

5 Working Paper

Agricultural Assessment

Hartley Associates International

Alan Hartley
158 Crescent Hills Road
Pretty Gully NSW 2469
Australia

Environmental Impacts of Resource Development
Horticultural Tree Crop Management
Agricultural Land Use Planning

Phone + 61 (0) 2 66 661410
Fax +61 (0) 2 66 661310
E-mail hartleyac@bigpond.com

DRAFT REPORT

THE IMPACT

ON

AGRICULTURAL LANDS

OF

PACIFIC HIGHWAY UPGRADE:

SAPPHIRE TO WOOLGOOLGA

July 2007

TABLE OF CONTENTS

| | |
|--|-----------|
| 1. INTRODUCTION | 3 |
| 1.1 LOCATION OF THE UPGRADE PROJECT | 3 |
| 1.2 COFFS HARBOUR CITY COUNCIL LEP ZONING | 3 |
| 1.3 METHODOLOGY | 3 |
| 1.3.1 <i>Physical Impact Index</i> | 3 |
| 1.3.2 <i>Current Activity Interference Index</i> | 4 |
| 1.3.3 <i>Current Farm Management Interference Index</i> | 4 |
| 1.3.4 <i>Property Fragmentation Index</i> | 4 |
| 1.3.5 <i>Farm Potential Land Use Interference Index</i> | 4 |
| 1.4 <i>Land Use Classification</i> | 4 |
| 2. LANDSCAPE FORM..... | 5 |
| 2.1 DESCRIPTIONS OF INCLUDED SOIL LANDSCAPE UNITS | 5 |
| 2.2 EFFECTS OF LANDSCAPE FORM ON AGRICULTURAL LAND USE | 6 |
| 3. DETAILED IMPACT ASSESSMENT | 7 |
| 3.1 PHYSICAL IMPACTS ON EXISTING PROPERTY BOUNDARIES | 7 |
| 3.2 IMPACTS ON CURRENT LAND USE..... | 7 |
| 3.3 INTERFERENCE WITH CURRENT FARM MANAGEMENT | 9 |
| 3.4 FARM POTENTIAL LAND USE INTERFERENCE INDEX..... | 10 |
| 4. WIND..... | 11 |
| 4.1 SEASONAL WIND PATTERNS | 11 |
| 4.2 EFFECTS OF MAJOR ROAD CUTTINGS ALONG THE WOOLGOOLGA BYPASS | 11 |
| 5. INDUSTRY PERSPECTIVES AND GROWER REACTION..... | 13 |
| 5.1 GENERAL INDUSTRY PERSPECTIVE | 13 |
| 5.2 GROWER REACTION | 14 |
| 5.3 PEST AND DISEASE CONTROL: SPRAY BUFFER ZONE..... | 14 |
| 5.4 IRRIGATION | 15 |
| 5.5 CONTAMINATED SOIL MOVEMENT..... | 15 |
| 5.6 DEMAND FOR LIFESTYLE BLOCKS..... | 15 |
| 6. ORGANIC PRODUCERS..... | 16 |
| 6.1 CERTIFICATION REQUIREMENTS | 16 |
| 6.2 INVESTIGATION TECHNIQUE..... | 17 |
| 6.3 LOCATION OF ORGANIC PRODUCERS AND ORGANIC INTEREST | 17 |
| 6.4 SOURCES OF POTENTIAL IMPACT | 18 |
| 7. MITIGATION MEASURES | 18 |
| 7.1 BANANA AND LARGER FARMS | 18 |
| 7.2 ORGANIC PRODUCERS AND ASSOCIATED LIFESTYLE PROPERTIES | 20 |
| 8. CONCLUSIONS..... | 20 |
| A1. APPENDIX 1: CRITERIA FOR SELECTING AGRICULTURAL PROPERTIES..... | 21 |
| A.2. APPENDICES 2 TO 8: DATA BASES..... | 22 |
| A.3. APPENDIX 9: SEASONAL WIND ROSES FOR COFFS HARBOUR..... | 23 |

1. Introduction

1.1 Location of the Upgrade Project

The project involves a proposal to upgrade a section of the Pacific Highway (by widening and deviation) between 7.2km and approximately 40.2km north of Coffs Harbour, including a bypass to the west of Woolgoolga.

This study forms part of the Environmental Impact Assessment of the project and deals specifically with the impacts on agricultural properties.

1.2 Coffs Harbour City Council LEP Zoning

Most of the agricultural properties are classified 1A (Rural Agriculture) in the Coffs Harbour City Council LEP 2000 Zoning as amended to date and are usually greater than 2.5 hectare in area. There has been, and still is, a strong demand for lifestyle blocks in the region and this is reflected in the number of 2 to 5 acre (1 to 2.5 hectare) blocks that have already been developed but which are still zoned 1A land. Some of the smaller properties that had small orchards, greenhouses and netted areas have been included where these pursuits formed a major feature of the property. Most lifestyle blocks in clearly defined subdivisions however, which were clearly not being used for formal agriculture were excluded from the agricultural screening. (Appendix A1).

Blocks 89, 90 and 176 which grow bananas are zoned 1B (Rural Living) but they have been included since the bananas are a dominant feature on the properties. Other undeveloped areas of 1B land have been excluded.

Land that lies wholly or partially within the South Woolgoolga Investigation Area which could be taken out of agricultural production has been included since the investigations are still ongoing. This includes block 58 with blueberries and blocks 326, 172, 203 and 59, all with bananas.

1.3 Methodology

Aerial photography and on-site viewings were used to determine which properties were agricultural properties (see Appendix A.1). Additional data was collated from Coffs Harbour City Council, Organic Organisations, Department of Primary Industries and discussions with some land owners. The results were discussed with a number of owners and/or managers of properties with typical impact levels, so the final result is an appreciation of the impacts of the Proposal on the current farm operation and on future farm potential as it is reflected by the underlying land use capability.

The intensities of the impacts are numerically rated and tabulations of the indices are provided in the report, together with interpretative guidelines.

1.3.1 Physical Impact Index

The physical impact on a property is assessed as the degree to which the Proposal, including batters and subsidiary road works, impacts on the boundaries of the property. The range of impacts assessed is:

1.3.1.1 Property Boundary

The degree of impact is subject to the extent of encroachment into a property. Encroachment into a property may itself involve no more than impinging onto a boundary, to cutting a corner, or cutting more deeply into the property. A seriously to critically affected property is identified if the Proposal encroaches greater than 25% into the property.

1.3.1.2 Internal Access

If the Proposal affects internal access within the property, the degree of impact is identified ranging from minor where one end of the property is affected to major where the Proposal crosses the property and affects operations.

1.3.1.3 Effects on Operations

The effects of the Proposal that encroaches into a property are assessed in terms of the effect on structures including netted areas, buildings and housing.

1.3.1.4 Effects on Drainage and Water Supply

The effects of the Proposal encroaching into a property are assessed in terms of the impact on drainage and water supply, including dams, and the degree to which daily access to water is affected for both stock and crops.

1.3.2 Current Activity Interference Index

Impacts on current farm activity are assessed by estimating the area involved for each current land use and the degree to which the Proposal physically impacts on each activity. The impacts are minor where less than 15% of the area is affected and critical when over 25% is affected. Impacts are assessed for each farm activity and are then expressed as a cumulative index for the whole farm

1.3.3 Current Farm Management Interference Index

The degree to which overall current farm management is impaired depends both on the impacts on individual crop areas and also on the interference experienced with on-farm access. The degree of interference can range from minor if only periodic disruption is involved to critical if the Proposal impacts daily access for either stock or for crop husbandry.

The combination of impacts on farm access and on crop areas provides the Current Farm Management Interference Index.

1.3.4 Property Fragmentation Index

Property fragmentation measures the extent to which the Proposal impacts each Land Use Class on a farm, and it is designed to illustrate the long term effect on property use. The area of each land class on a property is estimated together with the degree to which each land use class is impacted by the Proposal. The impact is minor if less than 15% is affected and critical if the proportion affected is greater than 25%. The overall impact is expressed as the Property Fragmentation Index on a whole property basis.

1.3.5 Farm Potential Land Use Interference Index

This index expresses the degree to which the overall farm operation and property is affected and it is calculated as the product of the Current Farm Management Interference Index and the property fragmentation index

1.4 Land Use Classification

The classification system applied is that set out in the Rural Land Evaluation Manual¹. There are six classes:

- Class 1 is arable land suitable for intensive cultivation where constraints to sustained high levels of agricultural production are minor or absent

¹ New South Wales Department of Planning (1988) RLEM. Rural Land Evaluation Manual, Sydney.

- Class 2 is arable land suitable for regular cultivation for crops but not suited to continuous cultivation. It has a moderate to high suitability for agriculture but edaphic (soil factors) or environmental constraints reduce the overall level of production and may limit the cropping phase to a rotation with sown pastures
- Class 3 is grazing land or land well suited to pasture improvement. It may be cultivated or cropped in rotation with pasture. The overall production level is moderate because of edaphic or environmental constraints. Erosion hazard, soil structural breakdown or other factors including climate may limit the capacity for cultivation and soil conservation or drainage works may be required.
- Class 4 is land suitable for grazing but not cultivation. Agriculture is based on native pastures or improved pastures established using minimum tillage techniques. Production may be seasonally high but the overall production level is low as a result of major environmental constraints.
- Class 5 is land unsuitable for agriculture or at best suited only to light grazing. Agricultural production is very low or zero as a result of severe constraints, including economic factors, which preclude land improvement.
- Specialist Class is land which, because of a combination of climate and soil, is well suited to intensive production of a crop or a narrow range of crops whose special requirements limit their successful culture to such land. This class may include some lands formerly described as unique.

Much of the land on the agricultural properties affected by the Proposal falls within the Specialist Class. This has been subdivided for the purpose of the report into two sub-categories: Specialist Class (bananas) and Specialist Class (blueberries) to take into account diversification into netted blueberries on lower and gentler slopes that can be too cool for bananas. The classification is not exclusive however and blueberry plantings are expanding into former banana areas where water for irrigation is available.

2. Landscape Form

Variation in landscape form plays a minor role in determining impacts on the agricultural lands since most of the severely impacted properties are located on strongly sloping lands west of Woolgoolga that fall into the same landscape unit.

2.1 Descriptions of Included Soil Landscape Units

The Soil Landscape map and report (Milford 1999²) provides an overview of the soil and agricultural land resources in the area. Soil landscapes are defined as “areas of land that have recognisable and specifiable topographies and soils that are capable of presentation on maps, and can be described by concise statements”. Each landscape was allocated a name and a symbol and these have been used here to define the units on which the Proposal is located.

The landscape units all comprise bedded partially metamorphosed sedimentary rock that is reflected in soil profiles.

The deviation west of Woolgoolga passes mainly through Megan landscape unit described as

- an erosional landscape, comprising rolling low hills with moderately deep structured yellow, red and brown earths and associated soils typically on slopes of 5-20% but up to 33% where there is a transition to steeper hills of Suicide landscape unit. The unit is mainly under Eucalypt forest, particularly through the Wedding Bells State Forest lands, but in the study area it has been cleared and used for bananas and increasingly for

² Milford H.B. (1999) Soil Landscapes of the *Coffs Harbour* 1:100 000 Sheet. Dept. Land and Water Conservation. Sydney

residential subdivision. The soils are acid, locally stony, of low subsoil fertility and high erodibility.

On some steeper slopes there is a transition to the Suicide landscape unit described as

- a colluvial landscape, comprising steep hills and dissected valleys and the soils are predominantly moderately deep to deep, well structured yellow earths with colluvial and red earth soils on steeper and lower slopes respectively. They are strongly acid and low fertility, with a high erosion hazard. The unit is found in the Wedding Bells State Forest and also associated with Megan landscape unit in areas used for banana production.

The highway south of Woolgoolga transects lower lying landscape units:

- Moonee, a transferral landscape, comprises undulating rises, footslopes and drainage plains adjacent to steeper low hills and hills. The soils are moderately deep poorly drained humic mottled clays. They are strongly acid, slowly permeable, have high subsoil sodicity and erodibility and are of low fertility. The lands are used mainly for grazing. The natural forest is often sub-tropical rainforest mixed with wet sclerophyll open forest. Remnants of the closed canopy rainforest are a feature of many rural residential and some agricultural holdings especially along small stream courses.

And

- Newports Creek, a swamp landscape, occupies low, level to undulating coastal back-barrier floodplains on estuarine sediments. The soils are poorly drained deep yellow podzolics that are strongly to very strongly acid locally strongly sodic or saline and subject to seasonal waterlogging and flooding. The unit has been used extensively after filling for residential subdivision and recreation.

And

- Coffs Creek an alluvial landscape comprises level to gently undulating floodplains and terraces in the lower catchments of coastal streams. The soils are variable but deep and poorly drained. In the study area the unit is used for horse grazing and similar activities on small rural holdings. Elsewhere it is used after filling and drainage for industrial and commercial subdivision.

2.2 Effects of Landscape Form on Agricultural Land Use

The main agricultural land use on properties affected by the highway relocation is banana growing, though there is active diversification into blueberry production. The most common landscape unit near Woolgoolga and west of the highway near Sapphire is Megan, though it includes the Suicide unit on included steeper slopes. The unit is used for bananas since the steep slopes provide air drainage for frost prevention, and productivity is maintained by mulching the harvested corms, and by applying a heavy fertiliser regime. This form of management overcomes the inherent low fertility, but the soils are very prone to erosion, and continuing banana production on these lands depends on a high level of intensive management. The bananas are susceptible to wind damage and individual plants on exposed borders can require staking for support.

Blueberries are grown on mounded beds and are netted for total exclusion of birds and animals. The mounding improves drainage and overcomes problems associated with shallow soil. Blueberries are most easily managed on flat to gently sloping lands, but are being grown on the available land on properties which are only marginally profitable for bananas. The lower slopes are favoured, since blueberries can tolerate cooler conditions than bananas and require a cold winter for flower initiation. Irrigation is essential so locations near water along the valley bottoms

are an advantage. Wind damage is generally not an issue for blueberries since they are a low growing bush, and the fields are protected by netting.

3. Detailed Impact Assessment

3.1 Physical Impacts on Existing Property Boundaries

The impact of proposed changes in the highway location on the boundaries of affected properties was determined by examination of aerial photography and by ground truthing during field inspections. The scale of impacts is shown in Table 31.1 for affected blocks.

Table 3.1.1 Cumulative Index of Physical Impacts: Identity of Affected Properties by Block Reference Number

| Null Case – Minor Impact on Farm Operation: Index <4 | Moderate Impact on Farm Operation: Index 4 to 6 | Serious Impact on Farm Operation: Index 7 to 10 | Critical Impact on Farm Operation: Index >10 |
|--|---|---|--|
| 241 | 326 | 122 | 118 |
| 173 | 390 | 89 | 245 |
| 49 | 112 | 176 | 117 |
| 91 | 340 | 307 | 380 |
| 58 | 222 | 29 | 59 |
| 184 | 230 | 146 | 203 |
| 161 | 69 | | 374 |
| 286 | | | 189 |
| 90 | | | 178 |
| 260 | | | 172 |
| 364 | | | 81 |
| | | | 66 |
| | | | 250 |
| | | | 376 |
| | | | 99 |
| | | | 212 |
| | | | |
| 11 | 7 | 6 | 16 |

This simple screening tool was initially used to identify the scale of impacts associated with various route options. Its effectiveness has been confirmed in this study. The properties shown here to have major and critical physical impacts include those for which current management or future potential have also been identified as being similarly affected.

Most of the seriously and critically impacted properties are located along the deviation west of Woolgoolga. However proposed new secondary road junctions south of Woolgoolga particularly at Unwins, Gaudrons and the Old Coast roads will also have serious impacts on affected properties.

Where the highway upgrade simply impacts on boundaries without any significant encroachment within the property, the effects on subsequent property management tend to be low, unless there is a direct interference with water supply or drainage.

3.2 Impacts on Current Land Use

Current land use was determined from field inspection supported by interviews with property occupiers on some typical impacted properties.

Forty agricultural properties with a total area of 440.65 hectares were identified as being affected by the Proposal. A breakdown of land use on affected properties is listed below. Fallow/grass refers to grassland which can be either fallow or used for grazing. Forestry refers to remnant native forest which is located on private property and excludes State Forest.

| Land Use | Number of Properties |
|-------------------------------------|----------------------|
| Bananas | 9 |
| Bananas, blueberries | 3 |
| Bananas, fallow/grass | 1 |
| Blueberries | 1 |
| Fallow/grass | 1 |
| Fallow/grass, blueberries | 1 |
| Forestry | 2 |
| Forestry, bananas | 3 |
| Forestry, bananas, fallow/grass | 3 |
| Forestry, fallow/grass | 13 |
| Forestry, fallow/grass, blueberries | 1 |
| Forestry, fallow/grass, hydroponics | 1 |
| Nursery | 1 |

A breakdown of the overall land use and the degree to which crop areas are affected are shown in Table 3.2.1.

Most of the land affected by the Proposal was not intensively farmed and 71.3% of the total area of 440.65 hectare investigated was under forest or grassland.

Of the 97 hectare of bananas on the affected properties, 35.2 hectare was located on properties where the impact on the planted areas was rated as critical, with the loss of over 25% of the block, usually by bisection of the stand. While this did not represent a total loss of 35.2 hectare, the extent of the impact was such that viability of the total area was critically compromised. For those properties where the proportion of the block affected was less than 25%, the area affected usually comprised one corner of the overall stand.

Of the 15.8 hectare of blue berries (excluding nursery and greenhouse area) 5.9 hectare were located on properties where the impact on the planted areas was rated as critical (loss of greater than 25% of the block). Again, while this did not represent a total loss of 5.9 hectare, the extent of the impact was such that viability of the total area was critically compromised. The remaining area of blueberries was on properties where the proportion of the block affected was less than 15%, usually involving encroachment on to one corner of a block.

A plant nursery and a hydroponics farm will both be severely affected by the project.

Table 3.2.1 Summary of Current Land Use of Affected Properties and Overall Intensity of Impacts

| Current Land Use | % Impacted | Area (hectare) | % of Total (440.65 ha) |
|------------------|------------|----------------|------------------------|
| Forestry | None | 37.4 | 8.5 |
| | <15% | 59.2 | 13.4 |
| | 15-25% | 1.9 | .4 |
| | >25% | 24.9 | 5.7 |
| | | 123.4 | 28.0 |
| Bananas | None | 17.4 | 3.9 |
| | <15% | 39.1 | 8.9 |
| | 15-25% | 5.4 | 1.2 |

| | | | |
|----------------------|--------|---------------|--------------|
| | >25% | 35.2 | 8.0 |
| | | 97.0 | 22.0 |
| Fallow, grass | None | 143.5 | 32.6 |
| | <15% | 30.3 | 6.9 |
| | 15-25% | 3.2 | 0.7 |
| | >25% | 13.8 | 3.1 |
| | | 190.8 | 43.3 |
| Blueberry, nursery | None | 0.4 | 0.1 |
| | <15% | 9.4 | 2.1 |
| | 15-25% | 0 | 0 |
| | >25% | 8.0 | 1.8 |
| | | 17.9 | 4.1 |
| Fruit orchard | None | 1.2 | 0.3 |
| | <15% | 0 | 0 |
| | 15-25% | 0 | 0 |
| | >25% | 0 | 0 |
| | | 1.2 | 0.3 |
| Housing, dams, other | None | 9.4 | 1.8 |
| | <15% | 0 | 2.1 |
| | 15-25% | 0 | 0 |
| | >25% | 1.0 | 0 |
| | | 10.4 | 2.4 |
| TOTAL | | 440.65 | 100.0 |

3.3 Interference with Current Farm Management

The degree to which current farm management is impacted depends on how the land is currently being used, and the extent to which internal access to the crops, water, drainage and structures is impeded. The intensity of the interference for individual properties is shown in Table 3.3.1. Those properties growing the high value crops bananas, blueberries, nursery and hydroponics are identified.

Of the 19 properties growing bananas, there are only 8 that have been assessed as being seriously to critically affected in terms of current farm management. One of these eight properties has lady finger bananas that are more difficult to grow but return higher fruit prices. The 8 most severely affected properties account for 40.6 hectare of crop, or about 41.8% of the area of bananas on the affected properties. While the whole 40.6 hectare will not be lost, interference with the stand will preclude the most critically affected properties (accounting for 35.2 of the 40.6 hectares) from continuing as separate operating farms. The same assessment applies to the other properties listed as critically affected.

Table 3.3.1 Current Farm Management Interference Index: Identity of Affected Properties by Block Reference Number

| Null Case – Minor Impact on Farm Operation: Index <2 | Intensive Crop | Moderate Impact on Farm Operation: Index 2 to 5 | Intensive Crop | Serious Impact on Farm Operation: Index 6 to 8 | Intensive Crop | Critical Impact on Farm Operation: Index >8 | Intensive Crop |
|--|----------------|---|----------------|--|----------------|---|----------------|
| 241 | | 91 | B | 117 | | 118 | |
| 173 | B, bl | 172 | B | 59 | H | 245 | B, bl |
| 222 | | 89 | B | 81 | Blf | 380 | |
| 49 | B | 29 | | 176 | B, bl | 203 | B |
| 326 | B | 376 | bl | 69 | B | 374 | B |
| 58 | Bl | | | | | 189 | B |
| 390 | B | | | | | 178 | |

| | | | | | | | |
|-----------|-----|----------|--|----------|--|-----------|---|
| 307 | B | | | | | 66 | B |
| 122 | | | | | | 250 | N |
| 184 | | | | | | 99 | |
| 112 | B | | | | | 212 | |
| 340 | | | | | | | |
| 161 | | | | | | | |
| 286 | | | | | | | |
| 90 | B | | | | | | |
| 146 | | | | | | | |
| 260 | | | | | | | |
| 230 | Blf | | | | | | |
| 364 | | | | | | | |
| 19 | | 5 | | 5 | | 11 | |

B: banana Cavendish Blf: lady finger bananas bl: blueberry H: hydroponics N: nursery

3.4 Farm Potential Land Use Interference Index

Each affected property was examined in the field and an agricultural land use classification prepared. The scale of impacts on the land areas in each land use capability class was determined and from this, an overall estimate was made of the intensity of interference caused to overall farm potential land use. The results are summarised in Table 3.4.1.

The number of properties identified as having future land use potential seriously and critically affected is greater than the total number of properties identified as having a serious and critical impact on current farm management because the potential land use interference index examines land available for potential cropping in addition to that currently being utilised. There are also more properties falling into the critical category with this index.

In making a final assessment, the most severe impact identified for any index is the impact of greatest significance for the property. Those properties listed in the serious and critical columns in Table 3.4.1 are effectively the properties that are worst affected in terms of overall management as a farm by the Proposal along this sector. In total the seriously and critically impacted properties comprise 19 out of 40 (47.5%) of the properties, so the realisation of impact from the highway deviation and from changes to side road intersections is very strong.

Table 3.4.1 Potential Land Use Interference Index: Identity of Affected Properties by Block Reference Number

| Null Case – Minor Impact on Farm Potential: Index 0 | Moderate Impact on Farm Potential: Index >0 to 1.5 | Serious Impact on Farm Potential: Index 1.6 to 5 | Critical Impact on Farm Potential: Index >5 |
|---|--|--|---|
| 241 | 91 | 172 | 118 |
| 173 | 326 | 89 | 245 |
| 222 | 307 | 29 | 117 |
| 49 | 122 | 376 | 380 |
| 58 | 184 | | 59 |
| 390 | 112 | | 189 |
| 340 | 364 | | 178 |
| 161 | 69 | | 81 |
| 286 | | | 66 |
| 90 | | | 176 |
| 146 | | | 250 |
| 260 | | | 203 |
| 230 | | | 374 |
| | | | 99 |
| | | | 212 |
| 13 | 8 | 4 | 15 |

4. Wind.

The Coffs Harbour to Woolgoolga region has developed a strong sub-tropical banana industry based on the original availability of land that, by virtue of its proximity to the ocean and topography was free from frost and largely protected from cold and destructive winds. Bananas are susceptible to slow growth in cold conditions and are very prone to lodging in high winds.

Anecdotal evidence (NSW Dept. of Agriculture) is that during storms and periods of strong onshore winds, there are eddies in the included valleys that can cause localised problems, but not sufficient to be limiting for the growth of the crop. There is no evidence that banana plantings have historically had to be abandoned from specific aspects on sloping locations on account of cold winds.

Blueberries, the other major crop in the area, and one of growing significance, are a low growing bush usually protected by permanent or at least seasonal netting and are not prone to wind damage. However the structures on which the netting is suspended can be damaged by very strong winds that blow down one or more supporting poles and this form of damage could become more frequent with time as untreated pole strength deteriorates through fungal and/or insect attack.

4.1 Seasonal Wind Patterns

A set of eight wind roses depicting seasonal wind direction are shown in Appendix 9 based on quality data from the Coffs Harbour monitoring station. The data report wind speed and direction at 0900 and 1500 hours.

During Spring and Summer, winds in the early morning are variable and generally calm to light with a slight bias towards the south west to south. Wind velocities are generally less than 20km/hr though the velocity can exceed 20 km/hr for 10-15% of the time when the wind is from the southwest. In the afternoon the wind swings around from the south to be predominantly north easterly. For up to 40% of the time velocities range generally between 10 and 30 km/hr, while for about 10% of the time wind speeds will exceed 30km/hr.

The wind pattern is similar during the early morning in Autumn and Winter. The wind is generally calm to light with a westerly bias for about 60% of the time, but the south westerly winds are more prominent than in the warmer seasons, blowing between 10 and 30 km/hr. During the day, the wind direction is more variable, blowing generally from the east in an arc from south to the north east. From both the south and the north east, velocities range from 10 to 30 km/hour for up to 40% of the time, but wind speed is less from the other quarters. The persistence of the north easterly wind declines during winter compared with the other seasons.

A feature of the wind pattern is the absence of strong westerly winds during Winter which originate from the inland continental mass and which are cold and can persist for days at a time. The data also indicates that the region is not affected to any degree by hot north westerly winds also of inland continental origin during late Spring and Summer which can be very drying and debilitating for crops. Protection from both sources of damaging wind is of major regional advantage.

4.2 Effects of Major Road Cuttings along the Woolgoolga bypass

The Project includes a bypass from the existing highway alignment around Woolgoolga. It starts near Unwins Road and is aligned generally north-west as far as Newmans Road and then generally north-south to the southern boundary of the Wedding Bells State Forest. The diversion will involve some road cuttings varying from about 80 to 120 metres wide and up to about 22 metres deep below the existing land surface alternating with sections at and above the existing land surface. It is possible that wind could be funnelled along the cut sections, to then disperse laterally at the end of the cut at and above the prior ground level.

The hill slopes across which the alignment is located face generally east but they are dissected by a number of shallow valleys that create a mosaic of varying easterly aspects, so the wind direction at any particular site could be affected by the local topography. This description accords with anecdotal experience. The wind directions measured at Coffs Harbour are sufficiently variable for wind at some periods of the day and in all seasons to channel through the road cuttings, but changes in local velocity and direction arising from the geometry of the cuttings are likely to be variable. Whatever wind effects that might be generated will have the greatest potential effect at the ends of road cuttings where any channelled wind will disperse.

It is unlikely that wind blowing through short sections of cut will cause cooling to the point of frost formation. The wind itself tends to dissipate potential frost, and the cuts will contain tarmac and traffic, both of which will have a heating rather than a cooling effect. The fact that the cuttings alternate with sections above existing ground level will also mitigate any potentially damaging cooling effect.

The following tabulation (Table 4.2.1) identifies agricultural properties included in this study (excluding lifestyle and rural residential) that are affected by the bypass, where road cuttings begin or end and where there could potentially be some wind effect. The tabulation also shows the Potential Land Use Interference indices previously determined from other aspects of the Proposal

Table 4.2.1 Properties Included in the Agricultural Assessment Affected by Road Cuttings and Potential Land Use Interference Indices previously reported for Properties at the Ends of Cuttings

| Block Number | Cut | Fill | Ends | Existing Impact Rating |
|--------------|-----|------|------|------------------------|
| 172 | | + | | |
| 178 | + | | | |
| 390 | + | | | |
| 189 | + | + | + | Critical |
| 374 | + | + | + | Critical |
| 59 | + | | | |
| 364 | + | | | |
| 380 | + | + | + | Critical |
| 222 | + | + | + | Minor |
| 117* | + | + | + | Critical |
| 245 | + | + | + | Critical |
| 99 | + | | | |
| 118 | + | + | + | Critical |
| 69 | + | + | + | Moderate |
| 286 | + | + | + | Minor |
| 376* | + | + | + | Serious |
| 212 | + | + | + | Critical |

Seven out of eleven properties located at the end of a section of road cutting have already been identified as being critically impacted by the Project without taking into account any wind effects. Two others will be moderately to seriously affected, again without taking into account any wind effects. The extent of the impacts is such that continuing operation of the affected properties has already been compromised. The large property 286 suffers a very minor impact on one boundary where the land use is predominantly grassland, while property 222 suffers a minor impact on one forested corner of the property.

The properties marked with an asterisk* had blueberries planted at the time of field inspection. The protective netting structures are the most vulnerable targets for wind damage, so the integrity

of the structures should be examined as the construction proceeds. However, given the highly variable natural wind patterns, further variations in these patterns arising from road cuttings are likely to be very localised near the ends of cuttings and are also likely to be insignificant compared with the other physical impacts identified in this study.

5. Industry Perspectives and Grower Reaction

5.1 General Industry Perspective

Agriculture in the Coffs Harbour and Woolgoolga regions generally has been undergoing substantial changes even within the period during which this highway upgrade has been under investigation. Blueberries are now the fastest expanding crop on the North Coast, and they are being planted as an alternative crop to bananas particularly along the lower valley bottoms where there is access to water for irrigation, and where the cooler temperatures are less suitable for bananas. There is currently a strong export market for blueberries, in contrast to the position with bananas.

Bananas are predominantly consumed as fresh product with Cavendish bananas accounting for approximately 95% of the market. The remaining 5% is represented by Lady Finger bananas and other cultivars. Most holdings are less than 3 hectare of crop, which has a cycle time of 12-18 months in NSW compared with 9 to 12 months in the tropics.

On a national basis, the NSW banana crop has been steadily declining (Table 5.1.1) and the industry anticipates that there will continue to be contraction in the future, possibly at a rate of around 5% per year.

The Australian banana industry is a mature industry and the majority of sales are of generic, undifferentiated product. The industry as a whole is expected to grow production to meet population expansion, with virtually no opportunity for export. Production will therefore favour areas with highest per hectare productivity, and the NSW industry will continue to be disadvantaged in this regard.

The current Banana Industry Council (BIC) estimate of banana areas is about 500 hectare near Coffs Harbour and about 450 hectare north of Bucca Road, which covers the area being considered in this report. The area of bananas on properties seriously to critically affected by the Proposal (35.2 hectares) is therefore 7.8% of the total area of bananas to the north of Bucca Road and about 3.7% of the area of bananas in the Coffs Harbour- Woolgoolga region. The total area of bananas on farms directly affected by the Proposal (97.0 hectares) is approximately 21% of the total area of bananas north of Bucca Road and 10.2% of the total area of bananas in the Coffs Harbour- Woolgoolga region.

The total area under bananas within the Coffs harbour region is declining in the face of competition from North Queensland where the growth rate and yield is much higher. Additionally, investment in land and the market for lifestyle blocks have provided opportunities or substantial profit from real estate trading.

Table 5.1 1 - Australian Banana Market Throughputs (tonnes) by State of Origin, 1993-2005

| Year | Queensland | New South Wales | Northern Territory | Western Australia | TOTAL |
|------|------------|-----------------|--------------------|-------------------|---------|
| 1993 | 159,039 | 58,067 | 1,073 | 16,523 | 234,703 |
| 1994 | 135,870 | 61,111 | 1,786 | 14,346 | 213,114 |
| 1995 | 149,309 | 49,074 | 1,130 | 16,165 | 215,678 |

| | | | | | |
|------|---------|--------|-------|--------|---------|
| 1996 | 152,773 | 46,927 | 2,172 | 12,754 | 214,625 |
| 1997 | 147,705 | 48,067 | 2,625 | 12,494 | 210,890 |
| 1998 | 187,322 | 35,049 | 3,050 | 8,581 | 234,002 |
| 1999 | 156,302 | 35,157 | 4,243 | 10,641 | 206,343 |
| 2000 | 179,493 | 29,788 | 4,105 | 7,741 | 221,126 |
| 2001 | 206,869 | 21,358 | 3,575 | 8,606 | 240,409 |
| 2002 | 207,429 | 17,212 | 893 | 7,213 | 232,747 |
| 2003 | 256,016 | 13,213 | 931 | 5,786 | 275,945 |
| 2004 | 236,883 | 10,031 | 856 | 5,819 | 253,588 |
| 2005 | 253,048 | 7,858 | 132 | 3545 | 264,583 |

Sources: Queensland Fruit and Vegetable Growers, South Australian Banana Promotions Committee, Chamber of Fruit and Vegetable Industries Inc., Association of Australian Banana Wholesalers and Northern Territory Department of Primary Industry and Fisheries. Note: Totals may not add due to rounding

There was resurgence in NSW banana industry fortunes during 2006, following cyclone devastation in the main producing area of North Queensland, but growers contacted during this survey acknowledged that this is likely to be of one to two year's benefit for this area. Long term growers following high standards of crop management continue to make satisfactory profits. Re-investment in land and the market for lifestyle blocks have provided opportunities for substantial profit from real estate trading.

5.2 Grower Reaction

Interviews with banana growers and grower representatives during this survey have revealed a split in attitude depending on whether an individual property is one of those where the Proposal encroaches on the property or one where the location has only a minor impact.

While there has been a favourable response in terms of gaining better access to receival points for produce, concern has been expressed about the probable loss of viability on the most seriously impacted properties, with predictable concerns about re-location, and the lack of similar land in the region on which to re-locate.

Impacts on the blueberry industry are not as widespread or as serious as those for bananas. The blueberry industry depends on seasonal pickers, and upgraded infrastructure that increases the flow of permanent and itinerant workers to the area is highly positive. The major concern of growers is loss of access to a reliable irrigation sources, and potential problems that will arise from increased attention to managing spray drift, and the additional costs of erecting screens or waiting for effective vegetation buffers to develop.

5.3 Pest and Disease Control: Spray Buffer Zone

Pest and disease control in bananas is directed mainly at panama disease and banana bunchy top virus (BBTV) detection and eradication. Abandoned and neglected plantations are prone to pests and disease and are a potential source of infection for commercial plantations. NSW Agriculture has the power to enforce compliance with legislation and to eradicate these patches. Feral bananas are the bane of the industry. The industry at Woolgoolga used fixed wing aerial spraying (currently with the fungicide triazole (Tilt™) and misting oil) for control of leaf spot (*Mycosphaerella musicola*) and leaf speckle (*M. musae*) for many decades. Both these can be controlled using summer cover sprays. The industry then changed to helicopter spraying for better and safer coverage on the sloping land.

During 2005-06 however, there was only one aerial spray applied, and the contract lapsed because insufficient farmers were prepared to enter an agreement, which required a minimum of 40 hectare of crop. The reluctance to commit to aerial spraying is an indication of the pressure on farm returns arising from the increasingly high degree of competition being provided to the NSW industry from North Queensland. This situation turned around in 2006 following the devastating

cyclone in NQ. However growers do not see a long term improvement in relative pricing. The steepness of the banana lands, the lack of internal access for machines and health issues associated with backpack overhead spraying all limit the extent to which individual farms can manage effective disease control.

A helicopter can spray within about 150 metres of houses or closer depending on wind direction, but will not operate within 200 metres of a highway as a matter of rule, but up to 300 metres where there is a possibility that the misting oil will smear windscreens. This wider buffer is expected to apply along the bypass west of Woolgoolga where the road alignment cuts across the terrain, potentially producing wind eddies. The impact will be direct on those farms not sprayed since production will be diminished, and indirect on other properties since there will be an unsprayed cordon of crop in which the disease will be unchecked.

Based on a 300 metre buffer zone, a further 13 banana growing properties accounting for an estimated additional 27 hectare of crop could face an aerial spraying restriction. Of the affected properties, 11 are located on the deviation around Woolgoolga.

Blueberries are a capital and labour intensive crop, prone to a number of pests and diseases. The beds are laid out to be accessible by ground spraying. The potential for spray drift will be an issue for plantings immediately adjacent to the highway location until suitable screens erected or effective vegetation buffers are developed. The chemicals used for insect pest control have a higher potency than the misting oil, and the onus will rest with the producer to ensure spray operations are safe

5.4 Irrigation

Most farms near Woolgoolga do not irrigate, though they need water for the packing sheds. Most draw the water from valley bottom dams. With the diversification into blueberries, access to irrigation water is critical, which is the reason why particular attention has been focussed on water and drainage related impacts in the assessment process. Valley water and the associated moist forest vegetation are features on many lifestyle estates in the region, and protection of the resource is a sensitive item.

5.5 Contaminated Soil Movement

Dieldrin and other chlorinated hydrocarbons were used until the early 1980s for disease and pest (borer) control and given the long history of the industry in the area, it would be unusual if pockets of residue did not exist particularly at old spray filling points. On-farm investigations, separate to this study, have been undertaken to determine the potential for pesticide residues and other contaminants to be present. It is understood that there were no major issues in relation to potential contamination at likely locations within farms along the proposed highway alignment. The results of these investigations are detailed in the Phase 2 Limited Soils Investigation report (Connell Wagner, 2006)

The major concern with regard to panama disease is that the causal fungus *Fusarium* is soil borne and is particularly able to spread in wet soil caked on footwear and vehicles. Removing and dumping soil removed from any banana property triggers specific guidelines and instructions for both disease and persistent chemical control administered by the responsible Government Departments. The specific instructions lie outside the scope of this report.

5.6 Demand for Lifestyle Blocks

The agricultural industry in the area has for some year been coping with an increasing demand for lifestyle blocks in the region, both along the coastal fringe with views over the ocean, and in the hinterland valleys. Much of the banana growing land occupies sea facing slopes to take advantage of the warmer aspect. This land is now under strong demand for real estate. Given the

combination of demand for lifestyle blocks, higher offered values and a generally static or declining income from banana growing, a move away from farming into from the development and/or subdivision of land (subject to Council approval) is likely to continue.

Produce stores and light industry in the area have for some years been providing for changing agricultural demand unrelated to highway proposals. There is a growing market for garden products, supported by lifestyle landowners, while the surge in blueberry plantings has introduced new opportunities for irrigation, netting, agricultural chemicals and related equipment sales.

6. Organic Producers

Properties that have become certified organic producers and those which are contemplating or have started a certification process with one of the several organic grower peak bodies are smaller than the conventional farms discussed to date. In the study area they are found amongst the “lifestyle” or “hobby farm” subdivisions particularly in the Bark Hut Road/Palmer Road/Poundyard Creek catchment areas. Organic farming principles have an inherent appeal to residents on areas of around 3 hectare or less where it is possible to produce mulch and animal manure on the property, engage in mulching practices and adhere in part to the requirements of organic farming. Certification however is a much more stringent step, requiring particular care regarding the source of any materials brought on to the property. Properties that have proceeded to full certification are commercial producers of organic produce.

An organic producer is committed to growing and supplying produce free of synthetic chemicals, fertilisers or genetically modified organisms. The organic farming concept is one that involves the use of chemical free organic matter to enhance and sustain soil fertility and structure, avoids pollution to external lands and waters, works towards a closed system of recycling on farm, minimises the use of non-renewable resources and enhances biological cycles on farm.

There is a growing commercial demand for organic produce, based on a belief that organic produce does not contain synthetic chemicals and is consequently healthier, of better nutritional value and better tasting. Consumers are willing to pay a premium for certified organic products.

6.1 Certification Requirements

There are a number of organic grower organisations and the major ones each produce a set of standards for certification. They are broadly similar, and they set out a philosophy for organic production as well as specific standards. The bodies have international affiliations and are developed in conjunction with AQIS standards for Organic and Biodynamic produce, with relevant Commonwealth and State laws and with current and relevant total quality management systems.

A three year conversion period is the minimum before a property can receive organic certification. A first audit is conducted a year after an initial application for certification is received, to examine the farming practices being applied, to determine the commitment of the farmer to organic farming principles and to sample and assay soil, water and product or tissue for synthetic chemicals, heavy metals and genetically modified organisms. The property is expected to develop an organic management plan, which for primary industry involves fertility and soil management, pest disease and weed management, biodiversity and environmental management, water management, contamination prevention management, records keeping and monitoring practices. Certification is only granted after three years of production (crop or livestock) that complies with the standard. Should a property convert only part of its area, progress to full certification can take up to 10 years. While freedom from synthetic chemicals is a prominent feature of organic produce, the organic farming system encompasses a commitment to biological improvement leading to a self generating biologically secure and sustainable farming base.

Maintaining certification involves an annual audit, random additional audits and tissue tests, maintenance of records and compliance with standards. Certification can be suspended if there is a breach of conditions and, in the extreme, can be removed for a persistent departure from standards. Section 4.8.26 of the Australian Certified Organic General Standard provides for a minimum time period of 12 months for re-registration should a certified area be contaminated from environmental or unforeseen sources. Depending on the rate of rehabilitation the period of exclusion from registration could extend to 3 years. Where contamination recurs, switching between certified and uncertified could be disallowed altogether. Environmental contamination beyond the control of the owner therefore has the potential to cause loss of labelling and accreditation, even though crops or livestock may appear to be growing normally. Levels of organochlorines in product tissue must not exceed 10% of the maximum level laid down under Australian and New Zealand Food Standards. There is no tolerance for organophosphates or other synthetic pesticides including synthetic pyrethroids. The certification standards contain no references to air quality, so concerns about fumes from a relocated highway are of a personal nature rather than being critical for organic status.

6.2 Investigation Technique

Three major grower organisations were contacted, representing various aspects of organic farming, animal raising, biodynamic and organic principles and the production of prepared foodstuffs to organic standards. They were the Biological Farmers of Australia Cooperative Ltd. (BFA), Organic Growers of Australia (OGA) and the National Association for Sustainable Agriculture Australia (NASAA).

Local bodies such as the Mid-North Coast Organics Inc. and the Coffs Regional Organic Producers' Organisation Inc. which are affiliates of the key bodies were contacted and a local meeting was also held at Woolgoolga to contact organic farmers. For the convenience of organic farming oriented property owners in the area, the meeting was held at night since most worked elsewhere during the day. This suggests that at least for the non-certified properties, organic or organically inclined production is currently a secondary occupation.

Apart from BFA, the major organisations would not divulge the identity of certified members. An email was therefore circulated to the Secretaries of the major organisations:

"... (Hartley Associates International) .. has been contracted to examine the impacts of the Pacific Highway upgrade and relocation proposals in the Woolgoolga to Sapphire (post code 2456) area of northern NSW.

As a part of our study, we want to be sure that we have included certified organic farms and or properties that have started the certification process in the scope of our investigations. Many of these farms are smaller than the obvious larger farms and are very difficult to identify unless we know where to look. I appreciate the requirements in regards to individual privacy and understand therefore why you may be unable to forward contact details of particular members.

For this reason, would it be possible for you, as a peak body to email any of your members that may be in this postcode, advise them of our ongoing investigation, and ask them, if they are interested, to contact my email address.....

BFA identified one certified coffee producer; OGA advised that there were six certified producers in the postcode, while NASAA did not acknowledge the email.

6.3 Location of Organic Producers and Organic Interest

Based on these enquiries, the following certified producers have been identified:

- M/s and Dr. Taylor, Malibu Drive Korora, not affected by the road proposal.

- Mr. Kasmarik (Kasmac Coffee) Johnson's Road Sandy Beach, not affected by road proposal and inland of the alignment.
- Mrs. Nagel, Bark Hut Road, producing organic chickens, herbs and vegetables and irrigating from a spring fed dam below the proposed deviation.
- Mr. and Mrs. Freeman, 66 Palmer Rd. (CW No. 78), producing organic vegetables, garlic and juice and irrigating from a spring fed dam below the proposed deviation.
- Messrs Greenfield and Cleary, Campbell Close Korora (CW No. 257), not affected by the road proposal, being inland of the road alignment.
- Mr. and Mrs. Glover, Pacific Highway Woolgoolga (CW No. 363), not directly affected by road works but downstream of a watercourse affected by the proposal.

The following respondent identified themselves as having commenced certification:

- Mr. and Mrs. Clouten, Greys Road Woolgoolga (CW No. 340), biodynamic mangoes, south-west and up slope of the proposed deviation

In addition, a number of residents in the Bark Hut Road and Palmer Road precinct had adopted healthy living organic principles while DG and JR Johnson were permaculture consultants with a commercial demonstration property.

Subdivided land near the proposed Woolgoolga bypass alignment is serviced by roads running inland from the coast and aligned more or less along east west ridge crests, with individual properties then sloping back into a shallow valley. Springs arising at the heads of the valleys feed the streams which are reported to be permanent, though properties downstream from the source can suffer shortages during dry periods. Many properties have small dams from which water is pumped for irrigation and the certified organic properties are licensed irrigators. Access to the water supply is important since there are restrictions on the use of potable town supply for irrigation.

6.4 Sources of Potential Impact

The major source of potential impact is contamination of the water source during construction and from ongoing stormwater runoff. The proposed road deviation inland of the current highway location crosses the heads of a number of small valleys more or less at a level where the springs appear. The potential exists for an impact on the integrity of the springs themselves in addition to contamination of the water flow. A major concern is contamination of the water supply arising from storm rain during construction. A continuing concern is the disposal of stormwater runoff containing synthetic chemicals, or hydrocarbon spillage, from road drains after construction and responsibility for the maintenance of control structures.

The potential for remote impact by contamination of water sources is not confined to the Palmers Road and Bark Hut Road precinct alone, and impacts on water could affect properties well downstream of the actual road location, organic certified properties or otherwise.

7. Mitigation Measures

7.1 Banana and Larger Farms

There continue to be outbreaks of panama disease in lady finger banana crops in the Woolgoolga and Safety Beach areas, underlining the need for particular vigilance in moving spoil and controlling sediment from former banana plantations. The responsibility for managing banana disease control rests with NSW Agriculture (also see section 5.3) and inspectors working from the Coffs Harbour office enforce current regulations on the movement of plant material and soil. However, during construction, appropriate management measures should be put into place when moving spoil and controlling sediment from banana properties potentially affected by panama disease. These management measures should be developed in consultation with NSW Agriculture.

While Coffs Harbour Council has a Rural Lands Strategic Plan in place to provide specific planning for rural communities, its aims are community based and general, and it does not provide mitigation measures for the property specific impacts identified in this study. However there is a strong demand for residential expansion in the greater Coffs Harbour Council area and this is affecting some properties that were formerly agricultural but which are now included in urban development investigation.

Most concern about the impacts of the Proposal has been expressed by banana farmers on small properties where the effect of the project will have a major effect on the viability of the property. The options facing most of these farmers are to move out of the industry in this area altogether, or to use compensation payments to purchase other properties. Given the declining role of bananas in the local economy, the high establishment cost of blueberries (up to \$90,000 per hectare excluding land by DPI estimates) and the high cost of land, the choices facing long term farmers are difficult.

In certain instances residual agricultural land may represent an opportunity for consolidation with an existing adjacent land owner. While ultimate responsibility will rest with the potential purchaser to ensure that the land is suitable for the desired purpose, given its proximity to the Proposal, assistance could be provided in making this decision. Specialist consultants engaged by the RTA could, in consultation with agricultural landowners *severely* or *critically* affected by the Proposal, develop a Strategy for the consolidation and management of residue lands.

Opportunities to diversify away from bananas into blueberries as an export crop and to participate in the demand for life-style real estate have buffered the impacts of falling banana prices for some growers for some years. The accelerated interest in blueberries has been stimulated by very high gross margin returns (over \$50,000 per hectare) which from long horticultural experience are unlikely to be sustained as supply and demand become more balanced. The opportunity for diversification into blueberry (and other) production could help mitigate impacts on farms affected particularly by the highway diversion at Woolgoolga.

The RTA could support this process by facilitating access by owners of *severely* or *critically* impacted agricultural properties to the specialist consultants who may provide advice in this area, for example, facilitating access to specialist consultants who prepared the agricultural report. Specialist support in assessing opportunities for agricultural diversification, including comparative set-up costs, may be useful for *severely* or *critically* impacted property owners. This opportunity could be made available to farmers for a period of 24 months following project approval.

Changing land use in the area has opened opportunities for garden nurseries servicing the influx of new housing estates. Plant nurseries depend on reliable irrigation, and two critically impacted properties, one with a hydroponics setup and the other a plant nursery have been identified in this study. However, the severity of impacts on nearby properties utilising the same water sources can be mitigated by ensuring that water storages are preserved and/or replaced prior to construction and water movement down the small valleys is un-impeded both during construction and in the long term.

Spray drift is a concern from both banana and blueberry plantings. In the case of blueberries, ground rigs have to be used for spraying, but the chemicals used are of greater potency since they include insecticides, so fast growing vegetation screens or physical structures will be needed to control drift on to or near the relocated highway. The Proposal should include the provision of a suitable buffer (fast growing vegetation screens or physical structures) for existing blueberry farms located adjacent to the upgrade. For those farms that expand into blueberry production after approval of the Proposal, the responsibility for the erection of a suitable buffer would lie with the

land owner. A fast growing low tree hedge, typically *Hakea* spp. has been used elsewhere for this purpose.

For bananas, a 300 metre aerial spray buffer has been proposed, and banana plantings within the buffer zone, even though they may not be directly impacted by road works, will be affected. Sub-optimal disease control will result in yield loss within one to two years, and the effect will become more widely dispersed when there is a build up of diseased plants. In most cases ground based spraying is not an option on the plantings which have been laid out without sufficient internal access.

7.2 Organic Producers and Associated Lifestyle properties

The major mitigation measure is ensuring that highway design incorporates a system for disposing surface runoff from the highway pavements and shoulders in a manner that does not contaminate water sources used for irrigation in subdivided medium intensity residential areas. The design should include measures to strictly enforce construction standards that prevent contamination of water sources particularly as a result of high intensity storms during construction.

Geophysical investigations should pay particular attention to the source of permanent springs in the foothill region to ensure that highway design preserves the integrity of the water flows.

8. Conclusions

The study has identified nineteen agricultural properties that will suffer serious to critical impacts on overall farm management as a direct result of upgrading and relocation of the highway. Most of these properties are on the proposed deviation around Woolgoolga, or at the sites of upgraded highway intersections with existing feeder roads. In addition to the direct impacts, thirteen other banana plantings within a buffer zone 300 metres either side of the Woolgoolga bypass could be affected by restrictions on aerial spraying of protective fungicide.

The nursery identified as being critically affected has been acquired, in response to a request from the owner under the hardship provisions of the Land Acquisition (Just Terms Compensation) Act 1991.

While the extent of aerial spraying has already been affected by declining profitability (apart from the recent reaction to the NQ cyclone), the spray exclusion zone along the deviation route will exacerbate the problem of managing leaf disease on those specifically affected properties.

There continue to be outbreaks of Panama disease in lady finger banana crops in the Woolgoolga and Safety Beach areas, underlining the need for particular vigilance in moving spoil and controlling sediment from former banana plantations.

The study has confirmed the existence of certified organic farms within the more closely subdivided areas lying east of the proposed highway route, for which certification could be jeopardised should water sources or land become contaminated. Spoil or sediment from former banana plantations could contain residual chemicals which are prohibited under organic certification guidelines.

As a mitigation measure, high design and construction standards must be imposed to guarantee the integrity of springs in the foothills transected by the relocated highway, prevent contamination as a result of storm run-on during construction, and ensure that ongoing storm water disposal from the highway which could carry hydrocarbon and chemical contaminants does not contaminate existing streams. Substantial vegetation buffers inland of the route should be planted to protect long term agricultural use there.

APPENDICES

Appendix 1: Criteria for Selecting Agricultural Properties

Appendices 2-8: Indices Database

Appendix 9: Seasonal Wind Roses for Coffs Harbour

A1. Appendix 1: Criteria for Selecting Agricultural Properties

Properties included in the assessment of impacts on agricultural enterprises are selected on the following criteria;

1. Area

All properties exceeding 2 hectare are included in the initial scan. This takes into account “5 acre” subdivisions where there could be commercial nurseries and certified organic farming.

2. Layout and Evidence of Farming Practices

Using air photos and mosaics, followed by field inspection, properties are either confirmed as being involved in commercial agriculture (layout of crop rows, paddock development, water resource, sheds and facilities) or else lifestyle and rural residential lots. The latter are often clearly identified within formal subdivisions of similar sized lots and the presence of a few livestock on these properties does not necessarily indicate a dominant agricultural land use.

3. LEP Zoning

Most agricultural properties have a rural land zoning. However many lifestyle blocks also retain the same general zoning so zoning of itself does not necessarily determine the agricultural status. The demand for land for closer subdivision is high within the project area, so land use can be in a transition between rural and closer settlement. Land zoned 1B Rural Living that is still being used for commercial banana production has been included, but land wholly within other residential classifications, including 2A residential low density and Urban Investigation area have been excluded.

A.2. Appendices 2 to 8: Data Bases

| | | | No. | No. | No. | No. | No. | No. | No. | No. |
|---|--|---|------------|------------|------------|-----------|-----------|-----------|------------|-----------|
| Connell Wagner Property Number | | | 340 | 161 | 286 | 66 | 90 | 89 | 176 | 69 |
| 1. Physical Impact | | | | | | | | | | |
| Existing Road Frontage Altered | | | | | | | | | | |
| No change | | 0 | | 0 | | | | | | |
| Widened to impact boundary | | 1 | 1 | | 1 | | 1 | | | |
| Impinging into property | | 2 | | | | 2 | | 2 | 2 | 2 |
| Impinging into property | | | | | | | | | | |
| none | | 0 | | 0 | 0 | | 0 | | | |
| cuts corner <5% | | 1 | 1 | | | | | | | |
| excises <25% | | 2 | | | | | | 2 | 2 | 2 |
| excises >25% | | 3 | | | | 3 | | | | |
| Access inside is affected | | | | | | | | | | |
| none | | 0 | | 0 | 0 | | 0 | | | |
| crosses one end | | 1 | 1 | | | | | | 1 | 1 |
| changes entry | | 2 | | | | | | | | |
| crosses property affects operations | | 3 | | | | 3 | | 3 | | |
| Affects work centres and structures | | | | | | | | | | |
| none | | 0 | | 0 | 0 | | 0 | | | 0 |
| close proximity to centres and structures | | 1 | 1 | | | | | 1 | 1 | |
| impacts directly on buildings | | 2 | | | | 2 | | | | |
| impacts directly on housing | | 3 | | | | | | | | |
| Impedes access to water or drainage | | | | | | | | | | |
| none | | 0 | 0 | 0 | 0 | | 0 | 0 | | 0 |
| non-daily access affected or minor impact on drainage | | 1 | | | | | | | | |
| daily stock access affected, moderate impact drainage | | 2 | | | | | | | | |
| daily access for water, and/or major impedance drainage | | 3 | | | | 3 | | | 3 | |
| Sum of Physical indices | | | 4 | 0 | 1 | 13 | 1 | 8 | 9 | 5 |
| LEP Zoning | | | 1A | 1A | 1A | 1A | 1B | 1B | 1B | 1A |

Appendix 3: Property Fragmentation Index

| Connell Wagner Property Number | | | | 376 | 241 | 173 | 245 | 364 | 58 | 117 |
|--|------------|----------------|---|--------------|-------------|-------------|-------------|--------------|-------------|-------------|
| Area hectare | | | | 11.55 | 5.4 | 5.83 | 6.4 | 60.99 | 3.3 | 6.71 |
| 7. Property Fragmentation Index | | | | | | | | | | |
| Class 1 land area | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Class 2 land area | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Class 3 land area | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Class 4 land area | % impacted | none | 0 | | | | | 54.99 | 0.33 | |
| | | <15% | 1 | 0.58 | | | | 6 | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Specialist Class (banana) | % impacted | none | 0 | | | 4.08 | | | 2.97 | |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | 3.20 | | | 2.01 |
| Specialist Class (blueberry) | % impacted | none | 0 | | 5.40 | 1.75 | | | | |
| | | <15% | 1 | 10.97 | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | 3.20 | | | 4.70 |
| <i>Area Check</i> | | <i>hectare</i> | | <i>11.55</i> | <i>5.40</i> | <i>5.83</i> | <i>6.40</i> | <i>60.99</i> | <i>3.30</i> | <i>6.71</i> |
| 8. Multiply area ha by intensity factor | | | | | | | | | | |
| 9. Sum these indices and divide by total area | | | | 1.0 | 0.0 | 0.0 | 3.0 | 0.1 | 0.0 | 3.0 |
| Farm Potential Land Use Interference Index | | | | 3.0 | 0.0 | 0.0 | 27.0 | 0.0 | 0.0 | 23.0 |

| Connell Wagner Property Number | | | | 118 | 222 | 380 | 59 | 49 | 91 | 203 |
|--|------------|--------------|---|-------------|--------------|-------------|-------------|-------------|-------------|-------------|
| Area hectare | | | | 6.03 | 13.16 | 5.19 | 4.36 | 5 | 4.35 | 7.35 |
| 7. Property Fragmentation Index | | | | | | | | | | |
| Class 1 land area | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Class 2 land area | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Class 3 land area | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Class 4 land area | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | 10.53 | | | | | |
| | | 15% but <30% | 2 | | | 3.63 | | | | |
| | | >30% | 3 | | | | | | | |
| Specialist Class (banana) | % impacted | none | 0 | | | | 0.87 | 3.75 | 3.92 | |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | | | 6.62 |
| | | >30% | 3 | 3.62 | | | | | | |
| Specialist Class (blueberry) | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | | | | 1.25 | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | 2.41 | 2.63 | 1.56 | 3.49 | | 0.44 | 0.74 |
| <i>Area Check</i> | | | | <i>6.03</i> | <i>13.16</i> | <i>5.19</i> | <i>4.36</i> | <i>5.00</i> | <i>4.35</i> | <i>7.35</i> |
| 8. Multiply area ha by intensity factor | | | | | | | | | | |
| 9. Sum these indices and divide by total area | | | | | | | | | | |
| Farm Potential Land Use Interference Index | | | | 27.0 | 0.0 | 20.7 | 15.8 | 0.0 | 0.9 | 18.9 |

| | | | | | | | | | | |
|--|------------|--------------|---|-------------|-------------|-------------|-------------|--------------|-------------|-------------|
| Connell Wagner Property Number | | | | 374 | 189 | 390 | 178 | 172 | 307 | 122 |
| Area hectare | | | | 8.95 | 3.81 | 2.28 | 4.09 | 24.83 | 6.41 | 6.15 |
| 7. Property Fragmentation Index | | | | | | | | | | |
| Class 1 land area | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Class 2 land area | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Class 3 land area | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Class 4 land area | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | 4.97 | | |
| | | >30% | 3 | | | | | | | |
| Specialist Class (banana) | % impacted | none | 0 | | | | | 12.42 | 2.56 | 4.31 |
| | | <15% | 1 | | | 2.28 | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | 7.16 | 3.81 | | 4.09 | | | |
| Specialist Class (blueberry) | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | 1.79 | | | | | 3.85 | |
| | | 15% but <30% | 2 | | | | | | | 1.85 |
| | | >30% | 3 | | | | | 7.45 | | |
| <i>Area Check</i> | | | | 8.95 | 3.81 | 2.28 | 4.09 | 24.83 | 6.41 | 6.15 |
| 8. Multiply area ha by intensity factor | | | | | | | | | | |
| 9. Sum these indices and divide by total area | | | | 2.6 | 3.0 | 1.0 | 3.0 | 1.3 | 0.6 | 0.6 |
| Farm Potential Land Use Interference Index | | | | 23.4 | 27.0 | 0.0 | 27.0 | 3.7 | 0.2 | 0.2 |

| | | | | | | | | | | |
|--|------------|--------------|---|--------------|--------------|-------------|-------------|-------------|--------------|-------------|
| Connell Wagner Property Number | | | | 184 | 112 | 81 | 340 | 161 | 286 | 66 |
| Area hectare | | | | 24.8 | 16.66 | 9.15 | 2 | 3.99 | 96.6 | 4.08 |
| 7. Property Fragmentation Index | | | | | | | | | | |
| Class 1 land area | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Class 2 land area | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Class 3 land area | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | 24.80 | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Class 4 land area | % impacted | none | 0 | | 0.83 | 1.37 | 0.80 | 0.40 | 95.60 | |
| | | <15% | 1 | | | | | | 1.00 | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | 0.61 |
| Specialist Class (banana) | % impacted | none | 0 | | 14.16 | | 1.20 | 3.59 | | |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Specialist Class (blueberry) | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | 1.67 | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | 7.78 | | | | 3.47 |
| <i>Area Check</i> | | | | <i>24.80</i> | <i>16.66</i> | <i>9.15</i> | <i>2.00</i> | <i>3.99</i> | <i>96.60</i> | <i>4.08</i> |
| 8. Multiply area ha by intensity factor | | | | | | | | | | |
| 9. Sum these indices and divide by total area | | | | 1.0 | 0.1 | 2.6 | 0.0 | 0.0 | 0.0 | 3.0 |
| Farm Potential Land Use Interference Index | | | | 1.0 | 0.1 | 17.2 | 0.0 | 0.0 | 0.0 | 27.0 |

| Connell Wagner Property Number | | | | 90 | 89 | 176 | 69 | 29 | 146 | 260 |
|--|------------|--------------|---|------------|-------------|-------------|-------------|-------------|-------------|--------------|
| Area hectare | | | | 2.9 | 4.26 | 6.02 | 2.17 | 6.29 | 9.19 | 12.01 |
| 7. Property Fragmentation Index | | | | | | | | | | |
| Class 1 land area | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Class 2 land area | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Class 3 land area | % impacted | none | 0 | | | | | | 7.35 | 9.61 |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | 6.29 | | |
| | | >30% | 3 | | | | | | | |
| Class 4 land area | % impacted | none | 0 | | 0.21 | | | | 1.84 | 2.40 |
| | | <15% | 1 | | | | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Specialist Class (banana) | % impacted | none | 0 | | 1.70 | | | | | |
| | | <15% | 1 | | | 3.01 | 2.17 | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| Specialist Class (blueberry) | % impacted | none | 0 | 2.90 | | | | | | |
| | | <15% | 1 | | | 3.01 | | | | |
| | | 15% but <30% | 2 | | | | | | | |
| | | >30% | 3 | | | | | | | |
| <i>Area Check</i> | | | | 2.90 | 4.26 | 6.02 | 2.17 | 6.29 | 9.19 | 12.01 |
| 8. Multiply area ha by intensity factor | | | | | | | | | | |
| 9. Sum these indices and divide by total area | | | | 0.0 | 1.7 | 1.0 | 1.0 | 2.0 | 0.0 | 0.0 |
| Farm Potential Land Use Interference Index | | | | 0.0 | 4.7 | 5.4 | 3.1 | 5.0 | 0.0 | 0.0 |

| Connell Wagner Property Number | | | | 250 | 230 | 99 | 212 | 326 |
|--|------------|--------------|---|-------------|--------------|-------------|--------------|--------------|
| Area hectare | | | | 0.38 | 10.15 | 6.85 | 10.17 | 10.84 |
| 7. Property Fragmentation Index | | | | | | | | |
| Class 1 land area | % impacted | none | 0 | | | | | |
| | | <15% | 1 | | | | | |
| | | 15% but <30% | 2 | | | | | |
| | | >30% | 3 | | | | | |
| Class 2 land area | % impacted | none | 0 | | | | | |
| | | <15% | 1 | | | | | |
| | | 15% but <30% | 2 | | | | | |
| | | >30% | 3 | 0.38 | | | | |
| Class 3 land area | % impacted | none | 0 | | | | | |
| | | <15% | 1 | | | | | |
| | | 15% but <30% | 2 | | | | | |
| | | >30% | 3 | | | | | |
| Class 4 land area | % impacted | none | 0 | | | | 6.37 | |
| | | <15% | 1 | | | | | |
| | | 15% but <30% | 2 | | | | | |
| | | >30% | 3 | | | | | |
| Specialist Class (banana) | % impacted | none | 0 | | 10.15 | 6.85 | 3.8 | |
| | | <15% | 1 | | | | | 10.3 |
| | | 15% but <30% | 2 | | | | | |
| | | >30% | 3 | | | | | |
| Specialist Class (blueberry) | % impacted | none | 0 | | | | | 0.54 |
| | | <15% | 1 | | | | | |
| | | 15% but <30% | 2 | | | | | |
| | | >30% | 3 | | | | | |
| <i>Area Check</i> | | | | 0.38 | 10.15 | 6.85 | 10.17 | 10.84 |
| 8. Multiply area ha by intensity factor | | | | | | | | |
| 9. Sum these indices and divide by total area | | | | | | | | |
| Farm Potential Land Use Interference Index | | | | 3.0 | 0.0 | 3.0 | 1.1 | 1.0 |
| | | | | 27.0 | 0.0 | 27.0 | 10.1 | 1.1 |

Appendix 4: Farm Management Interference Index

| | | | | | | | | | | | | | | |
|---|-----------------|---|--------------|-------------|-------------|-------------|--------------|-------------|-------------|-------------|--------------|-------------|-------------|--|
| | | | | | | | | | | | | | | |
| Connell Wagner Property Number | | | 376 | 241 | 173 | 245 | 364 | 58 | 117 | 118 | 222 | 380 | 59 | |
| Area hectare | | | 11.55 | 5.4 | 5.83 | 6.4 | 60.99 | 3.3 | 6.71 | 6.03 | 13.16 | 5.19 | 4.36 | |
| 4. Current Farm Management Interference Factor | | | | | | | | | | | | | | |
| Degree of disruption to daily operations involving water, drainage, access to crop areas, buildings, roads, | none | 0 | | 0 | | | 0 | 0 | | | | | | |
| housing etc caused by impingement | some | 1 | | | 1 | | | | | | 1 | | | |
| | daily for stock | 2 | | | | | | | | | | | | |
| | daily for crops | 3 | 3 | | | 3 | | | 3 | 3 | | | | |
| 5. Current Farm Management Interference Index | | | 3 | 0 | 1 | 3 | 0 | 0 | 3 | 3 | 1 | 3 | 3 | |
| 6. Multiply factor 4 by Index 3 | | | 3.00 | 0.00 | 0.15 | 9.00 | 0.00 | 0.00 | 7.65 | 9.00 | 0.00 | 9 | 6.6 | |

| | | | | | | | | | | | | | | | |
|---|-----------------|---|-----------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------|-------------|-------------|--------------|--|
| | | | | | | | | | | | | | | | |
| Connell Wagner Property Number | | | 49 | 91 | 203 | 374 | 189 | 390 | 178 | 172 | 307 | 122 | 184 | 112 | |
| Area hectare | | | 5 | 4.35 | 7.35 | 8.95 | 3.81 | 2.28 | 4.09 | 24.83 | 6.41 | 6.15 | 24.8 | 16.66 | |
| 4. Current Farm Management Interference Factor | | | | | | | | | | | | | | | |
| Degree of disruption to daily operations involving water, drainage, access to crop areas, buildings, roads, | none | 0 | 0 | | | | | 0 | | | | | | | |
| | some | 1 | | | | | | | | | 1 | 1 | 1 | 1 | |
| housing etc caused by impingement | daily for stock | 2 | | | | | | | | | | | | | |
| | daily for crops | 3 | | 3 | 3 | 3 | 3 | | 3 | 3 | | | | | |
| 5. Current Farm Management Interference Index | | | 0 | 3 | 3 | 3 | 3 | 0 | 3 | 3 | 1 | 1 | 1 | 1 | |
| 6. Multiply factor 4 by Index 3 | | | 0 | 3 | 9 | 9 | 9 | 0 | 9 | 2.85 | 0.3 | 0.3 | 0.95 | 0.60 | |

| | | | | | | | | | | | | | | |
|---|-----------------|---|-------------|------------|-------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|-------------|--|
| | | | | | | | | | | | | | | |
| Connell Wagner Property Number | | | 81 | 340 | 161 | 286 | 66 | 90 | 89 | 176 | 69 | 29 | 146 | |
| Area hectare | | | 9.15 | 2 | 3.99 | 96.6 | 4.08 | 2.9 | 4.26 | 6.02 | 2.17 | 6.29 | 9.19 | |
| 4. Current Farm Management Interference Factor | | | | | | | | | | | | | | |
| Degree of disruption to daily operations involving water, drainage, access to crop areas, buildings, roads, | none | 0 | | | 0 | 0 | 0 | 0 | | | | | | |
| | some | 1 | | 1 | | | | | | | | 1 | 1 | |
| housing etc caused by impingement | daily for stock | 2 | | | | | | | | | | | | |
| | daily for crops | 3 | 3 | | | | 3 | | 3 | 3 | 3 | | | |
| 5. Current Farm Management Interference Index | | | 3 | 1 | 0 | 0 | 3 | 0 | 3 | 3 | 3 | 1 | 1 | |
| 6. Multiply factor 4 by Index 3 | | | 6.75 | 0 | 0 | 0 | 9 | 0 | 2.85 | 5.4 | 3.12 | 2.5 | 0 | |

| | | | | | | | | | |
|---|-----------------|---|--------------|-------------|--------------|-------------|--------------|--------------|------------|
| | | | | | | | | | |
| Connell Wagner Property Number | | | 260 | 250 | 230 | 99 | 212 | 326 | |
| Area hectare | | | 12.01 | 0.38 | 10.15 | 6.85 | 10.17 | 10.84 | |
| 4. Current Farm Management Interference Factor | | | | | | | | | |
| Degree of disruption to daily operations involving water, drainage, access to crop areas, buildings, roads, | none | 0 | | | | | | | |
| housing etc caused by impingement | some | 1 | 1 | | | | | | 1 |
| | daily for stock | 2 | | | | | | | |
| | daily for crops | 3 | | 3 | | 3 | 3 | | |
| 5. Current Farm Management Interference Index | | | 1 | 3 | 0 | 3 | 3 | | 1 |
| 6. Multiply factor 4 by Index 3 | | | 0 | 9 | 0 | 9 | 9 | | 1.2 |

Appendix 5: Current Activity Interference Index

| Connell Wagner Property Number | | | | 376 | 241 | 173 | 245 | 364 | 58 | 117 | 118 | 222 |
|---|------------|----------------|-----------|--------------|------------|-------------|------------|--------------|------------|-------------|-------------|--------------|
| 2. Property Area | | | ha | 11.55 | 5.4 | 5.83 | 6.4 | 60.99 | 3.3 | 6.71 | 6.03 | 13.16 |
| 3. Current Activity Interference Index | | | | | | | | | | | | |
| Forestry | % impacted | none | 0 | | 1.6 | | | | | 1.0 | | 12.5 |
| | | <15% | 1 | | | | | 29.54 | | | | |
| | | <25% | 2 | | | | | | | | | |
| | | >25% | 3 | | | | | | | | | |
| bananas | % impacted | none | 0 | | | 4.8 | | | | | | |
| | | <15% | 1 | | | | | | | | | |
| | | <25% | 2 | | | | | | | | | |
| | | >25% | 3 | | | | 3.2 | | | | | |
| fallow, grass | % impacted | none | 0 | | | | | 27.45 | | | | 0.7 |
| | | <15% | 1 | 6.0 | 3.5 | | | | | | | |
| | | <25% | 2 | | | | | | | | | |
| | | >25% | 3 | | | | | | | 2.7 | 5.7 | |
| greenhouses | % impacted | none | 0 | | | | | | | | | |
| blueberry or | | <15% | 1 | 5.6 | | 0.9 | | | 3 | | | |
| nursery | | <25% | 2 | | | | | | | | | |
| | | >25% | 3 | | | | 3.2 | | | 2.7 | | |
| housing, other | % impacted | none | 0 | | 0.3 | 0.1 | | 4 | 0.3 | | | |
| | | <15% | 1 | | | | | | | | | |
| | | <25% | 2 | | | | | | | | | |
| | | >25% | 3 | | | | | | | 0.3 | 0.3 | |
| fruit orchard | % impacted | none | 0 | | 0.0 | | | | | | | |
| | | <15% | 1 | | | | | | | | | |
| | | <25% | 2 | | | | | | | | | |
| | | >25% | 3 | | | | | | | | | |
| <i>Area Check</i> | | <i>hectare</i> | | 11.55 | 5.40 | 5.83 | 6.40 | 60.99 | 3.30 | 6.71 | 6.03 | 13.16 |
| Multiply ha for each enterprise by intensity factor; | | | | | | | | | | | | |
| sum these then divide by area hectare | | | | 1.0 | 0.7 | 0.2 | 3.0 | 0.5 | 0.9 | 2.6 | 3.0 | 0.0 |

| Connell Wagner Property Number | | | | 380 | 59 | 49 | 91 | 203 | 374 | 189 | 390 |
|---|------------|----------------|-----------|-------------|-------------|------------|-------------|-------------|-------------|-------------|-------------|
| 2. Property Area | | | ha | 5.19 | 4.36 | 5 | 4.35 | 7.35 | 8.95 | 3.81 | 2.28 |
| 3. Current Activity Interference Index | | | | | | | | | | | |
| Forestry | % impacted | none | 0 | | | | | | | | |
| | | <15% | 1 | | | | | | | | |
| | | <25% | 2 | | | | | | | | |
| | | >25% | 3 | 4.4 | 0.9 | | | | | | |
| bananas | % impacted | none | 0 | | | | | | | | |
| | | <15% | 1 | | | 5.0 | 4.4 | | | | 2.3 |
| | | <25% | 2 | | | | | | | | |
| | | >25% | 3 | | | | | 7.4 | 9.0 | 3.8 | |
| fallow, grass | % impacted | none | 0 | | | | | | | | |
| | | <15% | 1 | | 1.7 | | | | | | |
| | | <25% | 2 | | | | | | | | |
| | | >25% | 3 | 0.8 | | | | | | | |
| greenhouses | % impacted | none | 0 | | | | | | | | |
| blueberry or | | <15% | 1 | | | | | | | | |
| nursery | | <25% | 2 | | | | | | | | |
| | | >25% | 3 | | 1.7 | | | | | | |
| housing, other | % impacted | none | 0 | | | | | | | | |
| | | <15% | 1 | | | | | | | | |
| | | <25% | 2 | | | | | | | | |
| | | >25% | 3 | | | | | | | | |
| fruit orchard | % impacted | none | 0 | | | | | | | | |
| | | <15% | 1 | | | | | | | | |
| | | <25% | 2 | | | | | | | | |
| | | >25% | 3 | | | | | | | | |
| <i>Area Check</i> | | <i>hectare</i> | | 5.19 | 4.36 | 5.00 | 4.35 | 7.35 | 8.95 | 3.81 | 2.28 |
| Multiply ha for each enterprise by intensity factor; | | | | | | | | | | | |
| sum these then divide by area hectare | | | | 3.0 | 2.2 | 1.0 | 1.0 | 3.0 | 3.0 | 3.0 | 1.0 |

| Connell Wagner Property Number | | | | 178 | 172 | 307 | 122 | 184 | 112 | 81 | 340 |
|---|------------|----------------|-----------|-------------|--------------|-------------|-------------|-------------|--------------|-------------|------------|
| 2. Property Area | | | ha | 4.09 | 24.83 | 6.41 | 6.15 | 24.8 | 16.66 | 9.15 | 2 |
| 3. Current Activity Interference Index | | | | | | | | | | | |
| Forestry | % impacted | none | 0 | | | | | | 5.0 | 1.8 | 0.8 |
| | | <15% | 1 | | 2.5 | 1.9 | | 19.8 | | | |
| | | <25% | 2 | | | | 0.9 | | | | |
| | | >25% | 3 | 1.0 | | | | | | | |
| bananas | % impacted | none | 0 | | | 0.1 | | | 1.7 | | |
| | | <15% | 1 | | 21.1 | | | | | | |
| | | <25% | 2 | | | | | | | | |
| | | >25% | 3 | | | | | | | 6.9 | |
| fallow, grass | % impacted | none | 0 | | | 3.8 | 4.9 | | | | |
| | | <15% | 1 | | | | | 3.7 | 10.0 | | |
| | | <25% | 2 | | | | | | | | |
| | | >25% | 3 | 3.1 | | | | | | | |
| greenhouses | % impacted | none | 0 | | | | | | | | |
| blueberry or | | <15% | 1 | | | | | | | | |
| nursery | | <25% | 2 | | | | | | | | |
| | | >25% | 3 | | | | | | | | |
| housing, other | % impacted | none | 0 | | 1.2 | 0.5 | 0.3 | 1.2 | | 0.5 | |
| | | <15% | 1 | | | | | | | | |
| | | <25% | 2 | | | | | | | | |
| | | >25% | 3 | | | | | | | | |
| fruit orchard | % impacted | none | 0 | | | | | | | | 1.2 |
| | | <15% | 1 | | | | | | | | |
| | | <25% | 2 | | | | | | | | |
| | | >25% | 3 | | | | | | | | |
| <i>Area Check</i> | | <i>hectare</i> | | 4.09 | 24.83 | 6.41 | 6.15 | 24.80 | 16.66 | 9.15 | 2.00 |
| Multiply ha for each enterprise by intensity factor; | | | | | | | | | | | |
| sum these then divide by area hectare | | | | 3.0 | 1.0 | 0.3 | 0.3 | 1.0 | 0.6 | 2.3 | 0.0 |

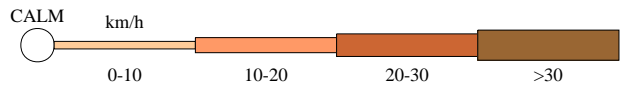
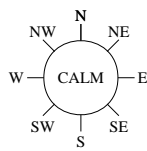
| Connell Wagner Property Number | | | | 161 | 286 | 66 | 90 | 89 | 176 | 69 | 29 | |
|---|------------|----------------|-----------|-------------|-------------|-------------|------------|-------------|-------------|-------------|-------------|------------|
| 2. Property Area | | | ha | 3.99 | 96.6 | 4.08 | 2.9 | 4.26 | 6.02 | 2.17 | 6.29 | |
| 3. Current Activity Interference Index | | | | | | | | | | | | |
| Forestry | % impacted | none | 0 | 0.4 | 10.0 | | | | | | | |
| | | <15% | 1 | | | | | | | | | |
| | | <25% | 2 | | | | | | | 0.98 | | |
| | | >25% | 3 | | | | | | | | 3.15 | |
| bananas | % impacted | none | 0 | | | | | | | 1.09 | | |
| | | <15% | 1 | | | | 2.3 | 4.0 | | | | |
| | | <25% | 2 | | | | | | 5.4 | | | |
| | | >25% | 3 | | | 3.9 | | | | | | |
| fallow, grass | % impacted | none | 0 | 3.6 | 85.6 | | | | | | | |
| | | <15% | 1 | | 1.0 | | | | | | | |
| | | <25% | 2 | | | | | | | | 3.15 | |
| | | >25% | 3 | | | | | | | | | |
| greenhouses | % impacted | none | 0 | | | | | | 0.4 | | | |
| blueberry or | | <15% | 1 | | | | | | | | | |
| nursery | | <25% | 2 | | | | | | | | | |
| | | >25% | 3 | | | | | | | | | |
| housing, other | % impacted | none | 0 | | | | 0.6 | 0.2 | 0.2 | | | |
| | | <15% | 1 | | | | | | | | | |
| | | <25% | 2 | | | | | | | | | |
| | | >25% | 3 | | | 0.2 | | | | 0.1 | | |
| fruit orchard | % impacted | none | 0 | | | | | | | | | |
| | | <15% | 1 | | | | | | | | | |
| | | <25% | 2 | | | | | | | | | |
| | | >25% | 3 | | | | | | | | | |
| <i>Area Check</i> | | <i>hectare</i> | | 3.99 | 96.60 | 4.08 | 2.90 | 4.26 | 6.02 | 2.17 | 6.29 | |
| Multiply ha for each enterprise by intensity factor; | | | | | | | | | | | | |
| sum these then divide by area hectare | | | | | 0.0 | 0.0 | 3.0 | 0.8 | 1.0 | 1.8 | 1.0 | 2.5 |

| Connell Wagner Property Number | | | | 146 | 260 | 250 | 230 | 99 | 212 | 326 |
|---|------------|----------------|-----------|-------------|--------------|-------------|--------------|-------------|--------------|--------------|
| 2. Property Area | | | ha | 9.19 | 12.01 | 0.38 | 10.15 | 6.85 | 10.17 | 10.84 |
| 3. Current Activity Interference Index | | | | | | | | | | |
| Forestry | % impacted | none | 0 | 1.84 | 2.40 | | | | | |
| | | <15% | 1 | | | | | | | 5.4 |
| | | <25% | 2 | | | | | | | |
| | | >25% | 3 | | | | | 6.85 | 8.64 | |
| bananas | % impacted | none | 0 | | | | 9.64 | | | |
| | | <15% | 1 | | | | | | | |
| | | <25% | 2 | | | | | | | |
| | | >25% | 3 | | | | | | | 1.1 |
| fallow, grass | % impacted | none | 0 | 7.35 | 9.61 | | 0.51 | | | |
| | | <15% | 1 | | | | | | | 4.34 |
| | | <25% | 2 | | | | | | | |
| | | >25% | 3 | | | | | | 1.53 | |
| greenhouses | % impacted | none | 0 | | | | | | | |
| blueberry or | | <15% | 1 | | | | | | | |
| nursery | | <25% | 2 | | | | | | | |
| | | >25% | 3 | | | 0.38 | | | | |
| housing, other | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | | | | | | |
| | | <25% | 2 | | | | | | | |
| | | >25% | 3 | | | | | | | |
| fruit orchard | % impacted | none | 0 | | | | | | | |
| | | <15% | 1 | | | | | | | |
| | | <25% | 2 | | | | | | | |
| | | >25% | 3 | | | | | | | |
| <i>Area Check</i> | | <i>hectare</i> | | 9.19 | 12.01 | 0.38 | 10.15 | 6.85 | 10.17 | 10.84 |
| Multiply ha for each enterprise by intensity factor; | | | | | | | | | | |
| sum these then divide by area hectare | | | | 0.0 | 0.0 | 3.0 | 0.0 | 3.0 | 3.0 | 1.2 |

A.3. Appendix 9: Seasonal Wind Roses for Coffs Harbour

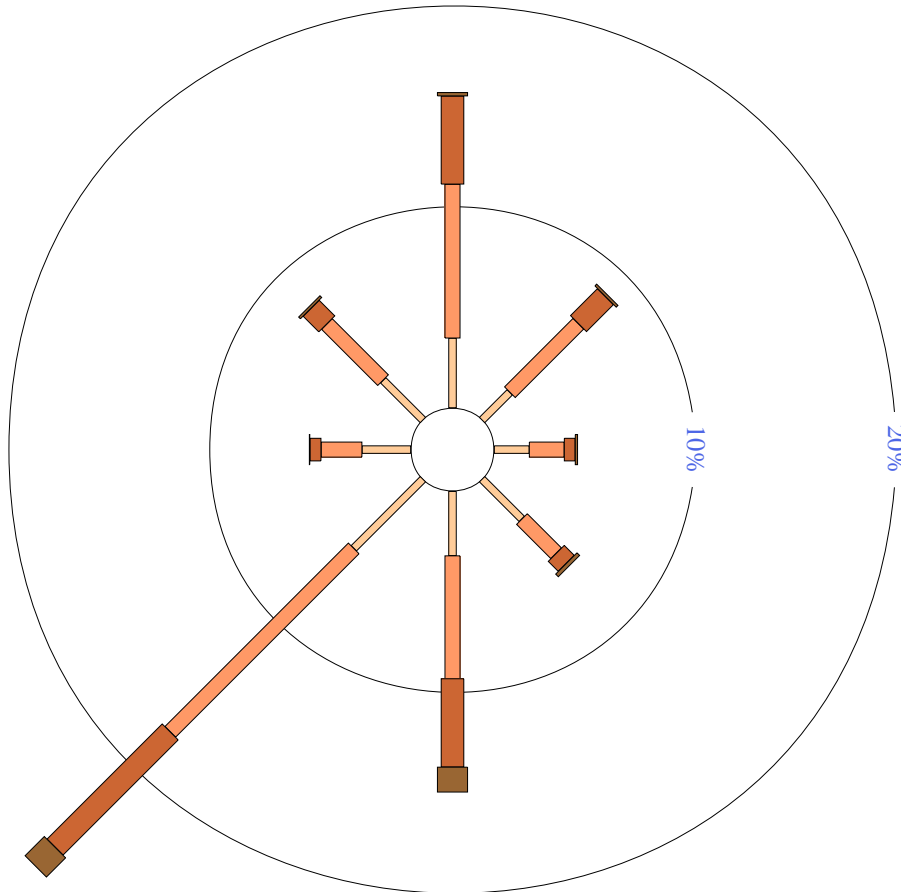
WIND FREQUENCY ANALYSIS (in km/h)
COFFS HARBOUR MO STATION NUMBER 059040
Latitude: -30.31 ° Longitude: 153.12 °

9 am Summer
 4888 Total Observations (1943 to 2004)



Scale factor = 30.0%

Calm 10%



Wind directions are divided into eight compass directions. Calm has no direction.

An asterisk (*) indicates that calm is less than 1% .

An observed wind speed which falls precisely on the boundary between two divisions (eg 10km/h) will be included in the lower range (eg 1-10 km/h). Only quality controlled data have been used.

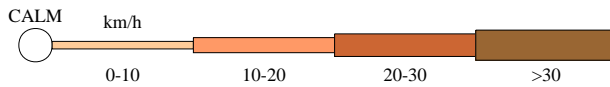
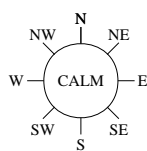


Australian Government
Bureau of Meteorology

Copyright © Commonwealth of Australia 2004
 Prepared by the National Climate Centre of the Bureau of Meteorology.
 Contact us by phone on (03) 9669 4082, by fax on (03) 9669 4515, or by
 email at webclim@bom.gov.au . We have taken all due care but cannot
 provide any warranty nor accept any liability for this information.

WIND FREQUENCY ANALYSIS (in km/h)
COFFS HARBOUR MO STATION NUMBER 059040

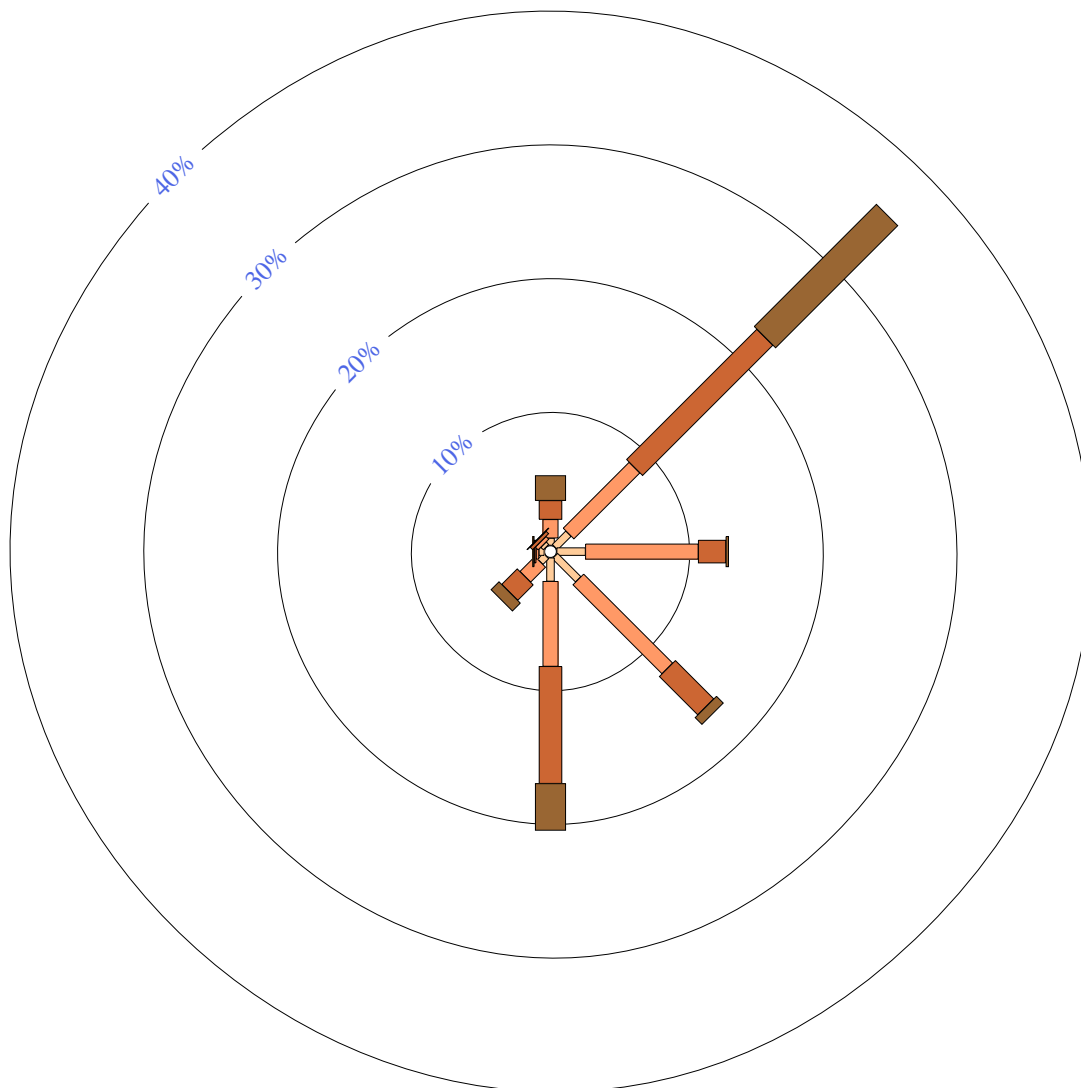
Latitude: -30.31 ° Longitude: 153.12 °



Scale factor = 30.0%

3 pm Summer
 4897 Total Observations (1943 to 2004)

Calm 2%



Wind directions are divided into eight compass directions. Calm has no direction.

An asterisk (*) indicates that calm is less than 1% .

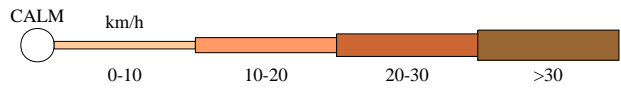
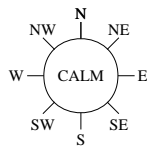
An observed wind speed which falls precisely on the boundary between two divisions (eg 10km/h) will be included in the lower range (eg 1-10 km/h). Only quality controlled data have been used.



Australian Government
Bureau of Meteorology

Copyright © Commonwealth of Australia 2004
 Prepared by the National Climate Centre of the Bureau of Meteorology.
 Contact us by phone on (03) 9669 4082, by fax on (03) 9669 4515, or by
 email at webclim@bom.gov.au . We have taken all due care but cannot
 provide any warranty nor accept any liability for this information.

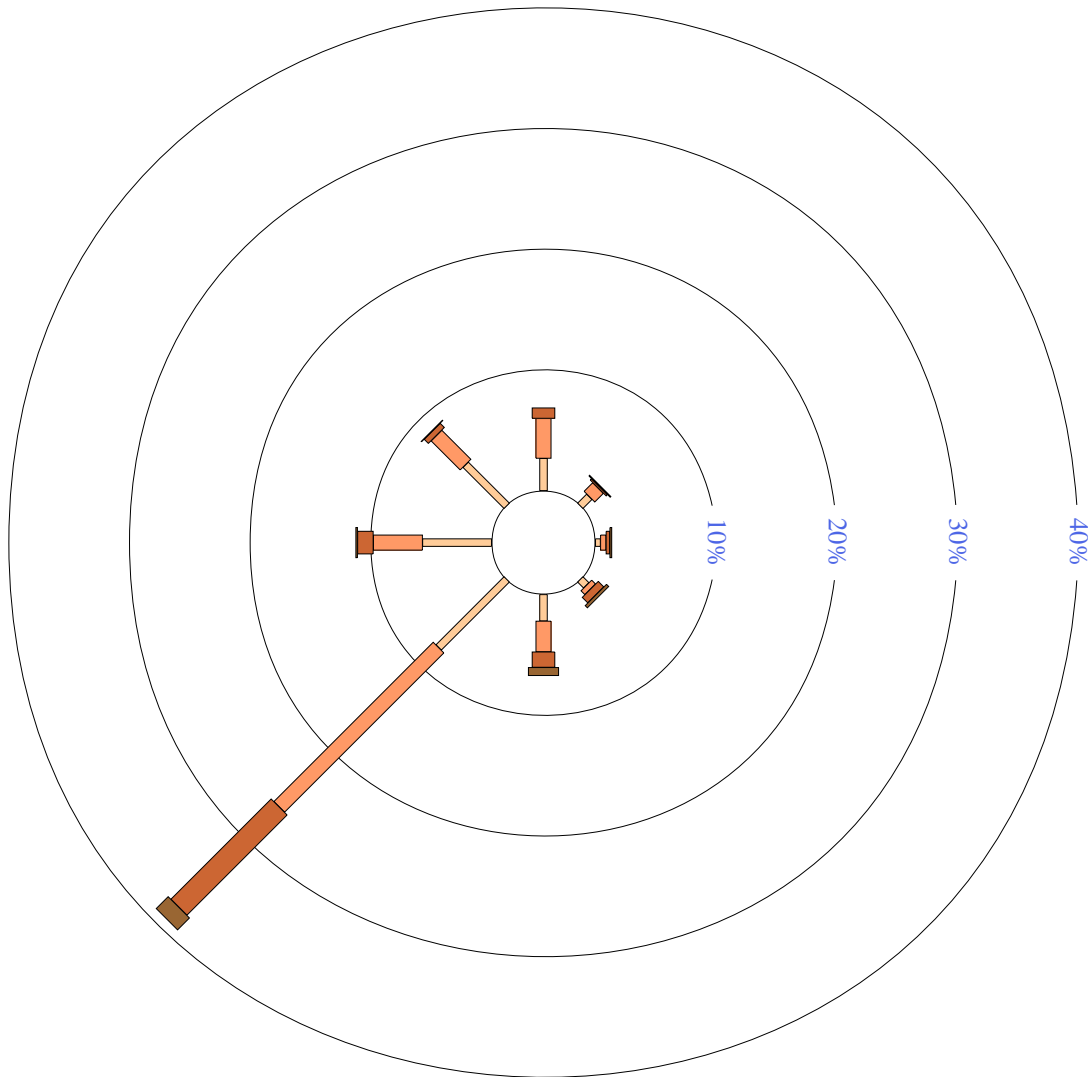
WIND FREQUENCY ANALYSIS (in km/h)
COFFS HARBOUR MO STATION NUMBER 059040
Latitude: -30.31 ° Longitude: 153.12 °



Scale factor = 30.0%

9 am Autumn
 5137 Total Observations (1943 to 2004)

Calm 21%



Wind directions are divided into eight compass directions. Calm has no direction.

An asterisk (*) indicates that calm is less than 1% .

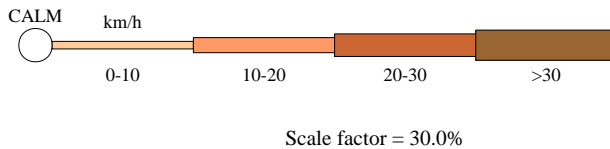
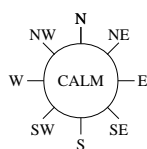
An observed wind speed which falls precisely on the boundary between two divisions (eg 10km/h) will be included in the lower range (eg 1-10 km/h). Only quality controlled data have been used.



Australian Government
Bureau of Meteorology

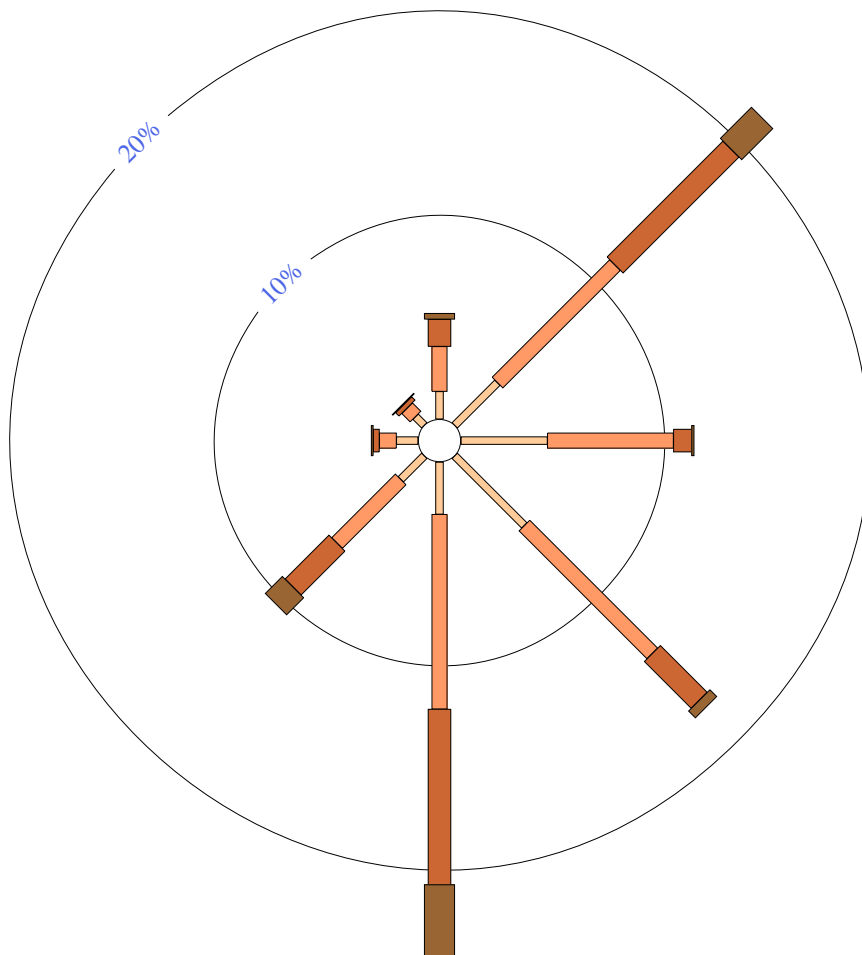
Copyright © Commonwealth of Australia 2004
 Prepared by the National Climate Centre of the Bureau of Meteorology.
 Contact us by phone on (03) 9669 4082, by fax on (03) 9669 4515, or by
 email at webclim@bom.gov.au . We have taken all due care but cannot
 provide any warranty nor accept any liability for this information.

WIND FREQUENCY ANALYSIS (in km/h)
COFFS HARBOUR MO STATION NUMBER 059040
Latitude: -30.31 ° Longitude: 153.12 °



3 pm Autumn
 5141 Total Observations (1943 to 2004)

Calm 5%



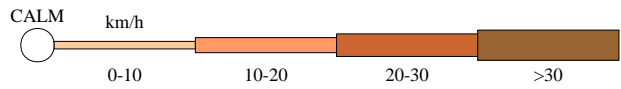
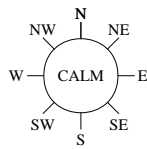
Wind directions are divided into eight compass directions. Calm has no direction.
 An asterisk (*) indicates that calm is less than 1% .
 An observed wind speed which falls precisely on the boundary between two divisions (eg 10km/h) will be included in the lower range (eg 1-10 km/h). Only quality controlled data have been used.



Australian Government
Bureau of Meteorology

Copyright © Commonwealth of Australia 2004
 Prepared by the National Climate Centre of the Bureau of Meteorology.
 Contact us by phone on (03) 9669 4082, by fax on (03) 9669 4515, or by
 email at webclim@bom.gov.au . We have taken all due care but cannot
 provide any warranty nor accept any liability for this information.

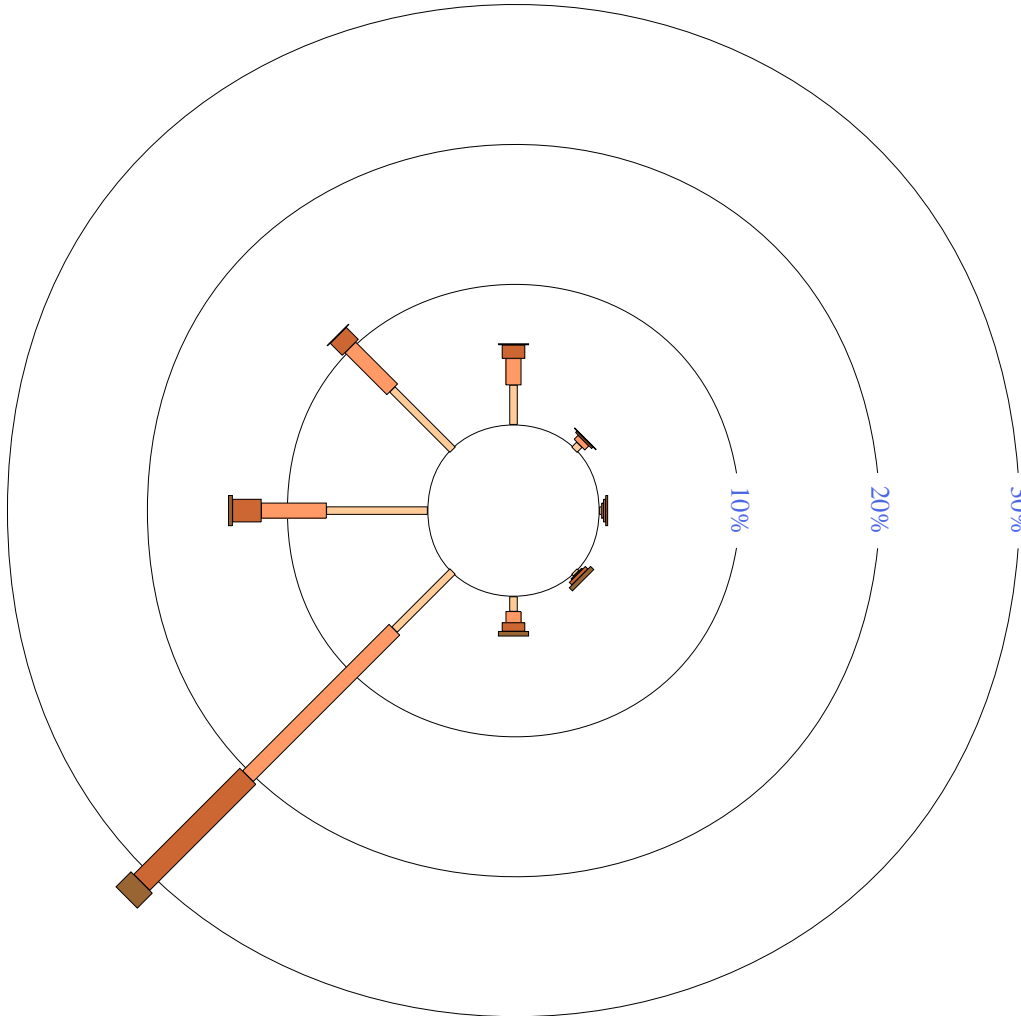
WIND FREQUENCY ANALYSIS (in km/h)
COFFS HARBOUR MO STATION NUMBER 059040
Latitude: -30.31 ° Longitude: 153.12 °



Scale factor = 30.0%

9 am Winter
 5057 Total Observations (1943 to 2004)

Calm 31%



Wind directions are divided into eight compass directions. Calm has no direction.

An asterisk (*) indicates that calm is less than 1% .

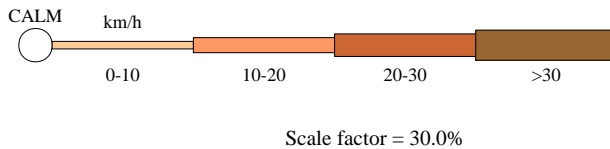
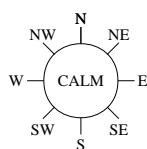
An observed wind speed which falls precisely on the boundary between two divisions (eg 10km/h) will be included in the lower range (eg 1-10 km/h). Only quality controlled data have been used.



Australian Government
Bureau of Meteorology

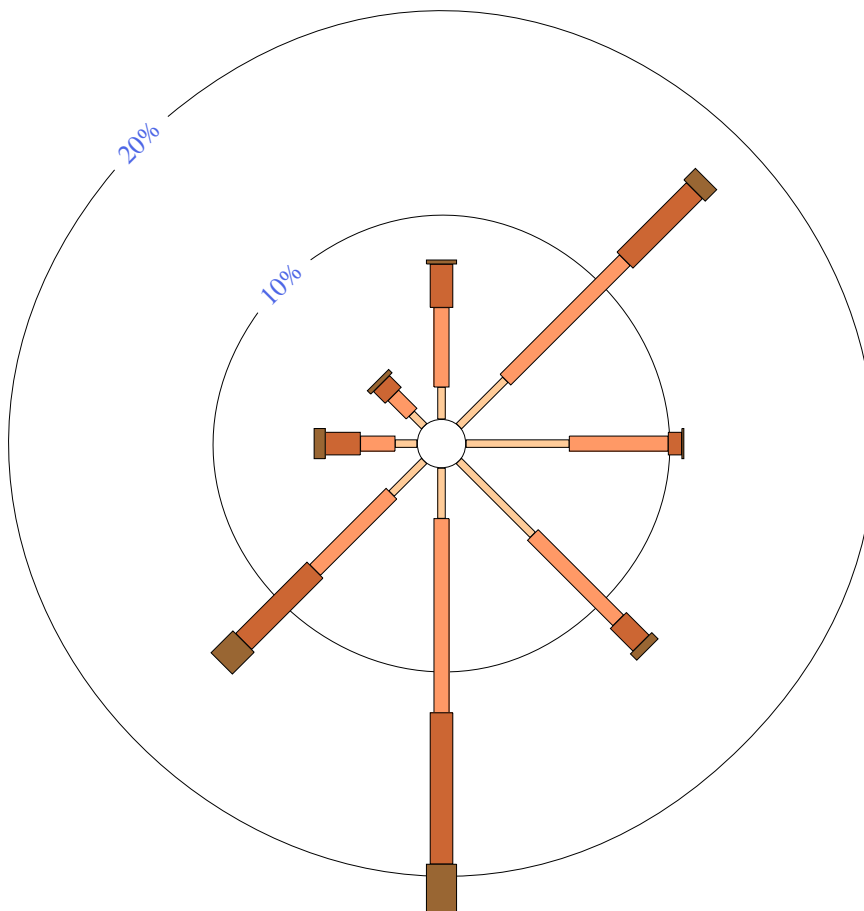
Copyright © Commonwealth of Australia 2004
 Prepared by the National Climate Centre of the Bureau of Meteorology.
 Contact us by phone on (03) 9669 4082, by fax on (03) 9669 4515, or by
 email at webclim@bom.gov.au . We have taken all due care but cannot
 provide any warranty nor accept any liability for this information.

WIND FREQUENCY ANALYSIS (in km/h)
COFFS HARBOUR MO STATION NUMBER 059040
Latitude: -30.31 ° Longitude: 153.12 °



3 pm Winter
 5075 Total Observations (1943 to 2004)

Calm 6%



Wind directions are divided into eight compass directions. Calm has no direction.

An asterisk (*) indicates that calm is less than 1% .

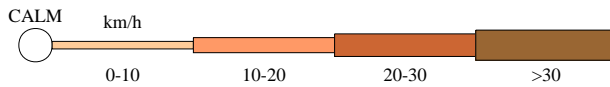
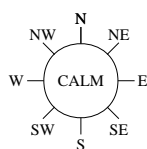
An observed wind speed which falls precisely on the boundary between two divisions (eg 10km/h) will be included in the lower range (eg 1-10 km/h). Only quality controlled data have been used.



Australian Government
Bureau of Meteorology

Copyright © Commonwealth of Australia 2004
 Prepared by the National Climate Centre of the Bureau of Meteorology.
 Contact us by phone on (03) 9669 4082, by fax on (03) 9669 4515, or by
 email at webclim@bom.gov.au . We have taken all due care but cannot
 provide any warranty nor accept any liability for this information.

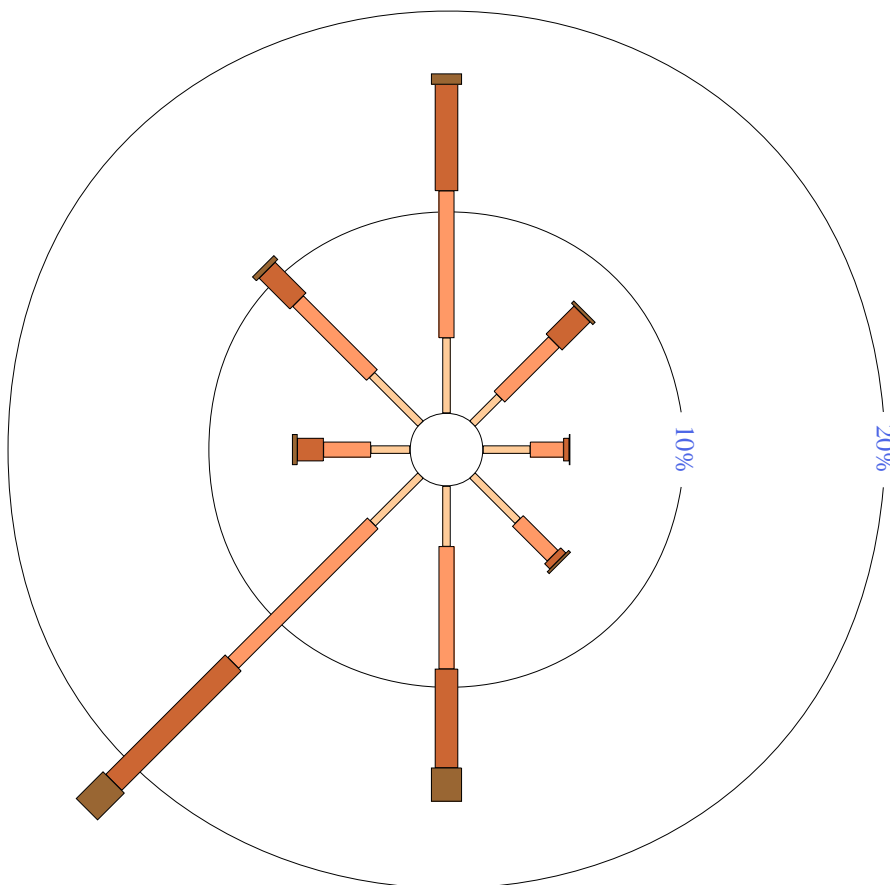
WIND FREQUENCY ANALYSIS (in km/h)
COFFS HARBOUR MO STATION NUMBER 059040
Latitude: -30.31 ° Longitude: 153.12 °



Scale factor = 30.0%

9 am Spring
 5043 Total Observations (1943 to 2004)

Calm 9%



Wind directions are divided into eight compass directions. Calm has no direction.

An asterisk (*) indicates that calm is less than 1% .

An observed wind speed which falls precisely on the boundary between two divisions (eg 10km/h) will be included in the lower range (eg 1-10 km/h). Only quality controlled data have been used.

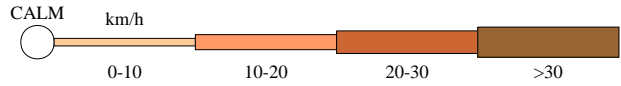
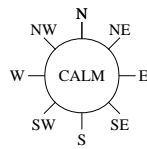


Australian Government
Bureau of Meteorology

Copyright © Commonwealth of Australia 2004
 Prepared by the National Climate Centre of the Bureau of Meteorology.
 Contact us by phone on (03) 9669 4082, by fax on (03) 9669 4515, or by
 email at webclim@bom.gov.au . We have taken all due care but cannot
 provide any warranty nor accept any liability for this information.

WIND FREQUENCY ANALYSIS (in km/h)
COFFS HARBOUR MO STATION NUMBER 059040

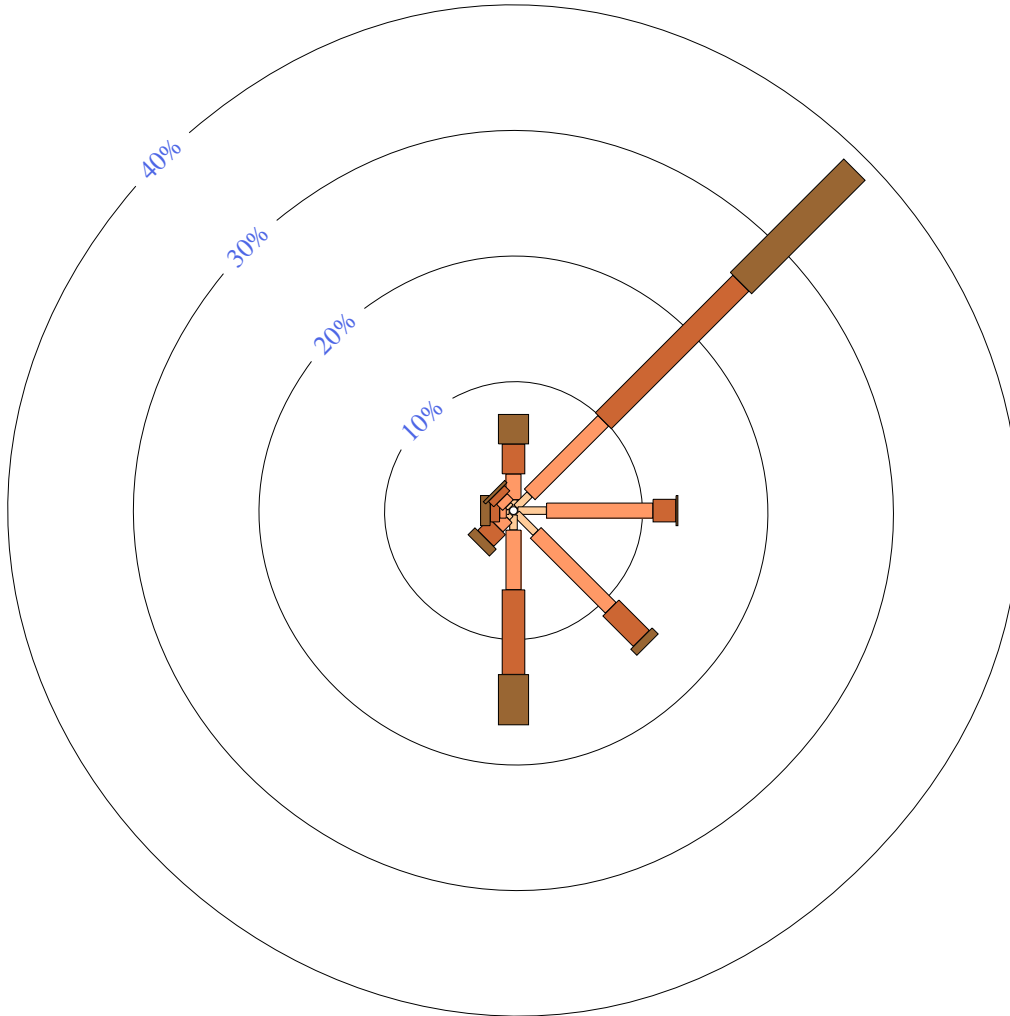
Latitude: -30.31 ° Longitude: 153.12 °



Scale factor = 30.0%

3 pm Spring
 5053 Total Observations (1943 to 2004)

Calm 2%



Wind directions are divided into eight compass directions. Calm has no direction.

An asterisk (*) indicates that calm is less than 1% .

An observed wind speed which falls precisely on the boundary between two divisions (eg 10km/h) will be included in the lower range (eg 1-10 km/h). Only quality controlled data have been used.



Australian Government
Bureau of Meteorology

Copyright © Commonwealth of Australia 2004
 Prepared by the National Climate Centre of the Bureau of Meteorology.
 Contact us by phone on (03) 9669 4082, by fax on (03) 9669 4515, or by
 email at webclim@bom.gov.au . We have taken all due care but cannot
 provide any warranty nor accept any liability for this information.