduced.

Table 4-9 Household income impacts

Region	Direct ($M)	Indirect ($M)	Total ($M)
Regional study area	$71.3	$105.9	$177.2
Total Queensland	$105.3	$160.1	$265
Total Australia	$105.3	$160.1	$265

4.3.4 Project employment

The proponent has planned for a 24 month construction period, commencing in early 2015. It is anticipated the construction project would directly generate 85 average annual FTEs jobs throughout Australia during the construction phase of the project (see **Table 4-10**). This would include:

- 51 FTE jobs based in the regional study area. Many of these positions would be in construction and labour jobs.
- 34 FTE jobs based in the rest of Queensland.

An additional 45 indirect FTE jobs are anticipated to be created during the construction phase, so the total employment impact during the construction phase in the regional study area is expected to be 95 FTE jobs. These estimates are derived using the Jacobs IO Model. The divergent numbers between the regional study area and Queensland and Australia demonstrate the different expenditure sourcing levels.

Table 4-10 Average annual employment FTEs

Region	Construction			Operation		
	Direct (FTEs)	Indirect (FTEs)	Total (FTEs)	Direct (FTEs)	Indirect (FTEs)	Total (FTEs)
Regional study area	51	45	95	11	8	19
Queensland	85	74	159	16	13	29
Australia	85	74	159	16	13	29

An alternative method of estimating direct employment for the construction phased uses a rule of thumb estimate derived from experience from previous wind farm projects. This method involves calculating an average number of workers per wind turbine estimate (based on other case studies) and multiplying it by the number of wind turbines to compute an estimate of direct employment. This result can be compared with the results from the IO modelling.

Rule of thumb numbers were taken from industry data included in a Clean Energy Council (Clean Energy Council 2012) report. That report uses data from the Hallett Wind Farm in South Australia. The actual employment at Hallett 1 was 66 average direct employees over the construction period with a peak workforce of 111 or some two thirds higher. The estimates per turbine and per mW are outlined in **Table 4-11**.

Table 4-11 Estimated Construction and Installation Employment Averages

Ave Emp./Tur	Peak Emp./Tur	Ave Emp./mW	Peak Emp./mW
1.47	2.47	0.69	1.17

Using the information seen in Table 4-11, the resultant employment estimates are shown in **Table 4-12**. The estimates suggest that employment estimated per mW is higher than on a per turbine basis. This is because the Hallett estimates were based on turbines of 2.1 mW capacity whereas Mt Emerald is proposing 3 mW capacity turbines. It seems reasonable to assume that construction and installation labour requirements will relate to the number of turbines rather than their capacity subject to the type of construction and materials used remaining the same. On this basis the per turbine estimate is arguably more reliable than the per mW figure. Alternatively, the per mW estimate could be adjusted to reflect different capacity turbines to the original calculations. Both these measures will give the same answer.

The resultant employment estimates shown in Table 4-12 are higher than the IO estimates. The average figure reported per wind turbines is significantly higher than the regional I-O Direct Employment estimate and a little higher than the Direct Employment figure for Queensland in Table 4-10. Moreover, the peak figure is understandably much higher than the IO Queensland direct employment figure. Given the per turbine figure reflects actual practice the difference may be explained by such factors as the relative newness of wind technology, the more rural and remoter site locations and the limited time to achieve productivity improvements in a new industry sector.

Although the IO estimate and the Rule-of-Thumb are dissimilar, they can be used complementarily.

Table 4-12 Estimated Mt Emerald employment over the construction period

Mt Emerald Specification	Numbers	Average employment	Peak employment
Turbines	63	92	155

Operational phase

Employment is expected to fall significantly in the operational phase compared to the construction phase (see **Table 4-10**), but will rise gradually over the operation period – mirroring the expenditure profile seen in **Figure 4-1.**

Employment and staffing during the project's operational phase would be managed by RATCH-Australia. The anticipated employment positions for the operational phase include:

- 10 to 12 maintenance and service technicians (based on one technician per six turbines; technicians must work in groups of two).
- One site manager.
- One site administrator.
- Four site ecologists/rangers (part time).
- Two cleaners/groundsman/handyman (part time).

4.3.5 Distribution of impacts

Figure 4-2 and **Figure 4-3** demonstrate the expected regional distribution of the economic impacts of the project. During the construction period, anticipated impacts are expected to be significantly greater for Queensland and Australia compared to the regional study area as many of the project components would be sourced from outside of the regional study area. However, when considered as a proportion of the economy, the economic impacts in the study area are larger than Queensland or Australia. The total output and value added

impacts are expected to be the same for Queensland and Australia as the two areas have identical output and value multipliers for those industries.

With respect to employment impacts, it is expected that some jobs would be created outside of the regional study area (**Figure 4-2** and **Figure 4-3**). This is due to the expenditure spent in rest of Queensland. Due to the fact that all the expenditure will be made in Queensland, the employment impacts for Queensland equate to the total employment impacts experienced in all of Australia.

Figure 4-2 Regional distribution of total construction impacts

Figure 4-3 regional distribution of total operations impact

Section 3 of the report suggests that the regional labour market has the depth to accommodate the job opportunities presented by the MEWF. **Table 4-13** shows the relative size of the direct and total employment impacts on the Tablelands and Far North Queensland labour markets. Furthermore, the higher unemployment rates in the local study area and the Tablelands region (6.4 per cent and 6.7 per cent compared to Queensland at 6.1 per cent) indicate that the MEWF could absorb some of the underutilised labour (shown in **Table 3-5)**. RATCH-Australia is committed to maximising local employment opportunities during the operations phase (as stated in its Commitments Register). However the contracted construction company has full discretion over hiring practices for the construction phase of the project.

Table 4-13 Average annual project employment as a proportion of the regional labour force

Impact	Proportion of existing labour force in Tablelands (%)	Proportion of existing labour force in Far North Queensland) (%)
Direct project employment (regional)		
Construction	0.29%	0.02%
Operation	0.06%	0.004%
Total project employment (direct, indirect combined)		
Construction	0.54%	0.04%
Operation	0.11%	0.01%

** Assuming that regional labour force is constant over the life of the project*

With respect to specific occupations during the operations phase, the local study area is expected to have underutilised labour to accommodate a significant proportion of the direct operational jobs which would be generated by the project. This includes jobs for assemblymen and road works, technicians and tradespeople and general labourers. Some employment positions would require training, which represents an opportunity to increase and diversify the skill set of the local labour force. The average number of direct annual jobs required by RATCH-Australia is estimated to be 16-20 for operations and up to 155 for the construction period. A simple estimate of available labour can be computed by supposing that the local study area's unemployment rate is constant across occupations – if the unemployment rate is 6.4 per cent (shown in **Table 3-5**), and there are 1,033 technicians and trade workers employed (shown in **Table 3-8**), this suggests that there are in total 1,103 technicians/trade workers in the local area's labour force[2]. There could therefore be 71 technicians/trade workers potentially available to work on the project. This figure should be treated as indicative only, as it assumes that the unemployment rate is constant across occupations, and current unemployment and labour force information may not be an appropriate guide to future availability of labour. The same estimate can be derived for available labourers in the study area, and this suggests that there are 1,226 labourers in the local labour force, and 78 of those are potentially available to work on the project. Those in professional occupations, such as ecologists, may be harder to source from the local area.

RATCH-Australia is committed to maximising employment opportunities for local and regional communities and will work closely with the selected construction contractor to increase local employment opportunities and provide training opportunities for staff. Section 3.4 outlines the labour market of the Tablelands region. A discussion on local labour availability to fill these positions is discussed in Section 4.3.5.

The Total Value Added impacts of the construction and operational phases of the MEWF are shown in **Table 4-14**. This demonstrates the size of the Total Value Added Impact of the wind farm in relation to the Far North Queensland's annual Gross Value Added.

Table 4-14 Regional Gross Value Added

Gross Value Added	Value ($M)
Construction Phase	$100 over 2 years ($50 per year)
Operations Phase	$286 over 25 years ($11.4 per year)
Regional Gross Value Added (Annual)	$12,286 in 2010-11

[2] 1,033 employed technicians/trade workers equals 93.6% (100-6.4%) of the total labour force. The total labour force therefore equals 1,033 divided by 93,6%.

5. Agricultural impacts

This section considers the potential for disruption to agricultural activities as a result of the project's operations. Specifically, the potential for disruption to aerial spraying activities as well as pest management provided by the local bat population were considered.

5.1 Pest management from local ecosystem related services

The purpose of this section is to investigate and report on the potential impacts of the project on ecosystem-related services which are provided by local bat populations. This includes assessment of both their economic contribution in terms of pest management and the likely extent of impact on the bat populations.

5.1.1 Method

The analysis was undertaken via a literature search of relevant Australian and international sources and conversion/ application to the current site and conditions. A literature review was conducted searching for relevant academic articles on bats and pest control. No relevant Australian studies were found. The most relevant overseas research was conducted by Cleveland et al. (2006) and examines the role of Brazilian Free-Tailed Bats in providing pest control services to cotton crops in Texas. This research is discussed in the following section.

5.1.2 Analysis

The EIS examines the potential impacts of the project on species of local, regional or national significance. Five of these species are bats. Only the Bare Rumped Sheathtail Bat is of interest for its pest control benefits, as both the Spectacled Flying Fox and Grey Headed Flying Fox are vegetarian, and the Semon's Leaf-Nosed Bat and Greater Large Eared Horseshoe Bat were not confirmed present on the site. The Bare Rumped Sheathtail Bat is known to occur on the site, and the extent of its local population has not been determined. Other non-listed insectivorous bat species may also be present on the site and provide pest control benefits.

Due to insufficient population data, the EIS was unable to estimate the number of bats which may potentially be killed due to turbine collisions or barotrauma. The Mt Emerald Wind Farm EIS (Vol. 2, p. 141) suggests that an annual average of one to three bat deaths per turbine is typical in the United States and Europe.

If local bat populations do decline due to the turbines, and no alternative predator species is present to control insect populations, this may result in an economic cost. There are two ways an economic cost could be incurred (following Cleveland et al 2006):

1) Increased costs associated with additional pesticide applications (to achieve the same pest management outcome as is provided already by a baseline the bat population).
2) Value of production declines due to increased crop damage/reduced yield.

For pesticide to be used efficiently, it should be applied only where increasing numbers of pests mean that the damage done by the pests exceeds the cost of the pesticide application (the economic threshold). Over the course of a growing season, the loss of a number of bats may potentially increase the total number of pesticide applications required over the growing season. In Texas, for instance, Cleveland et al. (2006) found that one million Brazilian Free-Tailed Bats foraging over 4,000ha of cotton plantation would plausibly reduce the need for one or two pesticide applications per season, at a cost of US$100,000 (US$25 per application per ha). This translates into a pesticide cost saving of up to US$0.2 per bat per season.

Given that pesticides are only applied when economically sensible to do so, they do not prevent all crop damage. Bats may prey on crop pests prior to pesticide application, and continue to do so after application as the pest population recovers. Cleveland et al. (2006) in their study of Brazilian Free-Tailed Bats found that the one million bats would prevent cotton crop losses of US$638,000 per season assuming no pesticide use

(dropping to US$574,000 per season if pesticide was applied). This represents around 12 per cent of the US$6 million total cotton crop value, or US$0.64 per bat.

It is not recommended that these values be applied to the project as there are significant differences in the circumstances of each case. The bat species themselves are very different (Bare Rumped Sheathtail Bats, for instance are around four times heavier than Brazilian Free-Tailed Bats). Kunz et al. (2011) note that the amount eaten by a bat varies considerably depending on factors such as species, season and reproductive cycle. There is likely also to be differences in their foraging ranges, diet, and the percentage of their diet consisting of crop pests (which themselves may be different between Australia and the United State).

Furthermore, the Brazilian Free-Tailed Bat case is relevant only to cotton production which does not occur around Mt Emerald. The value of crops produced in the area surrounding the MEWF, the value of any damage prevented by bats, and the cost of pesticide applications are likely to be significantly different. Overall, the project is not expected to result in significant economic impact as a result of potential impacts to local bat populations.

5.2 Agricultural impacts

For many farmers, aerial spraying is an economical method to treat crops with pesticides, insecticides and fungicides and fertilisers. Without this approach, farmers could experience diminishing crop yields. Hence, the magnitude of agricultural impacts is contingent on the extent to which the project may affect aerial agricultural spraying.

Wind farms may have an impact on aerial spraying activities through the wind turbine movements. Whilst operating, wind turbines generate wind in the surrounding area and thus can impair the targeting accuracy of aircraft spraying the pesticides, insecticides, fungicides and fertilisers.

Figure 5-1 presents the agricultural land uses (and other nearby land uses) within a five kilometre radius from the project, the furthest distance the wind turbines would affect aerial activities (RPS, 2014). The major agricultural activities around the project include:

- Banana farm.
- The Tablelands Sugar Mill.
- Peanut shell storage facility.
- Poultry farm.
- Intensive organic farming area.
- Unclassified farm.

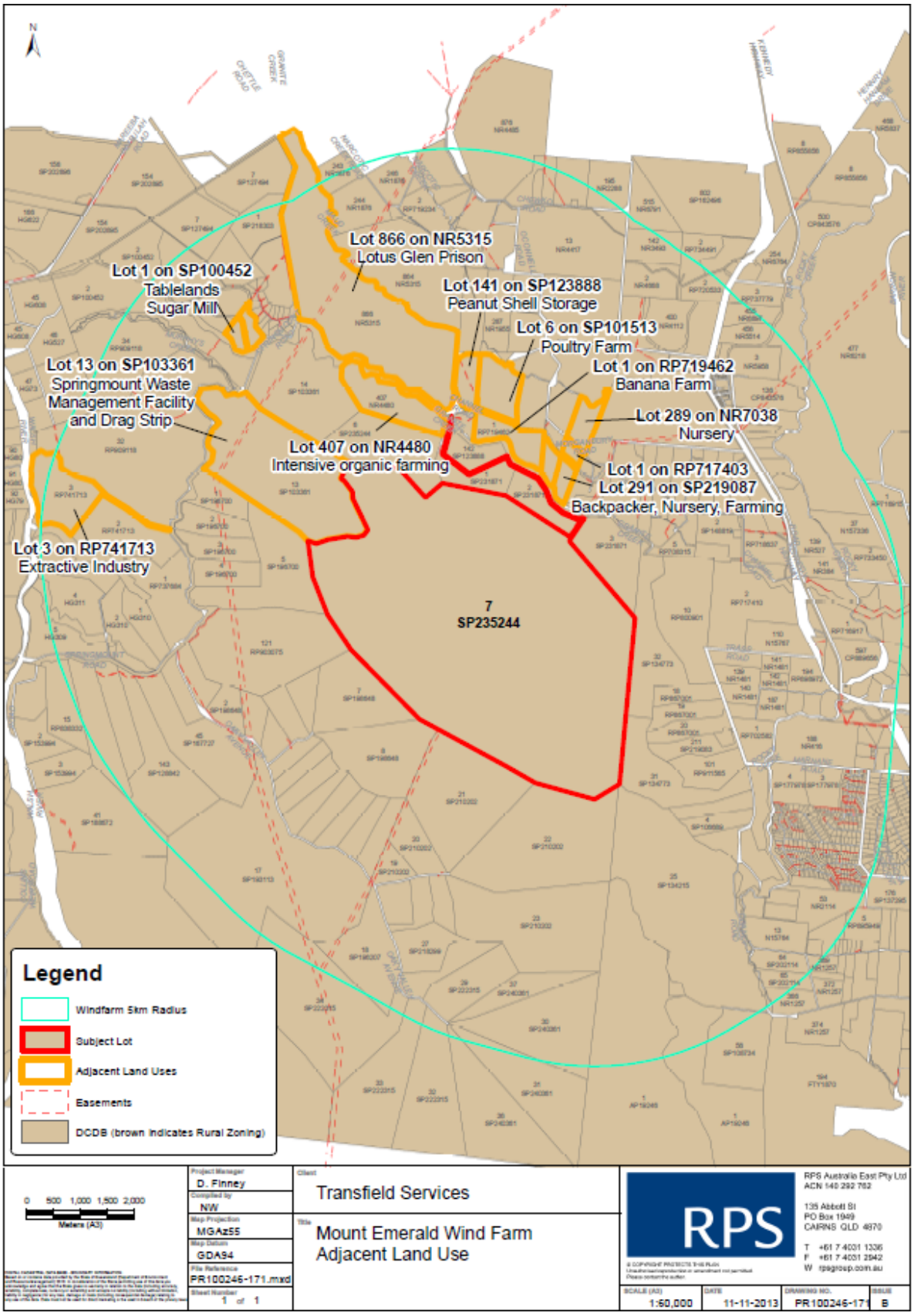

Figure 5-1 Project location and surrounding land uses

Source: Mt Emerald Wind Farm Environmental Impact Statement, RPS, 2014

5.2.1 Method of assessment

The banana farm is the only nearby property that would require aerial spraying. Therefore, agricultural impacts were modelled on the basis of the output from the banana farm. Jacobs' in house spatial consultants have estimated the total land area of the banana farm at 68.9ha. For the Tablelands region as a whole, the area of land under banana production is estimated by the Australian Bureau of Statistics (ABS) at 970 hectares, with a total gross value of banana production in 2010-11 of $26.7 million (Australian Bureau of Statistics 2012). This gives an annual farmland yield (output per hectare) for banana farms in the Tablelands region of $22,317.13 per hectare. By multiplying the yield with the potential impact zone, an estimate of the business as usual (BAU) output was derived. The resultant estimate is $1.54 million for the banana farm, per annum.

There is a large variation between the ABS Agricultural Census data and that provided by the Queensland Department of Agriculture, Fisheries & Forestry (DAFF) (2012). DAFF estimates that in 2010-11, there was 1,272 hectares of banana production in the Tablelands region, with a value of production of $95.2 million. This equates to a much higher yield of $78,333 per hectare. The resultant output estimate of the banana farm in question would be $5.16 million. Given this variation, both the ABS and State Government derived figures are used to form an estimate range of the potential economic impacts, where the lower estimate uses the ABS yield per hectare, and the upper estimate uses the Queensland government figure.

This assessment calculated the potential economic impacts on the banana farm if the project were to interfere with aerial spraying. The potential impacts associated with no spraying are:

- A complete termination of aerial spraying, thereby reducing agricultural yield compared to the business as usual approach.
- A complete termination to the operation of the farm due to uneconomical conditions brought by the lack of easily applied fertilisers and pesticide treatments.

The Food and Agriculture Organisation (FAO) estimates that 20- 40 per cent of the world's potential food production is lost annually to weeds, pests and diseases (Crop Life America, 2006). The European Crop Protection Association (2009) estimates that half of a farm's output may be destroyed if pesticides were not used.

5.2.2 Potential impacts associated with terminating aerial spraying

Under the scenario of a termination of aerial spraying, using insights from the European Crop Association, agricultural output at the respective farm could decline by about 50 per cent. This would represent an average annual loss of between $770,000 and $2,580,000. This fall in output equates to around a 2.8 per cent reduction in the output of the bananas in the Tablelands region, for both the lower and upper estimates. Overall, the Tablelands region would experience a minor decline in economic activity as a result of a cessation to aerial spraying at the banana farm under this scenario. It follows that there would be slight economic impacts to the Far North Queensland economy.

The base case output in the agricultural impact zone is assumed to remain constant over the 25 year operation of the MEWF. This provides an 'average' over a period of time, which will accommodate for the year to year fluctuations of agricultural output over the medium to long term.

Using the regional IO model developed for the impact assessment, the total effect on output, value added, employment and household income were estimated. **Table 5-3** provides the results, in terms of the difference economic variables between the business as usual approach and the aerial spraying termination scenario. This is based on the two estimates of output on the banana farm. The effects are represented on an annual basis and on the total duration of the project's operation.

Total output impact of the termination of aerial spraying over the project life is anticipated to be between $24.75M and $82.8M. Total VA impacts over the projects life cycle would be between $7.41 and $24.79M over

the projects life cycle. The corresponding total household income impact is estimated to be reduced by between $2.39M and $8M.

Table 5-1 Economic impact if aerial spraying was terminated

Economic Variables		Per Year ($m)		Project Life Total ($m)	
		Lower Estimate (ABS)	Upper Estimate (DAFF)	Lower Estimate (ABS)	Upper Estimate (DAFF)
Output	Direct	-$0.77	-$2.58	-$19.27	-$64.45
	Indirect	-$0.22	-$0.73	-$5.49	-$18.35
	Total	-$0.99	-$3.31	-$24.75	-$82.80
VA	Direct	-$0.23	-$0.76	-$5.70	-$19.06
	Indirect	-$0.07	-$0.23	-$1.71	-$5.73
	Total	-$0.3	-$0.99	-$7.41	-$24.79
Household Income	Direct	-$0.07	-$0.22	-$1.68	-$ 5.62
	Indirect	-$0.03	-$0.10	-$0.72	-$ 2.39
	Total	-$0.1	-$0.32	-$ 2.39	-$ 8.010

Table 5-2 details the direct employment impacts are projected to be between three and nine annual FTE jobs. The total employment impacts are approximately four and 12 annual FTE jobs.

Table 5-2 Employment impact of aerial spraying termination

Annual Year (FTE positions)		
Employment impact	**Lower Estimate (ABS)**	**Upper Estimate (DAFF)**
Direct	-3	-9
Indirect	-1	-3
Total	-4	-12

5.2.3 Potential impacts of terminating all farm operations

If alternative pest control processes to aerial spraying are not found, production at the banana farm may become unfeasible. This could lead to the termination of operation and production at the farm. **Table 5-3** shows the impacts on the regional study area if the banana farm stopped operating. If it stopped operating, this would lead to a reduction in farm output of between $1.54 and $5.16 million per year. This fall in output equates to around a 5.5 per cent decrease in the total output of bananas in the Tablelands region, for both the upper and lower estimates. The impacts on the regional economy are roughly twice as large as those estimated for the aerial spraying termination scenario.

Table 5-3 Economic impact of agricultural output termination

Economic Variables		Per Year ($m)		Project Life Total ($m)	
		Lower Estimate (ABS)	Upper Estimate (DAFF)	Lower Estimate (ABS)	Upper Estimate (DAFF)
Output	Direct	-$1.54	-$5.16	-$38.53	-$128.90
	Indirect	-$0.44	-$1.47	-$10.97	-$36.71
	Total	-$1.98	-$6.62	-$49.51	-$165.61

Economic Variables		Per Year ($m)		Project Life Total ($m)	
		Lower Estimate (ABS)	Upper Estimate (DAFF)	Lower Estimate (ABS)	Upper Estimate (DAFF)
VA	Direct	-$0.46	-$1.52	-$11.40	-$38.12
	Indirect	-$0.14	-$0.46	-$3.42	-$11.46
	Total	-$0.59	-$1.98	-$14.82	-$49.57
Household Income	Direct	-$0.13	-$0.45	-$3.36	-$11.23
	Indirect	-$0.06	-$0.19	-$1.43	-$4.79
	Total	-$0.19	-$0.64	-$4.79	-$16.02

Employment impacts are outlined in **Table 5-4**. A termination of farm operations could result in a loss of between five and 18 direct jobs, and an additional two to six indirect jobs.

Table 5-4 Employment impacts of agricultural output termination

Annual Year (FTE positions)		
Employment impact	**Lower Estimate (ABS)**	**Upper Estimate (DAFF)**
Direct	-5	-18
Indirect	-2	-6
Total	-8	-24

This assessment considered the two scenarios of potential impacts on aerial spraying at the banana farm located in proximity to the MEWF. Under these scenarios, the Tablelands region would experience a decline in economic activity if aerial spraying to the banana farm was to cease as a result of the project. It follows that there would be slight economic impacts to the Far North Queensland economy.

However, wind modelling completed for the EIS (RPS 2014) determined the project would not result in any significant impacts to local aerial spraying. In addition, RATCH-Australia is committed to working with the project neighbours to minimise any potential impacts and will temporarily shut down wind turbines in consultation with property owners/ managers and aerial sprayers if they threaten the efficacy of an aerial spray. As a result, the project is not expected to impact aerial spraying in the region.

6. Business and social impacts

During construction, the proposal has the potential to impact indirectly on social infrastructure, residential uses and sensitive uses through:

- Increased noise, dust and construction traffic, impacting on amenity for visitors and users of the facilities and changing perceptions about road safety.
- Potential traffic disruptions and delays due to increased construction traffic on local roads.
- Increased traffic on roads near schools, resulting in changes to perceptions about student safety.

As outlined in the *Traffic Impact Assessment Technical Note 2*, there are two potential routes which may be used by heavy vehicles associated with the project:

- Route 1 – Palmerston Highway
- Route 2 – Kuranda Range.

Route 1 would bypass the Cairns CBD to travel in a direct route to the Bruce and Palmerston Highways. This route largely avoids the commercial and residential areas of Cairns. However, Route 1 would result in an increase in heavy vehicles around the following sensitive uses:

- Small businesses located on and around Portsmith Street, Cairns. As well as industrial uses and utility services, there are several small businesses located on and around Portsmith Street near the Cairns Port. These include businesses providing services and products to residents and visitors, such as car and truck rentals, car repairs, locksmith and seafood market.
- Educational facilities located on or near the Bruce and Palmerston Highways, including:
    - Trinity Anglican School
    - White Rock State School
    - Bentley Park College
    - McDonell Creek State School
    - Miriwinni State School
    - Malanda State High School
    - Tolga State School
    - Walkamin State School.
- Residential uses located close to the Bruce and Palmerston Highways, including at Gordonvale, McDonnell Creek, Palmerston, Millaa Milla, Babinda, Miriwinni, Malanda, Atherton, Tolga and Walkamin.
- Accommodation and tourist facilities located on the Bruce and Palmerston Highways, particularly at Babinda, Malanda, Atherton, Tolga and Walkamin.
- Sport and recreation facililities along the Bruce and Palmerston Highways, particularly the Mamu Tropical Skywalk near Millaa Milla, Malanda Falls and Malanda, Soldiers Memorial at Atherton, Rotary Park at Atherton, Rocky Creek War Memorial Park at Tolga.

Route 2 would travel through the Cairns CBD, along the Captain Cook Highway

- Parks, accommodation, retail and commercial uses on Sheridan Street, Cairns.
- Residential properties located near to the Captain Cook and Kennedy Highways
- Tourist facilities and uses near the highway, particularly in the townships of Kuranda and Mareeba

- Open space, sport and recreation facilities near the highway, such as the Kuranda Rainforestation Nature Park at Kuranda and Nardellos Lagoon at Walkamin.

6.1.1 Social infrastructure

An increase in heavy vehicles may potentially impact perceptions of safety for children at schools along the transport route. Limiting construction traffic on these roads during school drop off/pick up times, from about 7.00am – 9.00am and 2.00pm – 4.00pm on weekdays would help to reduce potential concerns.

During construction, an increases in construction traffic, including heavy vehicles, may impact on access to social infrastructure, accommodation and tourist facilities in the study area. This may result in slightly longer travel times for road users. Traffic management planning will help to minimise impacts on residents and visitors from changed traffic conditions. Increased construction traffic also has potential to reduce amenity. Noise and dust from heavy vehicles may temporarily diminish visitor's experience of the social infrastructure and interrupt student concentration at schools.

Traffic on the Bruce, Palmerston and Captain Cook Highways is generally heavy and the existing background noise levels for social infrastructure would already be high. Construction traffic is not expected to significantly change noise levels along the transport routes. As a result, construction traffic for the project is not expected to impact social infrastructure significantly.

6.1.2 Local amenity

The study area is characterised by rainforest and natural environment, agricultural and primary industry land uses, rural residential development and small towns and settlements such as Mareeba, Atherton, Walkamin and Tolga. However, amenity in the study area is currently impacted by the existence of transport infrastructure, including major road and rail corridors.

During construction, changes in road traffic noise may occur for residential areas on either side of the Bruce, Palmerston and Kennedy Highways. There would also be an increase in light vehicles on the local road network from construction workers accessing the project site.

Traffic through the area is generally heavy and the existing background noise levels for residences located immediately adjacent to the Bruce, Palmerston and Kennedy Highways would already be high and dominated by road traffic during the day and night time periods. Any further increase in noise levels may be of concern for some residents.

6.1.3 Businesses

Impacts on amenity may be experienced due to increased dust, construction noise and construction traffic. This may create a difficult environment for local businesses, accommodation and tourist uses along the transport route, particularly those businesses with an outdoor trading area. However, construction traffic would be short term in nature and will travel along existing highway routes that already cater for large vehicles. As a result, heavy vehicles associated with the project are not expected to significantly change the local environment or amenity businesses are operating in or affect trade.

6.1.4 Socio-economic impacts from project traffic

The construction of the project would require the movement of wind turbines components, to and from the project site. As a result, traffic on nearby Tableland roads would increase compared to levels without the project. Any associated congestion from construction traffic could cause delays and increase freight and private car travel times. This would impose economic costs on third parties, including local businesses such as the Arriga Mill.

The principle document of reference with respect to traffic impacts is the Mount Emerald Wind Farm Traffic Impacts Assessments reports produced by Sinclair Knight Merz (2012, now Jacobs). The identified route in the report suggested the usage of the Kennedy Highway, Hansen Road, Springmount Road and Kippen Drive. This is because these roads are gazetted for large vehicles, which are also used by the Arriga Mill.

The assessment found the only significant change on these roads as a result of the project would be some vertical crest issues for low loaders in Hansen Road. Low loader vehicles can have problems traversing rising curved roads. Thus wear and tear costs may be exacerbated. However there would be no significant traffic delays on the route, and therefore no travel time increases. Furthermore, RATCH-Australia has committed to working with stakeholders to minimise potential impacts associated with construction traffic. Large deliveries to the project would be scheduled in a regulated manner, and with prior notification of the local residents.

The traffic impact assessment also noted that due to the fact that the route along Hansen Road and Springmount Road is assigned for large vehicles, it was recommended that special signage must be installed to denote that B-doubles are present along those local roads. Some more signage on intersections on Hansen Road/Chewko Road, Hansen Road/Channel Road and Springmount Road/Kippen Drive is also recommended. RATCH-Australia has committed to provide the added signage (through contractors) on the intersections outlined and provide traffic controllers if required to assist motorists where there are changed road conditions.

7. Tourism impacts

This section identifies and assesses potential impacts to tourism as a result of the project.

7.1 Study area

The Tourism Queensland "Tropical North Queensland" region is taken as the study area for this tourism profile. The Tropical North Queensland tourism region is considered to be a more reasonable baseline study area for assessing possible regional tourism effects of the project as it aligns with Queensland Government tourism data and more accurately reports on visitor numbers to the region.

Where appropriate, intra-regional information is provided that allows a finer context of the possible effects of the project to be discussed. In order to provide a context for the region tourism, comparative tourism statistics for the State of Queensland are also provided.

Figure 7-1 provides an overview of the tourism study area.

7.1.1 Method of assessment

The description of the existing tourism environment provides a baseline of the key tourism data and conditions of the study area from which potential impacts of the project can be assessed, including:

- Visitor numbers and characteristics.
- Visitor expenditure.
- Tourism employment.
- Identified key tourism assets.
- Tourism's economic value to the region.

The regional profile draws on Tourism & Events Queensland (TEQ) and Tourism Research Australia (TRA) published data from the National Visitor Survey (NVS) and the International Visitor Survey (IVS), regional economic and employment data from the ABS and from NIEIR Economic modelling and information form regional and local tourism websites and brochure material. This section also looks at Australian and international experience on the impacts of wind farm developments on regional tourism based on an international literature search and information from previous wind farm studies.

Figure 7-1 Tourism study area and location

Source: Queensland Tourism 2014

7.2 Tourism policy context

This section provides an overview of the broader tourism policies and strategies relevant to the project and the study area.

7.2.1 Tropical North Queensland Destination Tourism Strategy 2012-2016

The Tropical North Queensland Destination Tourism Strategy was published by Tourism Tropical North Queensland to provide a framework to guide tourism industry development in the TNQ region by coordinating stakeholders in a common direction to maximise the tourism potential of the TNQ destination so as to achieve a balance of economic, social and environmental outcomes.

The strategy builds on the key strengths of the region of the world heritage Great Barrier Reef and ancient rainforest and recognises the diversity of other tourism product and infrastructure. It seeks to:

- Build on the region's current reputation for quality product and service standards and develop this further through focussed industry development programs
- Protect TNQ's reputation as a leading sustainable tourism destination through focused sustainability and climate change programs and nurturing and upholding world heritage values
- Foster the on-going development of world class marine tourism operators in TNQ.

The project aligns with the objectives in the Strategy noted above in supporting its sustainability and climate change aims.

7.2.2 Tropical North Queensland Tourism Opportunity Plan 2010-2010

The Tourism Opportunity Plan (Plan) aims to:

- Identify new and upgraded tourism product that meets future visitor expectations and demands;
- Identify the need for new investment in infrastructure that supports the ongoing development of tourism;
- Provide relevant research based information on tourism supply and demand; and
- Provide an agreed focus and mechanisms for engagement with the tourism industry, infrastructure and private investors.

The Plan indicates a number of regional strengths including the 'rich diversity of the experiences available that attract long stay and repeat visitation'. It also notes a number of challenges in developing regional tourism including 'global warming/climate change leading to coral bleaching and potential extreme weather patterns that threaten to impact visitation'. The project could add an additional regional experience that addresses directly the industries concerns about the impact of climate change.

Various core tourism precincts are indicated including the Atherton Tablelands. Again given the range and variety of attractions and experiences as noted it is unlikely that the project will have an adverse impact on tourism visitation or experience.

A number of specific development opportunities are canvassed. Two affect the Tablelands and comprise development of an Adventure Cycle and Recreation Trail and improvement of the Tablelands accommodation by establishing more and varied accommodation options. Again, it is unlikely that the project will have an adverse impact on the successful implementation of either of these options.

7.2.3 Tropical North Queensland Strategic Plan 2011-2015

In June 2011, TTNQ released its five-year strategy (VISION 15), which identified the strategic direction for the organisation. The TTNQ Strategic Plan takes into consideration the inspiring and challenging vision of Tourism Australia – supported by both Federal and State Governments - to double the economic value of tourism to Australia from $70B to $140B by 2020. TTNQ has adopted similar methodology for the region and identified the key international and domestic markets integral to achieving a $1B increase in revenue by 2015.

The most recent update focusses on 2013-14 and indicates performance to the year-end 2012. A key strategy is to pursue events and sports tourism to future proof the tourism industry by boosting the shoulder seasons and developing a more consistent visitation throughout the year. This market is seen to be more robust than the leisure market and not influenced by the weather or airfare discounts.

7.2.4 Tropical North Queensland Strategic Marketing Plan 2011-2015

This Plan supports the Tropical North Queensland Strategic Plan 2011-2015. The Strategic Plan identified the key international and domestic markets integral to achieving a $1B increase in revenue by 2015 as the first stage to doubling economic value by 2020. The Tropical North Queensland Strategic Marketing Plan 2011 – 2015 was released by the TTNQ provides a marketing strategy and plan to support the Strategic Plan's objectives and assist in meeting the Federal and State Government's vision to double the economic value of tourism to Australia by 2020.

7.3 Regional profile

This section provides a profile of the broader Tropical North Queensland regions compared with Queensland as a whole. More specific information on the Tablelands region is provided where it is available.

7.3.1 Tourism attractions

The Tablelands offers a wide range of natural and man-made attractions. These include rainforests, volcanic craters, waterfalls, Limestone caves, Lakes, hot springs and gorges. The region also includes a number of National Parks although the edge of the nearest is more than ten kilometres from the Wind Farm site as the crow flies. The region also offers opportunities to see and interact with a range of native animals, reptiles and birds.

In addition to the wide range of natural attractions, the Tablelands offers an extensive range of man-made or operated attractions and experiences including heritage railways, houses, mines, villages, Chinese Temple, the international Skyrail cable car attraction to Kuranda, Hot Air Ballooning, the existing Windy Hill Wind Farm, a Distillery, various museums and specialist tourism retail outlets. The area also offers a range of food and wine attractions and a large number and range of accommodation and food and beverage operations.

While the Tablelands offer a wide range and depth of attractions the locality around the wind farm site has fewer attractions. A web site search of the area around the project suggested the nearest townships of Walkamin and Tolga offer a handful of published attractions including the Mt Uncle Distillery and the Walkamin Central Van Park and the Tolga Woodworks Gallery and Café, Adventure Connections Australia, the Peanut Place, Rainforest Gems and the Tablelands Heritage Centre.

The broader Tropical North Queensland Region offers the key attraction of the Great Barrier Reef, the Daintree River and Forest, Mossman Gorge, the Tjapukai Aboriginal Cultural Park and tropical beaches. It also offers opportunities for exciting off road 4WD adventures and on and in water activities including fishing, sailing snorkelling and scuba diving.

7.3.2 Visitation

Between1999 to 2012, around 16-18 million people visited Queensland per annum and between 1.3 and 1.6 million people visited TNQ. The visitation to TNQ is between 8% and 10% of the total Qld visitation. TNQ was the fifth largest tourism region in Queensland based on domestic overnight visitation at the end of March 2014 after Brisbane, Gold Coast, Sunshine Coast and Southern Queensland Country and fourth on nights above Southern Queensland Country. The proportion of domestic visitors who stayed overnight in TNQ comprised about 9.5 per cent to 11.7 per cent of all domestic visitors in Queensland. TNQ was ranked third in terms of domestic overnight tourism expenditure. It was also third largest in terms of international visitors and nights only topped by Brisbane and the Gold Coast. The average nights' stay in TNQ fluctuated between four and five nights and showed an overall downward trend from 1998 to 2013

Figure 7-2 provides visitation data for domestic overnight visitors, day trip visitors and international visitors to TNQ. The figures show that the international visitors were only some 17% of domestic visitors (combined overnight and day trippers) in 2012-13 and 43% of overnight visitors and 28% of day trippers separately. The

proportion of international visitors has declined over the 14 years shown from nearly 60% of domestic overnight visitors and just over 40% of day trippers to the region.

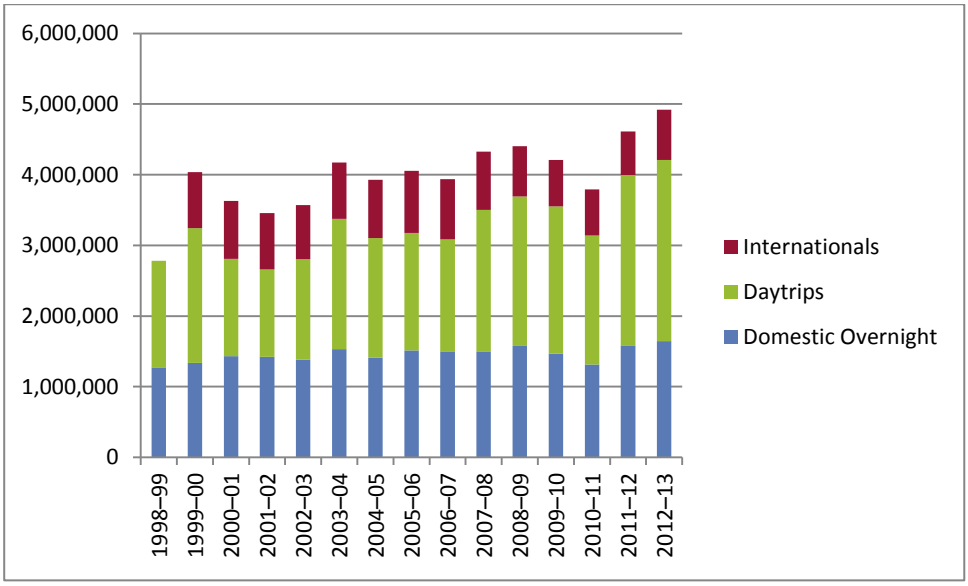

Figure 7-2: Visitation to Tropical North Queensland (persons)

Source: Tourism Research Australia 2014

Cairns attracts a significantly larger number of visitors and nights with the Tablelands comparison to Cairns at around 20 per cent of domestic overnight visitors, just over 40 per cent of day trips but only 3.6 per cent of international visitors.

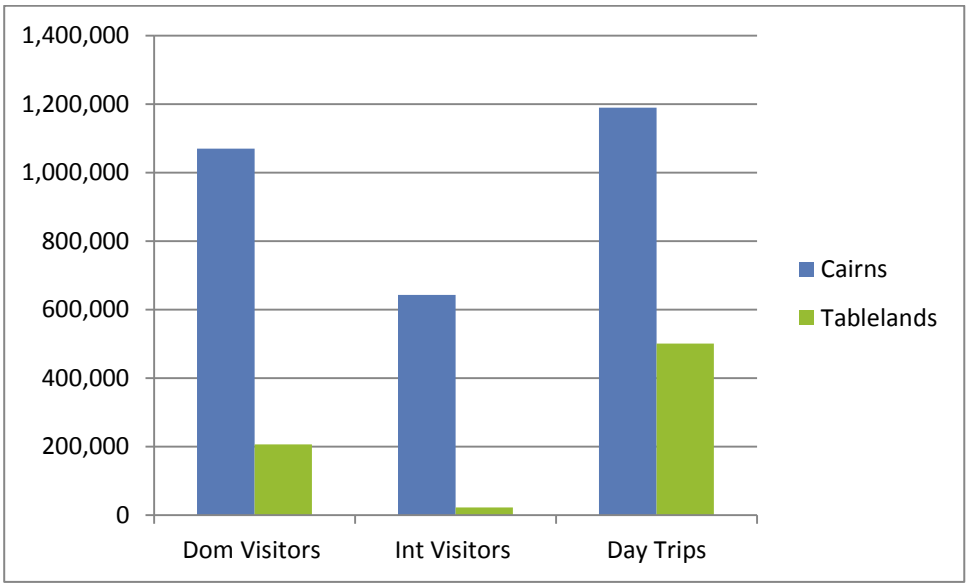

Figure 7-3: Average Visitation to Tablelands and Cairns 2009-2012 (persons)

Source: TEQ Tourism Profiles 2014

The Tablelands attracts a smaller proportion of domestic overnight visitor nights at around 12 per cent but significantly higher proportion of international visitor nights at some 6.6%. This reflects the longer average stays in the Tablelands by international visitors. In all destinations international visitors stay longer than domestic ones with international visitors to Queensland staying some 30% longer on average than international visitors to the Tablelands and some 60 per cent longer than international visitors to Cairns.

7.3.3 Tourism expenditure

Figure 7-4 presents the average annual tourism expenditure by type of tourist in the Tablelands and Cairns. As expected given the larger number of visitors to Cairns, the expenditure in Cairns is considerably higher than in the Tablelands region. The highest average per night expenditure across Cairns, Tablelands and Queensland was by domestic overnight visitors, at just over $200 per night in Cairns and Tablelands. International expenditure averaged at about $130 per night while day trippers spent just over $100 per night.

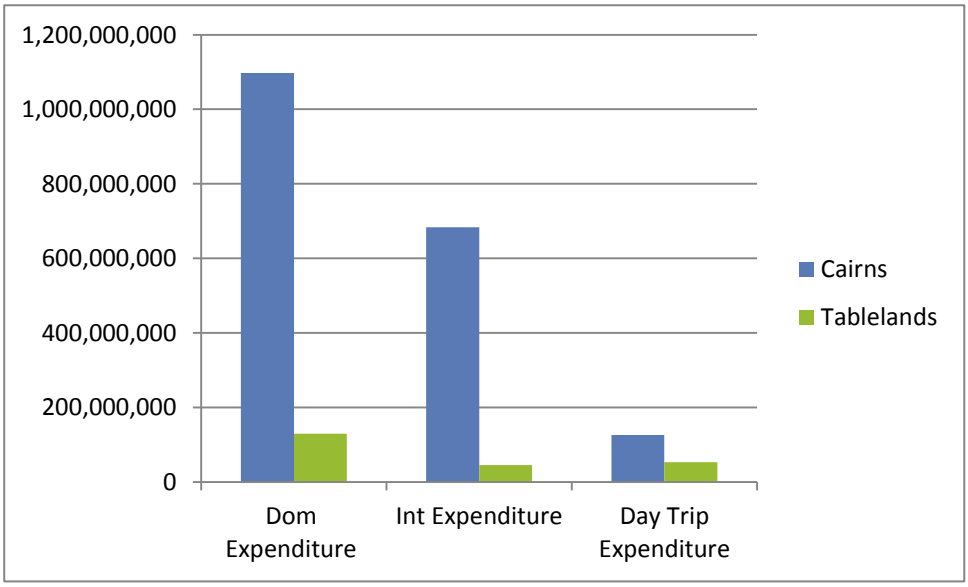

Figure 7-4: Average annual tourism expenditure 2009-2012

Source: TEQ Tourism Profiles

7.3.4 Visitor information

- The main purpose of visits to the TNQ is for holidays, particularly for international visitors. This reflects the strong reputation of the whole region and state as a holiday destination in Australia and overseas. A significant number of visitors' main reason for travelling to the Tablelands was to visit friends and relatives. Business travel is also important for Cairns and TNQ
- The top five activities for domestic overnight visitors and day trip visitors were visiting friends, eating out at restaurants, general sightseeing, bushwalking / visiting parks, and shopping.
- The key activities and experiences of interest to visitors to TNQ include cultural heritage, nature based activities, and food and wine activities for both domestic and international visitors. In addition, international visitors are interested in and participate in Indigenous activities and experiences.
- A small proportion of domestic visitors travel by air and these may be visitors from Brisbane, interstate or from further parts of the State. However, even visitors who have flown to Cairns may drive to visit the Tablelands.
- International visitors to TNQ tend to be either younger (ages 15-34 years) and older (ages 55 years and over). This probably reflects their status with younger visitors perhaps backpackers or camping on a longer less expensive and perhaps working holiday and older and more economically secure visitors coming as couples or singles without children. The smaller number of visitors in the prime working and family age (35-55 years) is likely to relate to the cost and time involved in holidaying in Australia from international destinations **Figure 7-5**.

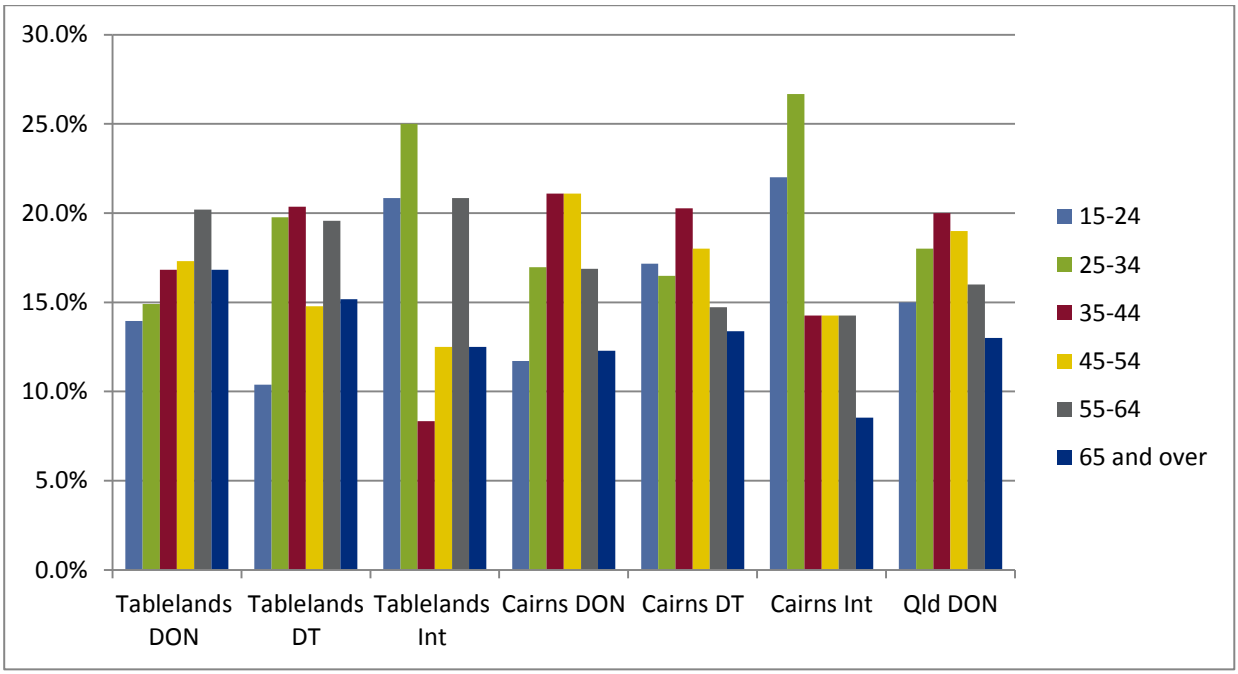

Figure 7-5: Breakdown by Age and Type of Visitor

Source: TEQ Tourism Profiles

7.4 Tourism industry workforce participation and employment

The following section provides information regarding labour force and employment in the tourism industry. It provides a comparison of the Tablelands tourism with the industry in the broader Tropical North Queensland tourism area and with Queensland data where appropriate. The key points are:

- In 2011, there were about 569 people in the Tablelands regional tourism and hospitality workforce, comprising 171 males (30 per cent) and 398 females (70 per cent).
- Tourism and hospitality work tended to be reasonably evenly spread across age groups although possibly marginally more likely to be under 45 years of age.
- There are also a very slightly greater proportion of part time employees some 51 per cent to 49 per cent full time.
- Around 38 per cent of tourism and hospitality employees have some form of qualification with 62 per cent with no qualification. Nearly 80 per cent of employees are Australian born which compares with some 68 per cent for Qld as a whole.
- There was also a higher proportion of employees in the lowest wage bracket up to $599 per week (62.7 per cent) compared with 53.1 per cent for Queensland as a whole.
- Tourism employment grew some 3.6 per cent in the Tablelands over the inter-census period from 2006-2011.
- Unemployment may be lower in the hospitality and tourism sector. However, the broader regional data arguably provides an indicator of relative rates across sectors. If so the regional tourism sector may have a similar differential unemployment rate as the broader regional estimate.
- Based on the industries that contribute to the tourism industry from the ABS Tourism Satellite Account there are potentially over 250 businesses that contribute to the tourism industry in the Tablelands and Cairns Region.
- Tablelands and Cairns contributed some $855M of tourism value added to the regional GRP in 2012-13 or approximately 6.9 per cent of total FNQ GRP. The Tablelands contributed some $35M or just over 3 per

cent to the Tablelands GRP. Both the Cairns and Tablelands tourism value added has reduced over the five years to 2012-13 and particularly the Tablelands. This at the same time the total Tablelands GRP remained broadly steady.

7.4.1 Summary of baseline tourism data

Tropical North Queensland is either the third or fourth largest tourism region in term of visitor numbers, nights or expenditure. The Coastal part of TNQ particularly Cairns and surrounds provides the major attraction and input into these figures. The Tablelands attracts some 20 per cent of domestic overnight visitors, 40 per cent of day trippers and some 3.6 per cent of international visitors. Overall it attracts around 25 per cent of Cairns' visitation due to the larger proportion of day trippers.

The Tablelands offers a wide variety and diversity of attractions, natural and manmade spread across the region. The key characteristics of visitors to TNQ and the Tablelands are:

- The main reason for visiting both TNQ and the Tablelands is on a holiday with visiting friends or relatives as the next most important reason.
- The main mode of transport to both TNQ and the Tablelands in by driving although the main mode of visiting Cairns is by air.
- The favourite activities are eating out in restaurants followed by visiting friends or relatives, general sight-seeing and shopping for pleasure. Visitors to Cairns put visiting the beach as high or higher than every activity than eating out.
- A higher proportion of international visitors tend to be in the younger and to a lesser extent older age cohorts in the Tablelands and Cairns. Whereas domestic visitors tend to be proportionately more in the middle age groups.

Tourism value added in both the Cairns and Tablelands areas reduced over the five years to 2012-13 and particularly the Tablelands. This at the same time that total Tablelands GRP remained broadly steady.

7.5 Possible impacts of wind farms on regional tourism

This section discusses some of the findings on the impact of wind farms on regional tourism from the international literature and from investigations of the possible impact of Australian wind farms.

7.5.1 Overseas experience

A summary of the findings from a range of international studies is set out by study below.

The impact of wind turbines on tourism - A literature review, The Tourism Company, 2012

This study reviewed a range of literature mainly from the UK and Ireland but also individual studies from the USA, France, Germany and the Czech Republic. Their study concluded with a number of observations on the findings as follows:

- The positive attitude of most tourists to green energy, including wind, is an important factor and could be used to advantage. However, attitudes to energy generation and the issues involved may change over time and it is important to keep abreast of this.
- Only a minority of tourists appear to be negative about wind turbines and believe that they spoil the landscape. However, this is a significant minority.
- Tourists' reaction to wind turbines appears to be affected by how and where they see them. Certain images have stimulated a majority negative reaction. Proximity may be an issue. In general, they prefer to see them in the distance.

- Generally tourists prefer smaller wind farms to larger ones. However, there is no firm evidence to judge their likely reaction to having a lot of individual turbines or small clusters dotted across a landscape. The impression from the research is that they may prefer to see them in one place rather than everywhere.
- Wind turbines are not seen as negatively as some other structures in the countryside, notably pylons.

Potential Economic Impact of Wind Farms and Associated Grid Infrastructure on the Welsh Tourism Sector, Regeneris Consulting and the Tourism Company, 2014

Key findings from this study are:

- **Negligible impact on the national tourism sector** - The current scale of wind farm development in Wales is modest, especially when compared with other European countries, including Scotland. National studies of tourism impacts of wind farms have shown that, where negative effects do occur, these are often in the form of displaced tourism. This is likely to be the case in Wales, where substantial areas of the country will remain unaffected by wind farm development. (The Tablelands is currently in a similar position with only one other small wind farm).
- **Limited evidence of local tourism impacts to date** - There are a number of areas in Wales where wind farms have been an established presence on the local landscape for a relatively long time. These include Powys, Anglesey and the South Wales Valleys which were all the subject of case studies. The case studies have not revealed any evidence of significant impacts on tourism to date.
- **Reactions to wind farms are complex and may change over time -** The evidence base shows a clear majority of people do not react negatively to wind farm developments or change their visiting behaviour as a result. However it also shows that visitor responses and reactions to wind farms are highly subjective and depend on the individual's own judgements and perceptions of the relative merits of onshore wind as a means of energy production.
- **Higher sensitivity to wind farms for certain visitor markets -** There are examples of certain locations which are more sensitive to wind farm development on account of their landscapes, types of visitor, limited product diversity and proximity to wind farms. This is particularly the case where the key visitor markets are older people visiting for the tranquillity, remoteness and natural scenery offered in some parts of Wales.
- **Some potential for positive impacts, often requiring further investment -** Although a number of studies point to the potential to attract visitors to areas containing turbines, there is little evidence that these positive effects occur in practice. There may, however, be some instances where wind farm development could enhance existing visitor attractions or be an attraction in their own right through investment in related visitor facilities.
- **No evidence that wind farms on visitor routes deter tourists -** There are a number of visitor routes which will be in close proximity to large concentrations of turbines. The general survey evidence presented in this study offers the only proxy for how visitors would react to these wind farms. This shows that small minorities of visitors would be encouraged, whilst others would be discouraged. Overall, however, there is no evidence to suggest that there would be any significant change in visitor numbers using these routes to reach destination elsewhere.
- **Negative impacts during construction -** The study has not shown there to be any evidence of a fall in visitor numbers as a result of disruption during construction. However, this was identified as a concern for many businesses in the case studies, particularly in relation to noise and traffic, and the closure and diversion of public footpaths or other popular routes.
- **Associated infrastructure -** The evidence base for tourism impacts of associated infrastructure is far less developed than that for wind farms. The few studies which have addressed the subject have focused on visitors' opinions of pylons, which consistently find that reactions are far more negative than toward wind turbines.

Summary of overseas evidence

The overseas studies identified:

- Tourists generally have a positive attitude to renewable energy and the majority of tourists are generally positive to wind farms.
- Wind farms generally have a limited or negligible impact on tourism at the regional level although there may be impacts on key assets at the local level. There is some evidence that wind farms can provide a positive benefit for tourism but usually this would require additional investment in visitor facilities and interpretation
- There is no evidence that wind farms deter visitors on visitor routes. Generally, only a few visitors may choose to stay away from areas with a wind farm and if so they may still visit the other parts of the region.
- Concern about wind farms tends to be greater prior to construction and more limited once in operation. There is greater concern about other structures such as pylons than turbines.
- Any limited adverse impacts for some visitors tend to be reduced if the wind farm is set back from touring routes and not adjacent to tourism attractions. The project will meet these criteria which should reduce or eliminate any limited impact.

7.5.2 Australian experience

Australia is relatively new in the development of wind farms. However there is some qualitative information of the impact of these wind farms on tourism. These are discussed below.

Hallett Wind Farm South Australia, Taken from "Economic Impact Assessment of Hallett Wind Farms", Sinclair Knight Merz 2010

Key findings of this report were:

- Discussions at the Visitor Centre in Burra (South Australia) and with other people including accommodation providers indicated that there have been no negative responses to the wind farms from visitors. Visitors are interested and ask about visiting and tours of the wind farms. There have been tours arranged by AGL which were very popular. The Visitor Centre was advertising the third public tour at the time of the interview.
- The Visitor Centre has had very consistent visitation of between around 25,300 and just fewer than 26,500 over the past seven years. The high visitation is in the non-summer months from March to October with lower visitation from November to February. Visitors tend to stay for one night.
- The Visitor Centre Manager would like to develop educational tourism. In addition to the mining heritage and the extensive built heritage, there are other attractions including key fossil sites. The wind farms have the ability to complement and add value to educational tourism on a range of levels including schools and post schools programs and small scale experiential programs for adults.
- In addition to the Burra Visitor Centre, AGL operate a Wind Farm Information Centre. The Information Centre has operated from January 2009 to date. To the end of April 2010 the Centre had received nearly 4600 visitors or between 9 and 10 people a day. The Information Centre provides information on the Hallett Wind Farms as well as general information about wind energy.
- One person interviewed was concerned that there may have been some possible crowding out of tourist accommodation due to the take up of beds by wind farm personnel but this was not obvious and others spoken to did not see it as an issue. In general the people spoken to saw the wind farms providing a benefit from continuity and longer term stay arrangements that have benefitted a wide range of local providers. Tourists to the region are generally travelling through and only stay for a short period and appear to have been accommodated successfully.

Research for Wind Farm Economic and Tourist Assessment, Sinclair Knight Merz, 2003

- The wind farm at Albany was completed in July 2001. It is located adjacent to the Bibbulmun Track (longest walking track in WA). Sections of the track were hardened to accommodate the anticipated increase of visitation due to the wind farm.
- When surveyed in 2003 it was noted that the Albany Council had put a traffic counter on the road going out to the site, which indicated 644 vehicles per day on a 7-day average visiting the wind farm or about 230,000 vehicles per year. Discussions with the Albany Visitor Information Centre (pers. comm. Joy Radley, 26 June, 2003) show that about half of the visitors to the Visitor Information Centre indicated interest in the wind farm and asked questions about its access and further information. It is also one of the more visited attractions in Albany.
- The wind farm still seems to be a popular attraction and is listed as one of the scenic attractions of Albany. It is also listed as an attraction by "tripadviser" which indicates it is the third most popular of 25 Albany attractions.
- Esperance in Western Australia has two wind farms located almost adjacent to each other. Both Ten-Mile Lagoon and Nine Mile Beach wind farms are adjacent to the Great Ocean Drive, a promoted tourist route to view and experience the surrounding area (e.g. scenic views to the ocean, inland lakes, historic sites, etc.). The wind farms are highlighted as one of the attractions for visitors staying in the town.
- Codrington Wind Farm, located near Port Fairy on the Great Ocean Road in southwest Victoria currently hosts a long standing commercial tourist operation 'Codrington Wind Farm Tours'. It is a viable member of the Port Fairy Tourist Association and is recognised as an attraction for tourists to visit by all tourism associations in the Shipwreck Coast.
- The tour operator estimates that around 5,000 people have taken the commercial tour (at $7.00 per head adult, $5.00 per child and $19.00 a family of four) each year, while an estimated ten times that number (around 50,000 people) had visited the viewing area. Codrington Wind Farm Tours has been in continuous operation since 2001.

Toora Wind Farm-South Gippsland Shire Victoria (Based on research undertaken by Sinclair Knight Merz for proposed wind farms in the Corner Inlet region), 2005

- Toora Wind Farm in South Gippsland comprises 12 turbines that generate 21 MW of electricity. The wind farm was completed for Stanwell in 2002.
- The information centre in Toora was funded, run and operated by Stanwell for the local Toora Wind Farm for the two years until August 2004 when it was closed. There was some local concern about the closure of the visitor information centre, as visitors were attracted by the centre. On the closure of the centre the information material was relocated into space at the antique shop which continued to provide a wind energy and tourism information service. While this service has waned over time, brochures and information are still available.
- During 2002 to 2004, it was estimated that the information centre received around 13,000 visitors in the 19 months from the wind farms opening to March 2004, or around some 700 visitors per month.
- The wind farm viewing area is also popular despite the limited viewing facilities and interpretation. Car counts taken at the viewing area at the time the visitor centre was operating suggested that there was an average of about 200 cars visiting each weekend. On peak days such as over Easter and during summer holidays the number could exceed 1,000 a day, while mid- week and winter periods are lower. On this basis the number of vehicles visiting the site could have been up to double the number of people visiting the centre and at an average of 2 per car suggests that some 35,000 people could have visited the site per year in the early years.
- Face to face and telephone interviews were undertaken with business people in the town and indicated a strong belief that the wind farm has brought significant tourism benefits to the town. The wind farm information centre and the site attracted new visitors including bus trips and individuals. Anecdotal information indicated people arrive by V Line bus specifically to see the wind farm and self-drive visitors

have indicated they had no intention of stopping in Toora until they were attracted by the wind farm and information centre signs.

- Discussions with the caravan park operator indicated that the wind farm has not affected their business. The Caravan Park is located just below the wind farm on the main Highway.

Macarthur Wind Farm (Taken from the Economic Impact Assessment of Oakland Hills and Macarthur Wind Farms), Sinclair Knight Merz 2012

This section discusses the findings from interviews with local businesses, representatives from Moyne Shire and representatives from contractors involved in the Macarthur Wind Farm project. The site visit indicated strong support from local businesses:

- Accommodation and food services providers have had a significant increase in sales over the period the wind farms have been in construction.
- SKM conducted a staff expenditure survey of 119 people working on the wind farm. The survey was conducted one morning during a toolbox safety meeting, week starting 10 September 2012. The survey questionnaire asked for the age, gender, current length of employment, future length of employment, employment sector and work type. The survey found that about 69 per cent of staff relocated to the region as a result of the employment opportunity and staff typically spent about 30 per cent of total expenditure on accommodation.
- Port Fairy has experienced a fairly substantial increase in occupancy during the project construction period, from 50% to 60%. The increase in demand as well as the workers ability to pay higher rates pushed prices from $300-350 per week to $380-450 per week.
- Areas where workers stayed experienced increase in trade however during the day, workers are able to purchase food from the on-site canteen and take away business.
- Brief conversations with other retail traders indicated that their business was up from both direct sales to wind farm employees and in some cases sales to other businesses that provide services to the wind farm workers.

Overall, from both the Australian and overseas experiences there is little evidence of any significant negative tourism impacts to date. In fact, based on the reviews of the wind farms above where the community have accepted and promoted the wind farm positively, there appears to be a positive local impact albeit small. The current operational wind farms in Australia seem to have attracted some new visitation into the regions in which they are located and they also seem to provide an additional destination for visitors already in the region or travelling through as part of a broader organised tour. The attraction can potentially be increased if there is significant linked interpretation as demonstrated in some of the overseas experience but even limited interpretation and information can add significantly to the visit experience. In addition local communities can benefit if they work with the facility by providing services to visitors including food and beverages, souvenirs, information and other visitor services.

In summary it is unlikely the project will have an adverse impact on tourism and with a little local investment in visitor facilities and interpretation could have a positive impact.

7.6 Regional overview of impacts on tourism industry

The key characteristics of the study area include:

- TNQ is in the top three or four tourism regions in Queensland with variously Brisbane, Gold Coast and the Sunshine Coast and Domestic Overnight visitors Southern Queensland Country. The visitor numbers suggests the predominance of coastal TNQ tourism as the driver of the broader TNQ region.
- The Tablelands offers a wide variety and diversity of attractions, natural and man-made spread across the region.

- The main reason for visiting both TNQ and the Tablelands is on a holiday, with visiting friends and relatives as the next most important reason. The main mode of transport to both TNQ and the Tablelands is by driving although the main mode of visiting Cairns is by air. The favourite activities are eating out in restaurants followed by visiting friends and relatives, general sight-seeing and shopping for pleasure. Visitors to Cairns put visiting the beach as high or higher than every activity than eating out.
- Tourism employment grew by around 3.6 per cent in the Tablelands from 2006 to 2011.
- Tourism value added in both the Cairns and Tablelands areas reduced over the five years to 2012-13 and particularly in the Tablelands. This at the same time that the total Tablelands GRP remained broadly steady.
- Overall, from both the Australian and overseas experiences, there is little evidence of any significant negative tourism impacts to date. In fact, based on the reviews of the wind farms in this report, there appears to be a positive local impact albeit small. The current operational wind farms in Australia seem to have attracted some new visitation into the regions in which they are located and they also seem to provide an additional destination for visitors already in the region or travelling through as part of a broader organised tour. The attraction can potentially be increased if there is significant linked interpretation as demonstrated in some of the overseas experience but even limited interpretation and information can add significantly to the visit experience. In addition local communities can benefit if they work with the facility by providing services to visitors including food and beverages, souvenirs, information and other visitor services.
- In summary it is unlikely the project will have an adverse impact on tourism in the Tablelands region.

8. Property Impacts

8.1 Study area

The study area for the property prices review was determined as an area up to 15 km from the project based on:

- The likely maximum area of visibility of the project which could be up to 15 km. Large turbines are potentially perceptible up to 20 km or more in good visibility conditions, but 10-15 km is more typical for the casual observer and details of individual turbines are lost by eight km (University of Newcastle 2002)
- It is anticipated that any effect on property prices would be related to distance from the nearest turbine or visible cluster of turbines and that once the wind farm is no longer or barely visible because it is too far away it should have no impact on prices. Vegetation and topography could restrict visibility and mean some properties may not have a view of the project despite being closer than the maximum unrestricted visible distance. In addition some people find wind farm views attractive
- The visual impact report looks at the visual impacts on properties within two km of the nearest turbine, two to five km and up to 10 km.

8.2 Method of assessment

The assessment is based on a:

- Literature and internet search and review of relevant material for Australia and overseas.
- Review of some of the findings from other Australian wind farms.
- Assessment of the possible effects on properties within sight of the project based on the findings from the review.

8.3 Assessment

A key issue often raised in community consultation during the planning of a wind farm is the effect on property prices in the surrounding region. There is a general perception that wind farms decrease property values of surrounding land. In Australia there is little data released to assess the impact of wind farms on property prices. Both Australian and international studies previously conducted for the purpose of identifying the impact of wind farms on property prices have largely focused on qualitative measures. Like previous studies into the effects of overhead transmission lines, qualitative data collected from telephone or face-to-face interviews is likely to reflect personal opinions in various areas and as such will produce varying results. This is particularly relevant to areas where there is currently a large degree of public opposition to proposed wind farms.

There is a problem in assessing property prices for the effects of one factor as they are affected by a range of reasons. Rural property prices tend to be more variable than metropolitan prices with often fewer potential buyers and further from amenities and infrastructure. Where these properties are purchased as weekenders or holiday homes the price may be more impacted by such factors as general economic conditions, personal confidence in retaining employment and increasing wealth, the perceived value of the purchasers first home and the ability to use it for funding rather than its proximity to a wind farm.

8.4 Literature review of property prices close to wind farm developments

This section considers a range of literature from international and Australian experience.

8.4.1 International literature on the effects of wind farms on property prices

There have been a number of investigations into the effects of wind farms on property prices from the mid-1990s to date. We discuss the findings from a reasonably representative selection of ten studies in this section.

Some of these studies refer to results from other studies so the conclusions relate to more than the studies listed below:

- 1996 quantitative study, Social Assessment of Wind Power (Institute of Local Government Studies, Denmark).
- 2001 qualitative study undertaken by SKM as part of the Portland Wind Energy project.
- 2002 qualitative study on public attitudes to Wind Power (Danish Wind Industry Association).
- 2002 qualitative study on the Economic Impacts of Wind Power in Kittitas County (ECO Northwest).
- 2003 quantitative study on the Effect of Wind Development on Local Property Values by Renewable Energy Policy Project.
- 2004 qualitative study undertaken by the Royal Institute of Chartered Surveyors (RICS) in the UK.
- 2009 Preliminary assessment of the impact of wind farms on surrounding land values in Australia NSW Department of Lands.
- 2013 Gone with the wind: valuing the local impacts of wind turbines through house prices Professor Stephen Gibbons London School of Economics.
- 2014 study of the relationship between wind turbines and residential property values in Massachusetts (Atkinson-Palombo and Hoen).
- 2014 The Effect of Wind Farms on House Prices (Centre for Economics and Business Research).

Social Assessment of Wind Power (Institute of Local Government Studies, Denmark) 1996

One of the earliest studies that investigated the impacts of wind farms on property prices. It was also quoted in the NSW Valuer General's preliminary report. The study based on hedonic modelling, applied regression analysis to determine the effects of individual wind turbines, small wind turbine clusters and larger wind parks on residential property values. The assessment was based partly on a contingent valuation survey of the perceived nuisance suffered by residents in the vicinity of a wind energy facility and estimating how much they were willing to pay to get rid of the facility and partly on a house price survey (hedonic method) to see whether proximity to a wind farm effects the property value. The study identified 8 households affected by a single wind turbine, 6 by a small cluster and 12 by a larger park.

The contingent valuation survey indicated some 13 per cent of residents living close to a wind energy facility thought they were a nuisance with the average cost of the nuisance for those who felt this estimated at DKK 982 ($218).

The house price survey suggested that houses close to a single wind turbine were approximately DKK 16,200 ($3,600) lower than similar houses further away and that this difference in value increased to some DKK 94,000 ($21,000) with a larger number of wind turbines close to the house.

The study had a number of weaknesses including the size of the sample, the lack of definition of the distances of the properties from the nearest wind turbine, the lack of information on the proportional difference in value and the lack of specification of the size and type of wind turbine. Wind turbine technology has improved significantly since the early 1990s.

Sinclair Knight Merz Socio-economic and Tourism, Portland Wind Energy Project EES 2001

Information from local real estate agents indicated that house prices in the Salmon Beach (Esperance Western Australia) residential area remained the same or increased after installation of the wind farm. This area includes highly sought after properties along Salmon Beach with some houses located less than 200 metres from a wind turbine. Of fifteen properties investigated (over approximately 2 years), only one reduced in value and this was due to the property being subdivided and sold as two lots.

Public Attitudes to Wind Power (Danish Wind Industry Association) 2002

This survey included the apparently contradictory conclusion that residents closer than 500 metres from the nearest wind turbine tend to be more positive about wind turbines than those further away. This may mean that some or all of these had wind turbines on their land or that the visual impact was able to be more contained.

Economic Impacts of Wind Power in Kittitas County (ECO Northwest) 2002

The Economic Impact of Wind Power in Kittitas County found no evidence supporting the claim that views of wind farms decrease property values. The study included a survey of relevant property prices from County tax assessor's records as a good source of unbiased information. Counties were selected with comparable wind projects with selection criteria of:

- Comparable sized wind farms.
- Residences within the view shed of wind turbines.
- Projects that had been developed long enough to have adjusted tax assessments.

The study included a sample of 22 wind projects in 13 counties. Within the sample, six counties had residences within the view shed and six did not. The last county had properties with views but the development was too new for any impact to be reflected in tax valuations. In all cases none of the assessors had changed property values as a result of the introduced views of the wind turbines.

Effect of Wind Development on Local Property Values by Renewable Energy Policy Project 2003

The REPP (USA study on the effect of wind farm development on local property values) is the most comprehensive study of the impact on property values of proximity to a wind farm to date. The study used regression analysis to analyse how property values changed over time in the view-shed compared with comparable properties without a view of the wind farm. Comparisons were made for properties with the two characteristics before and after the wind farm came on line. The study looked at ten projects and comparable communities. The study highlighted that in agricultural areas property value is determined by productive use value not issues of noise or visual amenity. Unless wind turbines are installed on the property, the value should not change.

The study used tax assessors' figures and was based on the hypothesis that "If property values had been harmed by being within the view-shed of major wind developments, then we expected that to be shown in a majority of projects analysed (in terms of consistently lower values for similar property within the view-shed compared with those without a view).

Instead, the study found that for the majority of projects the property values actually rose more quickly in the view-shed than they did in the comparable community". "Statistical evidence does not support a contention that property values within the view shed of wind development suffer or perform poorer than in a comparable region."

Impact of wind farms on the value of residential property and agricultural land (Royal Institute of Chartered Surveyors) 2004

The RICS (UK) study surveyed RICS members. Only 20% of the respondents have dealt with transactions affected by wind farms. 60% of the sample suggested that wind farms decrease the value of residential properties where the development is within view. 67% of the sample indicated that the negative impact on property prices starts when a planning application to erect a wind farm is made". "Once a wind farm is completed the negative impact on property values continues but becomes less severe after two years or so after completion. A significant minority of surveyors with experience of residential sales affected by wind farm developments (40%) indicated that there is no negative price impact." 63% suggested that there is no impact at all to the value of agricultural land.

Preliminary assessment of the impact of wind farms on surrounding land values in Australia NSW Department of Lands

The Preliminary assessment was based on a literature review and an analysis of property prices at selected Wind farm sites were investigated using the following analytical techniques:

- Before and after" sales analysis
- Matched pairs" sales analysis

These are conventional valuation techniques and have been widely used and accepted by the industry in property compensation matters. Additionally, a direct comparison of sales provides reasonably clear evidence as to whether or not there is a difference in price attributable to a property's proximity to a wind farm.

A summary of previous studies which have analysed sales transaction data is presented in the report and reproduced below. The studies vary in size and methodology. While some studies have found slight negative impacts, the larger more comprehensive studies have generally found no statistical evidence of reductions in value associated with the development of a wind farm. A more detailed description is provided in report.

Table 8-1: Summary of seven international studies

Author (year)	Country/Region	Methodology	Findings
Jorgenson (1996)	Denmark	Sample: 102 locations Analysis: Hedonic price modelling	Slight reduction in value found.
Sterzinger et. al. (2003)	United States	Sample: 25,000 Analysis: Hedonic price modelling	Increases in values found.
Henderson & Horning (2006)	Australia (Crookwell, NSW)	Sample: 78 Analysis: Conventional valuation analysis	No reduction in value found.
Sims & Dent (2007)	United Kingdom	Sample: 1,052 Analysis: Hedonic pricing modelling	No conclusive statistical relationship found.
Hoen & Wiser (2008)	United States	Sample: 450. Analysis: Hedonic price modelling with physical inspections of each sale. Possibly most robust study to date.	No statistical relationship found. Some isolated cases of value reduction.
Hives (2008)	Australia (Waubra, Victoria)	Sample: 12 Analysis: Conventional valuation analysis	No reduction in value found for rural properties. Possible reduction found in lifestyle properties.
Jess (2008)	Australia (Victoria)	Sample: 7 Analysis: Conventional valuation analysis	Revealed developer had purchased surrounding properties. One property value estimated to have reduced by 30% but subjective.

Source: Preliminary assessment of the impact of wind farms on surrounding land values in Australia NSW Department of Lands

The study findings included:

- The main finding was that the wind farms do not appear to have negatively affected property values in most cases. Forty (40) of the 45 sales investigated did not show any reductions in value. Five (5) properties were found to have lower than expected sale prices (based on a statistical analysis). While these small number of price reductions correlate with the construction of a wind farm further work is needed to confirm the extent to which these were due to the wind farm or if other factors may have been involved.
- Results also suggest that a property‟s underlying land use may affect the property‟s sensitivity to price impacts. No reductions in sale price were evident for rural properties or residential properties located in nearby townships with views of the wind farm.
- The results for rural residential properties (commonly known as 'lifestyle prop's') were mixed and inconsistent; there were some possible reductions in sale prices identified in some locations alongside properties whose values appeared not to have been affected. Consequently, no firm conclusions can be drawn on lifestyle properties.
- Overall, the inconclusive nature of the results is consistent with other studies that have also considered the potential impact of wind farms on property values.

Gone with the wind: valuing the local impacts of wind turbines through house prices, Gibbons

This study that suggests that property prices could be affected adversely by proximity to a Wind Farm. The study looked at the comparison of changes in house prices in areas where a wind farm has become operational and visible with price changes in comparator areas These comparator groups include: places close to wind farms that became operational in the past, or where they will become operational in the future; places close to wind farms sites that are in the planning process but are not yet operational; places close to where wind farms became operational but where the turbines are hidden by the terrain; and places where wind farm proposals have been withdrawn or refused planning permission.

The study concludes that Wind farms reduce house prices in postcodes where the turbines are visible. This price reduction is around 5-6% for housing with a visible wind farm of average size (11 turbines) within 2km, falling to 3% within 4km, and to 1% or less by 14km which is at the limit of likely visibility. The study suggests the effects are bigger and have greater geographical spread for larger wind farms. Wind farms with 20 or more turbines reduce prices by 3% at distances between 8-14km, and by up to 12% within 2km.

The study is an outrider and at odds with the bulk of the studies reviewed. The study itself notes some limitations in the results and the author suggests the work is not conclusive. It is interesting as it is one study that finds an adverse impact compared with many that find no evidence of any impact.

The relationship between wind turbines and residential property values in Massachusetts, Atkinson-Palombo and Hoen

This study looks at the possible effects on property prices in the more densely populated area of Massachusetts than the rural settings that have been largely studied to date. However, it also looked at small scale facilities with one or two turbines.

The study explored a large dataset of home sales occurring near wind turbine locations in Massachusetts. It analyses 122,198 arm’s-length single-family home sales, occurring between 1998 and 2012, within 5 miles of 41 wind turbines in Massachusetts. The home sales analysed in the study occurred in one of four periods based on the development schedule of the nearby turbines. These were prior to any announcement (more than 2 years before the announcement), pre-announcement (within two years of the Turbine announcement), post-announcement (after the announcement but before construction commenced) and post construction (after construction had started). It used a hedonic pricing model to estimate the effect the proximity to turbines has on home sale prices in combination with a suite of robustness tests that explored a variety of different model specifications and sample sets, organized around five research questions:

- Have wind facilities in Massachusetts been located in areas where average home prices were lower than prices in surrounding areas (i.e., a “pre-existing price differential”)?
- Are post-construction (i.e., after wind-facility construction) home price impacts evident in Massachusetts and how do Massachusetts results contrast with previous results estimated for more rural settings?
- Is there evidence of a post-announcement/pre-construction effect (i.e., an “anticipation effect”)?
- How do impacts near turbines compare to the impacts of amenities and disamenities also located in the study area, and how do they compare with previous findings?
- Is there evidence that houses near turbines that sold during the post-announcement and post-construction periods did so at lower rates (i.e., frequencies) than during the pre-announcement period?

The study concluded that the results do not support the claim that wind turbines affect nearby home prices. Although the study found the effects on home prices from a variety of negative features (such as electricity transmission lines, landfills, prisons and major roads) and positive features (such as open space and beaches) that accorded with previous studies, the study found no net effects due to the arrival of turbines in the sample’s communities. Weak evidence suggests that the announcement of the wind facilities had an adverse impact on home prices, but those effects were no longer apparent after turbine construction and eventual operation commenced. The analysis also showed no unique impact on the rate of home sales near wind turbines.

The effect of wind farms on house prices, Centre for Economics and Business Research

The Study discusses and analyses the actual house price growth recorded based on transactions completed within a 5km radius for seven wind farm sites. In each case, it compares house prices changes in the immediate vicinity of the wind farm with those in the wider county area, from 1 January 1995 to mid-2013, using Land Registry figures.

This analysis is designed to answer the question: What are the observed changes in house prices within 5km of the wind farm and the wider county level through the milestones associated with development of the site (planning, construction and completion)?

CEBR go beyond the descriptive analysis and undertake statistical tests to ascertain whether the wind farm installation had an isolated and statistically significant impact on house prices by stripping out other factors such as the cyclical rise and fall (“boom and bust”) within in the economic cycle. These tests are undertaken by establishing whether the wind farm installation causes a statistically significant impact to price growth within a 5km radius of the site which cannot be explained by wider county-level trends in house prices.

This assessment was designed to answer the question: What effect does the presence of a wind farm have on house price growth within 5km which cannot be explained by the business cycle or trends at the county level? Can we say that, with a certain level of confidence, based on the sample of transactions and sites studied, that there is a statistically positive or negative effect on house price growth arising from the presence of the wind farm?

The analysis of the raw house price data for transactions completed within the vicinity of the wind farms yielded no evidence that prices had been affected by the announcement, construction or completion of the wind farms for six out of seven sites.

In fact, the analysis shows that on average, house prices near wind farm sites grew faster for the periods between the start of construction and mid-2013 (0.8% annual growth) than at the wider county-level (0.5% annual growth). One site did see a noticeable downturn following the announcement that a wind farm would be built; however once the turbines were erected, local house price growth returned to the county-wide norm.

The second part of this study focussed on establishing whether the announcement, construction or completion of the wind farm causes a statistically significant impact to price growth observed within a 5km radius of the wind farm. In other words, we remove the effect of price variations caused by the natural business cycle and county level trends, and then ask whether the residual differences coincide with the presence of the wind farm.

To place this into context, we are testing whether there is a significant difference between the way house prices behave within 5km of the wind farm (an area covering approximately 79 sq km) and the wider county area (on average, covering 2,200 sq km) as a result of the wind farm installation.

The following three tests were undertaken to establish whether the wind farm installation had any significant effect across the five sites:

- Over the period between announcement of plans to construct wind farm and the present day – no statistically significant difference and no negative impact on house price growth within 5km of a wind farm.
- Over the period between start of construction and the present day – statistically significant positive impact on house price growth found within 5km of a wind farm.
- Over the period between wind farm completion and the present day – statistically significant positive impact on house price growth found within 5km of a wind farm.

For all three econometric tests conducted, we found no negative impact within 5km of a wind farm installation.

Although the number of case studies is limited, the report and its findings provide project-specific evidence on the impacts of wind farms on house prices. Together the descriptive and econometric analyses show that across the sites analysed, there is no evidence to suggest that there was a long-term negative impact on house prices, either during the period of construction or post completion of the wind farms.

Conclusion from international literature review

The substantial majority of the studies in the literature and case studies of actual practice have either found no evidence of wind farms reducing property prices or have concluded that there is no impact. However, one recent study has suggested that there could be an impact although any significant impact would largely relate to residential properties with a view of nearby turbines.

8.4.2 Australian information on wind farm impacts on property prices

This section sets out a range of information on the effects of wind farms on Australian property prices collated from a number of reports and other information from an internet search and from previous SKM projects. As with the literature search results above this information indicates that there is no evidence that wind farms have an adverse impact on residential property prices. They may but as one of many factors that could impact prices either up or down. It is even less likely they will impact agricultural property prices adversely as they had little or no impact on productive area and may assist in farm access particularly if farm access tracks are planned in conjunction with a whole farm plan.

Miscellaneous study findings

The Pyrenees Shire Council in Western Victoria is home to one of Australia's largest wind farms, Waubra (built and commissioned in mid-2009). A land evaluation report presented to council in August 2012 showed that from 2010 to 2012, residential properties in the Waubra area increased in value by 10.1 per cent.[3] This was the largest increase of any town in the Shire.

A 2006 study by Henderson and Horning Property Consultants looked at wind farms and property values over a 15-year period. The study assessed 78 property sales around the operating Crookwell wind farm between 1990 and 2006, and found no reductions in property values. The study concluded that:

- There was no measurable reduction in values of properties that have a line of sight to the Crookwell 1 wind farm.
- Soils, improvements and access to services are more important drivers of property values than visual impacts.

[3] Wind Energy Facts, Wind Farms and Property Prices, Clean Energy Council March 2003

Interviews with real estate agents

In order to consider the impact of a wind farm on property prices as part of the assessment for the then proposed Macarthur Wind Farm where data was not available or where data collection was costly, interviews were held with local real estate agents at existing wind farm locations. Wind farm locations, and hence real estate agents were targeted based on the comparative qualities that the wind farm had to the Macarthur Wind Farm. The notes below relate to the planning period for the Macarthur wind farm development.

- Crookwell: The Crookwell Wind Farm (1) was commissioned in 1998 with eight 600kW wind turbines. Crookwell over recent years has become sought after by lifestyle purchasers. Increased subdivision in the area resulted in an increase in 'weekenders' in the region and large agricultural holdings becoming scarce. It was also noted that substantial agricultural holdings rarely came on the market in the area and there is an increasing trend for older farmers to subdivide their properties to fund retirement. Due to its proximity to both Sydney (2½ hours drive) and Canberra (1½ hours drive) property prices in the area 'began to skyrocket about 3 years ago'. However over the last 12 months sales in the area have slowed significantly. It was felt that this was primarily due to the 'rise in interest rates and introduction of investment tax on land'. Currently properties in the area are taking some time to sell, however this is occurring right throughout the wider region and not just in proximity to the wind farm. A proposal is currently being put forward to develop 55 more wind turbines next to the existing site and 69 wind turbines at nearby Taralga. The land around the wind farm is largely agricultural with a limited number of lifestyle blocks in the view shed. One local real estate agent, whilst stating that he has not made any sales in the immediate vicinity of the wind farm in some time, has suggested that approximately 50% of his enquires from outside the region specifically request information about properties 'away from the wind farm'. Real estate agents have also identified concern from buyers about being 'surrounded by wind farms', hence the potential cumulative effect is creating a buyer fear. One local real estate agent also stated that the negative effect of wind farm development is felt more heavily on the property prices of smaller holdings (less than 300-400 acres).
- The twelve 1.8 MW wind turbines at the Albany Wind Farm were commissioned in October 2001. Albany is located 490 km south of Perth and home to 52,000 people. The Albany Wind Farm is located 12 km south west of the city centre, with an estimated 230,000 visitors on the road to the viewing area every year. Discussions with local real estate agents have indicated that prices in the area have been growing steadily over a number of years. This has probably been aided by the economic development generated from the recent Marina development in the area. It was felt that the wind farms did not have a negative impact on local property prices. It was noted that very few properties are in the immediate vicinity of the wind farm and properties with a direct view of the wind farm rarely come onto the market. The consensus from the real estate agents spoken to is that the wind farm does not have a negative effect on property prices.
- Esperance has a long history of wind power generation. The Salmon Beach Wind Farm was developed in 1987 with nine 60 kW wind turbines. Due to the success of the Salmon Beach development in 1993 the nearby Ten Mile Lagoon Wind Farm was developed. Over recent years due to wind turbine age the Salmon Beach Wind Farm has been decommissioned although 1onewind turbine remains on site as a monument. Adjacent to the Ten Mile Lagoon Wind Farm the Nine Mile Beach wind farm was commissioned in 2003. Discussions with local real estate agents have indicated that the local market is 'quite buoyant' with a number of buyers moving to the region to 'escape the rat race'. Local real estate agents indicated that the wind farms were a non-issue to the local market with property prices in the Esperance area continuing to rise.

Case study of property prices and the Toora Wind Farm 2005

The 12 wind turbine Toora Wind Farm (Toora, South Gippsland, Victoria) was commissioned in mid-2002. Over three years following commissioning the market changed notably with approximately 50 per cent of new buyers being lifestyle/weekenders'. Discussions with two local real estate agents who have operated in the area since before the Toora Wind Farm was proposed suggested property prices had improved in the area, despite being considered to be reasonably stagnant prior to that time.

Local agents suggested that 50 per cent of potential buyers 'did not want to be around the wind farm', reducing the number of potential buyers for properties in the immediate vicinity of the wind farm. However, this did not

seem to impact on prices although it may have affected the time taken to sell a property and could have led to increased differentiation of prices while the median continued to rise.

One of the biggest concerns of potential buyers identified by local agents was the 'unknown' factor of wind farms when they are in the development process rather than operational in terms of project certainty, how many wind turbines would be constructed, where they would be positioned, and noise and visual impacts. This unknown factor contributes to the reduced number of potential buyers. However, one local agent suggested that before the development of the Toora Wind Farm there were few sales in Toora. Since the Toora Wind Farm became operational, properties two km or more from the site are selling well, whilst properties 'in amongst the turbines' do not sell as well. It is important to note however that there are not a large number of properties on the market in the immediate vicinity of the wind farm.

A large regional debate on the effect of wind farms on the local community and property prices occurred in the context of the proposed wind farm developments at Bald Hills, Wonthaggi and Dollar. Despite this debate, sales in the area have followed a similar trend to that observed for Victoria as a whole with a slowing over the past 12 months. 40 sales were recorded in Toora over 2003, whilst only 33 were recorded across 2004. The following table gives details of the median price for the market over the period 1998-2004.

Table 8-2: Median sales (rural other and hobby farm) Toora and Shire of South Gippsland 1998-2004

Year	Landuse	Location	Median sale price ($)	Median price per hectare ($)
1998/99	Rural Other	Shire Sth. Gippsland	140,000	9,357
	Hobby Farm	Shire Sth. Gippsland	38,500	17,755
2000	Rural Other	Shire Sth. Gippsland	140,000	7,183
	Hobby Farm	Shire Sth. Gippsland	138,500	33,750
2003	Rural Other	Shire Sth. Gippsland	262,500	7,369
	Hobby Farm	Shire Sth. Gippsland	272,000	55,932
2003	Rural Other	Toora	248,750	23,848
	Hobby Farm	Toora	121,667	44,997
2004	Rural Other	Toora	214,750	9,677
	Hobby Farm	*Toora*	*83,750*	*17,172*

Source: DSE, Valuer General (2004)- A Guide to Property Values 2003

Concern was raised by real estate agents in regards to the more recent slowing of sales in the region and the impact the wind farm may be having on the local housing market. Rural property prices in the region are determined by a number of significant factors including the entrance of new buyers from larger markets such as metropolitan Melbourne. As shown in the following **Figure 8-1** the slowing in the Toora Market is broadly in line with slowing in the metropolitan market. As such, the development of the wind farm may have had a limited effect on the market. The impact of larger close markets may translate to regional areas where there is a significant regional centre such as Cairns or Townsville that could impact the neighbouring rural areas.

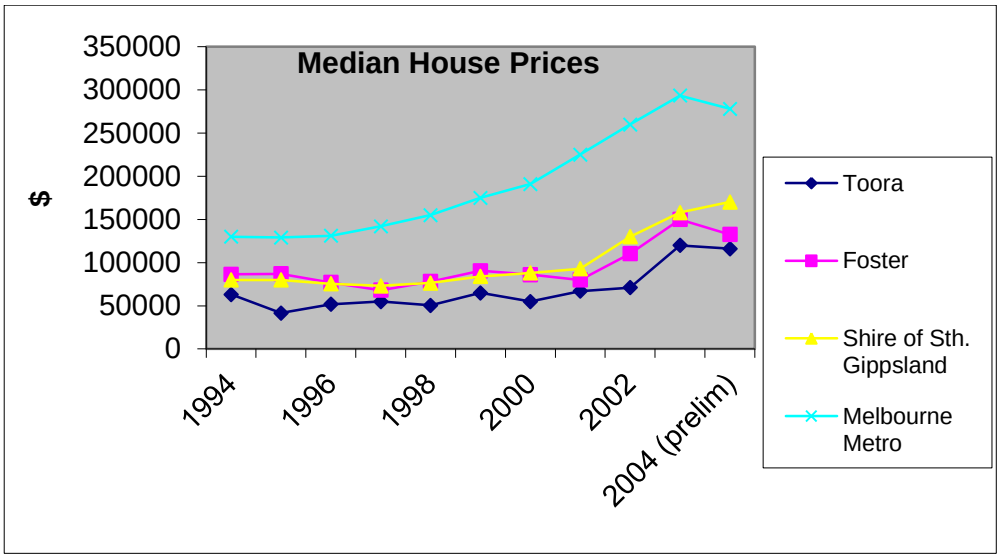

Figure 8-1: Comparison of South Gippsland regional residential property price movements with metropolitan Melbourne

Source: DSE, Valuer General (2004)- A Guide to Property Values 2003

Analysis of house price sales for post codes with wind farms (Australian Greens)

An analysis conducted by the office of Greg Barber MLC compares median house-price sales for postcodes with wind farms to the average prices of the local government area. It found no relationship between the presence of wind farms and lower property prices.

Commenting on the findings, Greg Barber said, “there is no evidence for the anti-wind claim of a 30-50 per cent drop in property values.” (An example of anti-wind farm activists claiming wind farms result in 30-50 per cent lower property prices can be found in the Australian Senate’s 2011 report on The Social and Economic Impact of Rural Wind Farms, page 54).

The Greens’ analysis supports previous findings by the NSW Valuer General reported above. The study also noted the Waubra findings reported in the Clean Energy Wind Farms and Property Prices also noted above that at Waubra, the location of one of Australia’s largest wind farms, the real estate value of residential properties had increased 10 percent over the two years to 2012. The Greens report included a series of graphs showing Median price for house sales for postcodes with wind farms, compared with their Local Government Area. The graphs show that property prices in all the areas don’t appear to have fallen during the pre-commissioning stages including planning, development and construction and, with the exception of Waubra, none of the areas showed a reduction in house prices following commissioning of the wind farm. Waubra does show a significant drop in the year after commissioning that was largely made up the following year as the median property price more or less recovered to the upward trend over the ten year period. The reason for the drop would require further assessment but could include sellers taking a wait and see approach or it could relate to one or more of the many reasons why property prices vary.

Experience from Bald Hill Wind Farm approval process

The issue of valuation and value transfer was raised in the Bald Hills Panel Hearing and was an issue examined in the panel report. Some key issues that came out of the Bald Hills Wind Farm Panel report included:

- Rate notices did not provide a good valuation that could be persuasive in an assessment of amenity impact for planning purposes.
- If there was a practical issue of saleability or valuation for property, local resident were in part the authors of it by what amounted to counter-advertising the merits of their own properties.

- "All that appears to emerge from the range of submissions and evidence on valuation issues is the view that the effect of wind energy facilities on surrounding property values is inconclusive, beyond the position that the agricultural land component of value would remain unchanged."
- "The rural zone is not a residential zone. It does not from its purposes seek to safeguard residential amenity. There are many residents in the rural zone, but they live on the land, subject to the basic proviso that it can be reasonably used to meet the zone purposes and in accordance with its table of uses. This in turn limits the degree to which the planning system can be expected to protect residential amenity in the zone".

8.4.3 Literature review findings

In summary the findings from the literature review and from the case study type material on the impacts of Wind Farms on property prices suggest that there is limited or no evidence that wind farms impact adversely on either rural agricultural land prices or residential house prices. One UK study has suggested that properties close to a wind farm and with clearly visible turbines could suffer reduced prices but it also suggested that properties a similar distance from the wind farm with no visible turbine could increase in price. This study is an outrider in terms of the majority of the literature and its author has indicated that it is not conclusive. However, this report looks at the implications of this worst case scenario in the next section.

The material from a number of wind farms in Australia tends to support the vast bulk of the overseas literature and shows no evidence of wind farms causing residential prices to reduce.

A number of comments in the literature and from interviews suggest that the uncertainty of whether a wind farm will go ahead or not and detailed planning issues like the number and siting of turbines can impact on property prices through reducing the number of buyers. Again most of the evidence does not support this suggesting there is no evidence that property prices are affected during any wind farm development stage.

8.5 Consideration of possible property price impacts

The considerable body of literature indicates that there is unlikely to be any adverse impact on property prices at any stage of a wind farm's development. However, as noted one study has suggested there could be. The effect predicted by the study depends on the distance the property is from the wind farm is greater the closer the property is to the wind farm and whether turbines can be seen from the property. The estimated impact is greater for properties that can see the wind farm and are closest to it.

The study suggests the reduction in property price for a property within two kilometres of the centre of a small wind farm (average size 11 turbines) could be some 5-6 per cent falling to 3 per cent within four kilometres and to broadly fall to nothing at the extremity of visibility say 14 kilometres or more. It suggests the impacts could be greater for large wind farms with up to a 12 per cent reduction in price within the 2 kilometres and 3 per cent between 8 and 14 km.

The visual impact assessment indicates that there are a total of 11 uninvolved residential view locations within the Mount Emerald Wind Farm two km viewshed. Some of the residences are currently unoccupied and if they remain so any impact on residential prices may not be relevant. None of these were assessed as having a high visual significance. Five were assessed as having a medium to high visual significance. Four residences were assessed as having a low to medium (2) or medium (2) visual significance. Two were determined as having a nil to low visual significance.

The assessment notes that the majority of residences located beyond the 2 kilometre distance from the nearest turbines are unlikely to be significantly impacted visually by the wind farm development

The first thing to note is the study measures distances from the centre of the wind farm to the residences whereas the visual impact assessment measures to the nearest turbine. In general the centre of the wind farm is likely to be at least 1 kilometre and potentially 1.5 km from the nearest turbine to any given residence. On this basis it is possible none of the residences are within two km of the wind farm as defined in the study. In

addition, looking at the photomontages, suggests that any residences within two km of the nearest turbine is only likely to view a proportion of the turbines the total development. On this basis it is arguably reasonable to assume that the impact as defined in the Gibbons study would relate to a small wind farm in line with the likely number of visible turbines. It appears that in some locations the visible number could be very few.

On the basis of the above arguments we could assume two of the nearer residences have no or very limited visibility of turbines and on the Gibbons findings could receive an increase in property price in theory. Five properties could face a potential three per cent fall in property value and a further four possibly a fall of between zero and three per cent. This level of fall might also be felt by a minority of properties located beyond the two kilometres. Price changes of this magnitude are likely to be overtaken both upwards and downwards by other drivers of property values such as general economic conditions, availability of work in the region and hence demand for housing, quality of supply encouraging existing residents to move and new ones to enter the region.

Properties at Oaky Creek Farms and Springmount Park underwent changes to property values due to subdivisions by developed Port Bajool Pty Ltd. Properties at the Springmount Park subdivision development are currently valued between $200,000 and $225,000 (www.onthehouse.com.au).

Some properties in the area have experienced a decline in property value. For example, a property consisting of 1.4 square kilometres of farming land on Springmount Road was sold in 2008 for over $1 million. However, in 2012, the same property sold for about $750,000. Another example is Lot 5 located on Springmount Road. It has been on the market since July 2012 and was valued at $445,000, and as of September 2014, its sale value decreased to $399,000 (www.onthehouse.com.au).

However, the region in general has experienced a net increase in property values. From year 2000 to 2014, house values in Mareeba have almost tripled in price. More recently, house values increased by about 5.5% from 2013 to 2014 in Mareeba. This demonstrates that house values in the region are likely to continue to improve (www.pricefinder.com.au).

In conclusion, wind farms have not been found to affect property prices negatively. A large number of studies by respected and independent organisations in many countries including Australia have not found any evidence of wind turbines reducing values of either agricultural or residential property.

Property values rise and fall for many reasons. People have difficulties in selling property or receive less than their asking price in a range of locations, markets and size and quality of housing. The evidence suggests that if a property close to a wind farm is taking time to sell or is not attracting the offers the vendor would like, consideration could be given to the broader economy and market, quality and locational aspects as reasons for the situation.

9. Energy supply impacts

This section considers on the additional costs of supplying wind energy in the context of the project.

A qualitative assessment was undertaken, through the use of existing relevant studies that have been conducted by professional researchers, specialist consultants or by system and/or transmission operators where possible. This has been related back, to the extent possible, to the current Queensland context.

9.1 Additional costs associated with wind energy

Public submissions on the Mt Emerald Wind Farm EIS 2014 identified concerns regarding 'hidden costs' associated with the development of wind energy. These costs include factors such as transmission infrastructure, back-up power, negative impacts on system security and reliability, maintenance costs and operational costs. Some of these additional costs are valid costs the project would be imposing on the electricity system, were it to be connected. However, some of the cost categories that have been cited are not true costs, but rather are issues that arise in a competitive market. Furthermore these mislabelled costs are not exclusive to wind generation but can be caused by a variety of generation sources. More detail about these is presented following.

9.1.1 Potential costs and impacts to energy supply

Worldwide, over 200 studies have shown that electricity grids will not experience major additional costs or technical problems until the proportion of intermittent renewable energy supply exceeds 30 per cent of the total energy mix. Many of these studies suggest that the threshold is considerably higher than 30 per cent. To put the development of the Mt Emerald wind farm in perspective, Queensland's intermittent renewable energy supply[4] would account for just one per cent of Queensland's total generation if it were to proceed.

Quantifying the additional cost imposed by wind power on the electricity system due to its intermittent nature has also been studied in many different jurisdictions throughout the world. These studies yield a spread of estimated cost impacts, which range from $0.6/MWh up to $10.5/MWh (Dedrick et al. 2014)[5]. The cost tends to increase as the penetration of wind increases in the system. The lower end of the range applies to wind penetrations of 3 per cent and the upper end at penetrations of 35 per cent. In the Mt Emerald wind farm context, where penetration would be around one per cent, this cost would be closer to $0.03/MWh (see **Section 9.3.2.1.** Another source of hidden cost for wind generation is the cost of additional planning reserves required to account for the fact that the majority of wind capacity does not make a useful contribution to these reserves which are required to ensure adequate system reliability. The estimated cost impost for Mt Emerald wind farm due to planning reserves is $1.1/MWh (see **Section 9.3.2.3**).

Further sources of additional cost would be transmission augmentation to export the wind from the region when regional demand is low and inflexible generation cannot be eased any more, which, for electricity systems that have this problem, typically occurs overnight. However, this is not presently an issue in Queensland since minimum demand is about 4,150MW and the minimum generation from all of the inflexible generators is about 3,200MW, leaving about 950MW of headroom for wind generation without the need to export into New South Wales. In comparison, the capacity of the Mt Emerald wind farm would be 189MW if all 63 3MW turbines were constructed. Clearly Mt Emerald wind farm would not be the cause of any transmission augmentation costs if it were constructed in the next few years.

The long-run marginal cost (LRMC) of economic wind sites in Queensland typically ranges from $120/MWh to $140/MWh, which implies that the additional cost of the Mt Emerald wind farm, due to its intermittency, amounts to about $1.13/MWh, which is less than one per cent of its LRMC.

[4] "Queensland" in this response refers to the areas in Queensland connected to the NEM.
[5] Note: cost estimates have been converted from USD to AUD.

The Australian Energy Market Operator (AEMO) has also conducted detailed wind studies across the national Electricity Market (NEM) to assess the technical feasibility of satisfying the 41TWh Large-scale Renewable Energy Target (LRET)[6]. In its simulations, 266MW of wind capacity was installed in Queensland by 2020[7]. The conclusions of the study relating to Queensland are as follows:

- *"power system frequency controls in Victoria, New South Wales and Queensland would not be significantly affected"*
- *"This report identifies relatively few impacts in Queensland, as the projected levels of wind generation there are small relative to the amount of conventional synchronous generation that will remain in this region. Relatively little change is expected from power system operation as seen today".*
- *"A review of simulated wind generation outputs for each region compared to its full potential" … "showed that wind generation should be able to reach its full potential capacity in Tasmania, New South Wales, and Queensland during 2020-21, when considering the network limits included in the market modelling"*

These conclusions are consistent with the high level summary presented above in that additional cost impacts of installing a modest amount of wind generation in Queensland are minimal.

9.2 Wind's variability

Before addressing the specific items in the submission, we note that the claims about wind's negative impact on the electricity system arise from its variability, which is perceived by some parties to be extreme. In pursuing this line of argument opponents of wind are potentially ignoring the fact that variability within the power system, on both the supply side and the demand side, has been and will continue to be a perennial operational issue. Power system operators have overcome this issue by operational practices that are now commonplace and quite standardised. It is through these very operational practices that power system operators have been dealing with the variability of wind generation. Furthermore, at low levels of wind penetration, as would be the case with the Mt Emerald project in Queensland, the cost of adjusting these operational practices to accommodate wind generation is minimal.

9.3 Additional operational costs, including maintenance costs

One of the hidden costs of wind is claimed to be the additional operational and maintenance costs of thermal generation plant, which are caused by wind due to the need for such plant to ramp their output up or down to compensate for wind's variability. It is claimed that forcing thermal plant to operate in this manner increases their operating cost because they are required to operate at inefficient levels on their heat rate curves. Another related issue is that wind generation forces plant into two-shift operation, also known as cycling, which is the process of shutting down a plant during low demand and starting it up again when demand increases. Repeated cycling of a power plant leads to fatigue, which results in more failures and thus more frequent need for plant maintenance. This is particularly an issue for combined cycle gas turbines (CCGTs) and especially coal plant, both of which were designed for base load operation. Coal plant in particular tends to be inflexible and incapable of two-shifting operation without incurring considerable maintenance costs.

While both of the above points are true, they cannot be attributed as a hidden cost of wind generation. The issues described above are ultimately market issues, and can potentially be introduced by any type of new plant entering a power system, not just wind turbines. For example, the introduction of a new inflexible coal plant in a system with low overnight demand could also potentially force plants that are lower in the merit order into two-shifting operations.

[7] Note that the Mt Emerald wind farm was not necessarily modelled by AEMO in this scenario. However since the AEMO scenario included more wind than the capacity of Mt Emerald wind farm it is reasonable to assume that conclusions drawn from this study are also applicable in the context of the Mt Emerald wind farm project.

9.3.1 Transmission infrastructure costs

Major transmission augmentation costs would be incurred by wind generation for two reasons: (i) to connect wind generation located in remote regions to the rest of the electricity grid; and (ii) to allow wind energy connected to the existing grid to be exported to higher demand areas of the grid in the case that local electricity supply exceeds local demand. The first reason is not applicable to the Mt Emerald wind farm, since it is located reasonably close to the existing transmission system. The second reason typically occurs overnight, when local demand is low and inflexible power plant, such as coal-fired generators, are running at their minimum stable generating level cannot be backed off any more. However, this is not presently an issue in Queensland since minimum demand is about 4,150MW and the minimum generation from all of the inflexible generators is about 3,200MW, leaving about 950MW of headroom for wind generation without the need to export into New South Wales.

Furthermore, electricity demand in Queensland is set to increase markedly over the next two years with the ramp up of LNG production, which will create additional electricity demand for gas compression. This ramp up in demand, which is in the order of 10% of Queensland's NEM-connected electricity demand, is approximately 500MW of base load demand, which would raise Queensland's minimum demand from 4,150MW to about 4,650MW. The maximum transfer capacity from Queensland into New South Wales is 1258MW across the QNI and Terranorra interconnectors. This implies that within two years Queensland could comfortably accommodate in the order of 2,500MW of wind capacity without the need for inter-regional transmission augmentation. In contrast, the capacity of the project would be 189MW if 63 3MW turbines were constructed. The project would not cause any transmission augmentation costs if it were constructed in the next few years.

9.3.2 Back-up power

The reference to wind generation's dependence on back-up power refers to the fact that thermal power plant is needed to ramp up generation when wind output falls away. This situation however is not exclusive to wind generation. For example, minute-by-minute changes in demand can be quite spiky, and can be the cause of generating plant having to ramp up or down. The sudden loss of a large power plant due to an unanticipated outage, also known as a forced outage, also requires rapid response from other generators in the system that may or may not be generating at the time. All of these situations are handled by power system operators through the employment of system reserves. There are three distinct classes of reserves[8]: (i) real-time operational, or regulation reserves; (ii) near-real-time contingency reserves; and (iii) longer term planning reserves. All of these forms of system reserve are critical in maintaining a secure and reliable power system[9].

9.3.2.1 Regulation reserves

In real-time on a power system loads of various magnitudes are switching on and off, constantly altering the demand that is being supplied by the system's generation fleet. In the NEM, AEMO employs fast-response plant operating in Automatic Governor Control (AGC) mode to instantaneously raise or lower generation output to maintain the frequency of the power system at 50 hertz. These raise and lower services, provided by the suitably equipped and accredited generators, are known as regulation reserves. As wind output similarly changes over these small time scales, the same mechanism is used to deal with this variability.

As more wind is added to the system it may be expected that the requirement for regulation reserves increases. In practice it has been found that diversification of wind farm locations can mitigate the need for additional regulation reserves. In any case, it should be noted that regulation reserves constitute only a small fraction of Ancillary Service costs, which themselves are just a fraction of the value of energy traded in the NEM. For example, over FY2009 and FY2010 the value of energy traded in the NEM was $19.7B, whereas the total cost of ancillary services over this time period was $377M and the cost of regulation reserves was only $10.3M, or

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less than 0.06 per cent of the value of energy traded. This equates to a unit cost of $0.03/MWh, which is negligible relative to wind generation's LRMC.

9.3.2.2 Contingency reserves

In the NEM there are six types of Frequency Control Ancillary Services (FCAS), whose purpose is to provide contingency reserves. These services are provided by generators that are online and synchronised to the grid, but not generating at either their full output (for "raise" services) or their minimum output (for "lower" services). The purpose of these services is to adequately deal with changes in system frequency due to large changes in either supply or demand. The NEM provides both "raise" and "lower" services at 6 second, 60 second and 5 minute timeframes.

The need for contingency reserves usually arises when a large generating unit, or a large load (e.g.a 280MW aluminium smelter potline) unexpectedly drops off the grid. In the case of the generator this would usually be due to an unforseen forced outage. When a large generator trips in this manner the system frequency and voltage immediately begin to fall since this causes the system load to draw less power, thus compensating for the reduced supply. Following this, all other online generators naturally increase their output, which is driven by the kinetic energy in the system rather than from additional fuel. The system then rebalances again at a lower frequency within a few seconds, and it is at this point that additional generation is supplied from the contingency reserves to raise the system frequency back to 50 hertz.

The demand for contingency reserves is mainly driven by the sudden loss of large generators or loads. Wind farms are comprised of groups of relatively small turbines (typically 1MW to 3MW), and it is extremely unlikely that a whole group of turbines operating at high output would simultaneously trip. Therefore any forced outage associated with wind generation would generally be handled by regulation reserves. Thus wind generation does not incur any cost with respect to contingency reserves.

9.3.2.3 Planning reserves

Planning reserves, also known as the system reserve margin, refer to generating plant that provide resources to meet forecast demand given variability in weather, economic conditions and plant outages. The NEM's measure of reliability of supply is called the reliability standard and it is set such that no more than 0.002 per cent of demand, or 1 GWh in 50,000 GWh, in each region is not served per annum. A number of studies (such as McLennan Magasanik Associates 2010, ROAM 2011, Simshauser 2010) have shown that wind capacity's contribution to system reliability is roughly equivalent to its average capacity factor (typically 25% - 40 per cent in Australia). For example, Simshauser found that in a no wind scenario the most efficient plant mix to service South Australia's load in 2010 would be 1800MW of CCGT plant and 1920MW of OCGT plant. However, including South Australia's wind farm fleet in the mix, which in 2010 amounted to 869MW of wind turbine capacity, resulted in only 1500MW of CCGT plant being required as well as 1920MW of OCGT plant. Thus South Australia's wind farm fleet effectively replaced 300MW of base load plant, implying that 35 per cent of its capacity, which is close to the average capacity factor of the South Australian wind farm fleet at the time, contributed to planning reserves.

In cost terms, Simshauser demonstrated that the cost impost of wind generation due to its reduced contribution to planning reserves relative to conventional generation technology, amounted to $8.1/MWh, which represented 4 per cent of a typical customer's electricity bill at the time. This also represents an increase of 6.8% relative to the cost of a wind farm at the time, which Simshauser assumed to be $120/MWh – not unlike the typical cost of a wind farm today. Simshauser also described a simple rule of thumb that could predict this cost impost with 95% accuracy: take the difference of the LRMCs of wind generation and the lowest cost base load capacity, and multiply it by the market share of wind.

In the case of Mt Emerald wind farm we assume a cost of $130/MWh, which is the typical cost of a new wind farm in Queensland.**Section**Error! Reference source not found.The lowest cost base load technology in Queensland is currently super-critical steam turbine burning pulverised black coal, with an approximate LRMC of $60/MWh. Mt Emerald's market share in Queensland at present would be 1.5 per cent, assuming the wind

farm had a capacity of 189MW. Using these assumptions implies Mt. Emerald wind farm's planning reserve cost impost would amount to $1.1/MWh, which is less than one per cent of its LRMC.

It should be pointed out at this point that there is a view that the variability of wind requires 100 per cent backup by gas plant operating at minimum load (which is very inefficient fuel-wise) in order to provide the necessary regulation reserve to deal with wind power's variability. This view argues that the emissions produced by the wasteful use of gas needed to operate the gas plant at minimum load to provide the necessary level of reserve, substantially offset the emissions savings achieved by the wind turbines, which are one of their key benefits, and is also a large hidden cost of wind generation. This view does not necessarily acknowledge the existence of the rest of the power system, which already has the methods and the capacity to deal with variability from both the supply side and the demand side, as has been demonstrated in the preceding three sub-sections.

9.3.3 System security

System security relates to the system's ability to achieve a new stable operating condition after a disturbance without threatening continuous supply to load that is not interruptible. This could require tripping some generation or some load shedding of interruptible load after a disturbance to achieve a new stable state. There are three main types of stability that system security could relate to: transient stability, frequency stability and voltage stability.

Transient stability primarily depends on the distribution of synchronous generation within a system. Highly centralised power systems, such as the NEM, are quite robust against transient instability. With respect to the integration of renewable technologies, studies have indicated that transient stability is not significantly affected by penetration levels up to 30 per cent to 40 per cent (see EirGrid 2010). Thus, in the case of Mt Emerald wind farm transient stability would not be threatened. The second of AEMO's conclusions in its wind integration study also confirms this.

We have already touched upon frequency stability in the discussion above on FCAS and contingency reserves. Our conclusion was that the addition of wind generation capacity would not require more FCAS because variations from wind generation could generally be handled by existing regulation reserve. The first of AEMO's conclusions in its wind integration study, confirms that in the Queensland region frequency controls would not need to be altered significantly to accommodate the 266MW of wind installed in Queensland.

Voltage stability relates to the ability of the power system to maintain steady voltages at all busbars in the system after a disturbance. Voltage instability is usually caused when the power system cannot produce enough reactive power to meet its own demands. In Australia most wind turbines that have been installed are fixed-speed induction wind turbines, which are incapable of producing reactive power, and therefore they create demand for reactive power, thus contributing to voltage instability. Reactive power is provided by conventional generation, or in its absence network operators can create reactive power by installing devices called Static Var Compensators (SVCs). However, a new generation of wind turbines, known as variable-speed doubly-fed induction turbines, do have reactive power support capability. Overseas experience has shown that installing these types of turbines in weak sections of the network (i.e. with poor voltage stability) can substantially improve voltage stability. If Mt Emerald wind farm were to employ fixed-speed induction technology then it may need to pay for the installation of SVCs, which by definition would not be a hidden cost. The cost of this equipment would increase the LRMC of the wind farm in the order of 2 per cent to 3 per cent.

9.3.4 System reliability

Wind farms can potentially impact system reliability in power systems where they displace slow-starting generation assets, although this is only an issue at large penetration levels. System reliability can be affected in this case if wind output declines unexpectedly and the slow-starting generators do not have enough lead time to warm up and begin generating. In such situations it is critical for the power system to have accurate wind power forecasting ability at various time scales to enable the optimal commitment of slow-starting assets. This is clearly not an issue in the project context, since the wind farm would not be displacing any slow-starting coal-fired generation units.

9.4 Potential energy supply impacts

Through a review of existing literature on all of the sources of the additional costs that can typically be associated with wind generation it has been demonstrated that whilst wind generation does impose some additional costs onto the power system, not all of these costs can be considered to be actual costs. In the specific case of Queensland's Mt Emerald wind farm the 'hidden' or additional costs associated with the project are estimated to be $1.13/MWh, which is less than one per cent of the LRMC of the project.

10. Report findings and conclusion

This report has provided an assessment of a range of economic changes that may occur as a result of the Mount Emerald Wind Farm project. In particular, the report considered concerns raised in submissions during the public notification phase for the Mount Emerald Wind Farm EIS, relating to:

- Socio-economic background and baseline.
- Economic impact and assessment of the project.
- Agricultural economic impacts from changes to local bat populations and aerial spraying.
- Tourism.
- Local property prices.
- Energy supply and costs.

10.1 Economic impacts

Expenditure required for construction and operation of the Mt Emerald Wind Farm would have a positive economic contribution to output, value added, employment and household income in the local and regional study areas and the broader Queensland and domestic economy. The magnitude of these impacts was estimated using Jacobs' in-house regional Input-Output (IO) model. Overall, the impact assessment found:

- Total domestic expenditure for construction is anticipated to be around $188.7, 60 percent of which would be spent in the Far North Queensland region.
- Total expenditure (for the entire project life cycle) in the regional area would be around 426.2M, with a resultant total output impact of around $939.7M.
- This would have an associated direct value-added impact of around $161.5M for Far North Queensland and a total value-added impact of around $386.7M.
- The total household income impact is estimated to be around $177.2M for the entire project life cycle, for the regional study area.
- The direct average annual employment impact expected in the construction phase is around 51 FTEs for Far North Queensland.
- Peak employment during the Construction Phase can be expected to rise to 155 jobs for all of Queensland.
- The 25 year operational phase would result in an average of 11 direct annual jobs to the regional study area. The total employment impact for the region during the operations phase is estimated to be 19 FTEs. RATCH-Australia is committed to maximising local employment opportunities and a significant proportion of operational positions are expected to be by local residents.

10.2 Social and business impacts

The project is not situated near to social infrastructure or community uses. As a result, the construction of the project is not expected to adversely impact on the amenity or functioning of other land uses or facilities. During construction, increased heavy traffic on main roads and highways may impacts on perceptions of safety for schools and other uses along the proposed routes. Residential amenity may also be temporarily impacted at times during the construction period, due to additional construction traffic and construction impacts such as increased noise and dust. These impacts are expected to be short-term in nature. RATCH-Australia will work with relevant authorities to develop and implement a traffic management plan to minimise potential impacts on traffic and land uses along the proposed haulage routes. RATCH-Australia will also notify nearby properties of upcoming works and activities to minimise potential impacts to residential amenity where possible.

10.3 Agricultural economic impacts

- The project is not expected to result in significant economic impact as a result of potential impacts to local bat populations.
- A banana farm located in proximity to the project site currently likely uses aerial spraying when necessary to apply pesticides and fertilisers to crops. Wind modelling completed for the EIS (RPS 2014) determined the project would not result in significant impacts to local aerial spraying. In addition, RATCH-Australia is committed to working with the project neighbours to minimise any potential impacts and will temporarily shut down wind turbines in consultation with property owners/ managers and aerial sprayers if they threatened the functioning of an aerial spray.
- However, two scenarios of potential impacts to aerial spraying were considered for the purpose of this assessment. A banana farm is the only property in proximity to the MEWF that would require aerial spraying. Under the scenario of a termination of aerial spraying at this property, agricultural output could decline by about 50 per cent. This would represent an average annual loss of between $770,000 and $2,580,000. This fall in output equates to around a 2.8 per cent reduction in the output of the bananas in the Tablelands region.
- If the termination of aerial spraying completely stopped the operation of the banana farm, this would lead to loss in farm output of between $1.54 and $5.16 million per year. This fall in output equates to a 5.5 per cent reduction in the output of the bananas in the Tablelands region. Overall, the Tablelands region would experience a decline in economic activity if aerial spraying to the banana farm was to cease as a result of the project. It follows that there would be slight economic impacts to the Far North Queensland economy.

10.4 Tourism impacts

- The overseas literature and local experience with wind farms suggests they have limited impact on regional tourism. In some cases, wind farm developments have provided a small positive benefit as an additional attraction for a region.
- The current operational wind farms in Australia seem to have attracted some new visitation into the regions in which they are located and they also seem to provide an additional destination for visitors already in the region or travelling through as part of a broader organised tour. The attraction can potentially be increased if there is significant linked interpretation as demonstrated in some of the overseas experience but even limited interpretation and information can add significantly to the visit experience. In addition local communities can benefit if they work with the facility by providing services to visitors including food and beverages, souvenirs, information and other visitor services.
- In summary it is unlikely the project will have an adverse impact on tourism and with some local investment in visitor facilities and interpretation could have a positive impact.

10.5 Property impacts

- The report considered potential changes to property prices for properties up to 15 km from the project site. A key issue often raised in community consultation during the planning of a wind farm is the effect on property prices in the surrounding region. There is a general perception that wind farms decrease property values of surrounding land.
- Overall, the assessment found that wind farms have not been found to affect property prices negatively. A large number of studies by respected and independent organisations in many countries including Australia have not found any evidence of wind turbines reducing values of either agricultural or residential property.

10.6 Energy market costs

- Through a review of existing literature on all of the sources of the additional costs that can typically be associated with wind generation it has been demonstrated that whilst wind generation does impose some additional costs onto the power system, not all of these costs can be considered to be actual costs. In the specific case of Queensland's Mt Emerald wind farm the 'hidden' or additional costs associated with the project are estimated to be $1.13/MWh, which is less than one per cent of the LRMC of the project.

Appendix A.

A.1 Jacobs (2014) Input Output Multiplers

Below in Table 10-1 and are the multipliers used for estimating the economic impacts of the economic impact assessment for the Far North Queensland region.

Table 10-1 Far North Queensland Multipliers

Industry	Total Output Impact	Direct VA	Indirect VA	Total VA	Direct Household Income	Indirect Household Income	Total Household Income	Direct Employment	Indirect Employment	Total Employment
Heavy and Civil Engineering Construction	2.27	0.35	0.53	0.88	0.18	0.28	0.47	0.99	0.80	1.79
Construction Services	1.47	0.27	0.17	0.44	0.14	0.09	0.23	0.67	0.82	1.49
Insurance	1.67	0.55	0.43	0.98	0.25	0.22	0.47	0.21	0.31	0.52
Professional, Scientific and Technical Services	2.03	0.43	0.48	0.90	0.26	0.26	0.52	0.66	0.66	1.32
Electricity Transmission, Distribution, On Selling and Electricity Market Operation	2.07	0.46	0.49	0.96	0.17	0.20	0.37	0.46	0.59	1.05
Road Transport	1.47	0.35	0.20	0.55	0.16	0.12	0.28	5.48	3.05	8.53
Building Cleaning, Pest Control, Administrative and Other Support Services	1.89	0.49	0.41	0.91	0.39	0.23	0.62	0.93	0.61	1.54
Public Administration and Regulatory Services	1.83	0.54	0.39	0.93	0.43	0.22	0.65	0.93	0.56	1.49
Electricity Generation	2.08	0.38	0.55	0.92	0.10	0.20	0.30	0.85	0.64	1.50

Below Table 10-2. are the multipliers used for estimating the economic impacts of the economic impact assessment for Queensland and Australia.

Table 10-2 Queensland and Australia Multipliers

Industry	Total Output Impact	Direct VA	Indirect VA	Total VA	Direct Household Income	Indirect Household Income	Total Household Income	Direct Employment	Indirect Employment	Total Employment
Heavy and Civil Engineering Construction	2.27	0.35	0.53	0.88	0.18	0.28	0.47	0.99	0.80	1.79
Construction Services	2.30	0.35	0.55	0.90	0.18	0.29	0.47	0.67	0.82	1.49
Insurance	1.67	0.55	0.43	0.98	0.25	0.22	0.47	0.21	0.31	0.52
Professional, Scientific and Technical Services	2.03	0.43	0.48	0.90	0.26	0.26	0.52	0.66	0.66	1.32
Electricity Transmission, Distribution, On Selling and Electricity Market Operation	2.07	0.46	0.49	0.96	0.17	0.20	0.37	0.46	0.59	1.05
Road Transport	1.47	0.35	0.20	0.55	0.16	0.12	0.28	5.48	3.05	8.53
Building Cleaning, Pest Control, Administrative and Other Support Services	1.89	0.49	0.41	0.91	0.39	0.23	0.62	0.93	0.61	1.54

Public Administration and Regulatory Services	1.83	0.54	0.39	0.93	0.43	0.22	0.65	0.93	0.56	1.49
Electricity Generation	2.08	0.38	0.55	0.92	0.10	0.20	0.30	0.85	0.64	1.50

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