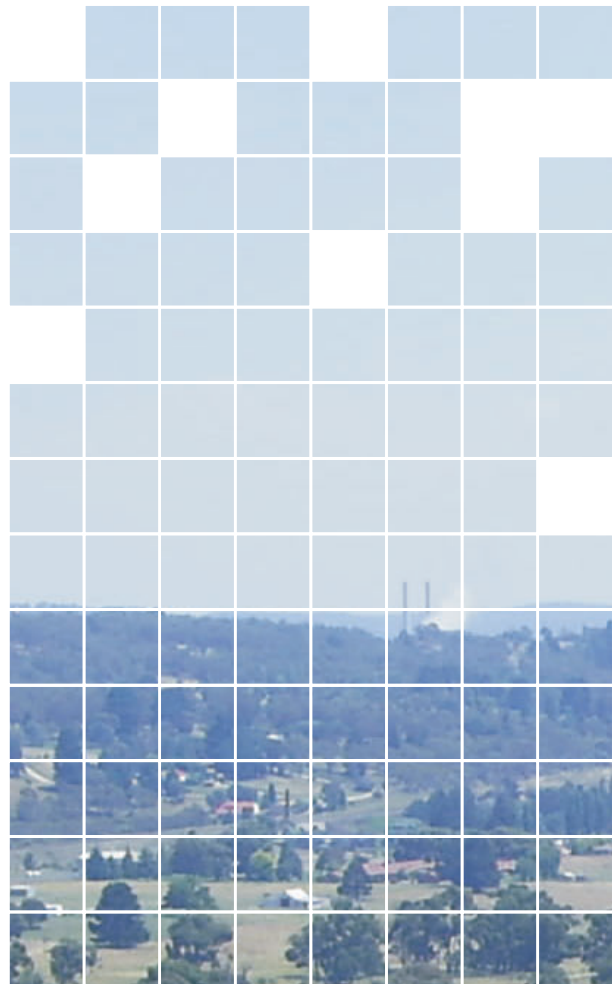




Marrangaroo Local Environmental Study

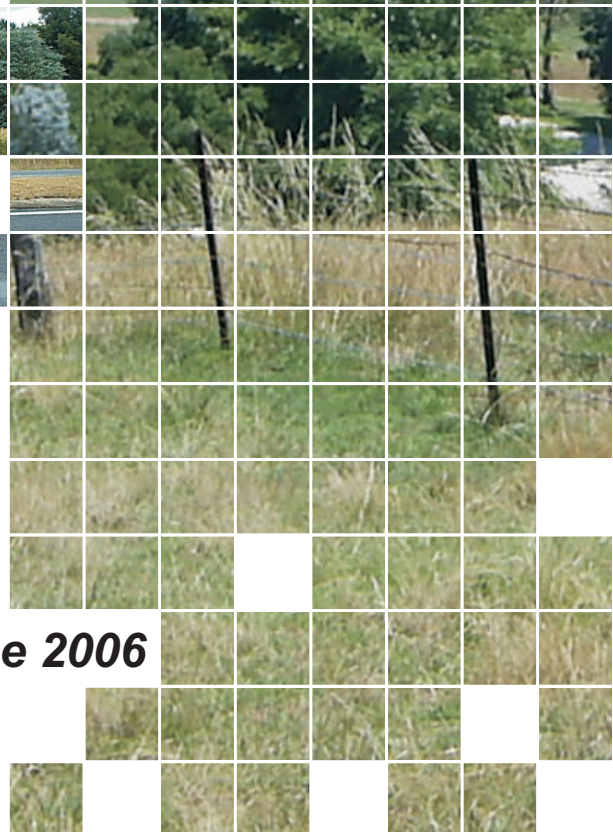
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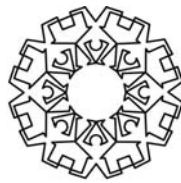


June 2006

MARRANGAROO LOCAL ENVIRONMENTAL STUDY

PREPARED FOR:
LITHGOW CITY COUNCIL

JUNE 2006

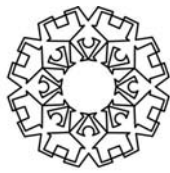


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Report Title:	<i>Marrangaroo Local Environmental Study</i>
Project:	Marrangaroo Local Environmental Study
Client:	<i>Lithgow City Council</i>
Report No.:	205177_LES_FINAL.doc
Draft/Final:	Final

Geolyse Pty Ltd and the authors responsible for the preparation and compilation of this report declare that we do not have, nor expect to have a beneficial interest in the Study Area of this project and will not benefit from any of the recommendations outlined in this report.

The preparation of this report has been in accordance with the project brief provided by the client and has relied upon the information, data and results provided or collected from the sources and under the conditions outlined in the report.

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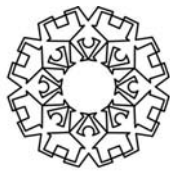
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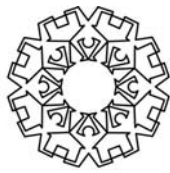
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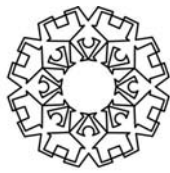
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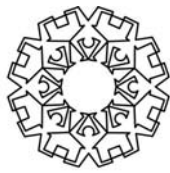
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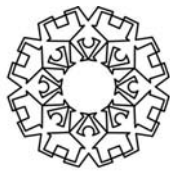
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Introduction

1.1 BACKGROUND

The last formal local environmental study prepared for Lithgow Council was undertaken in 1981 by Kinhill Pty Ltd. This examined the environmental and economic suitability of selected areas for development. Areas known as east and west Marrangaroo (which comprise the Study Area for this report) were examined for the future expansion of Lithgow and found to be suitable for a range of uses.

More recently, Council has responded to a demand for land in Lithgow by releasing two residential zoned areas at South Bowenfels which are slowly being taken up. However, this release has reduced the reserves of land available for future urban development.

In addition, developer driver demand influencing development of land within Marrangaroo was identified by Council as an area of concern given the flexible nature of the Lithgow City Local Environmental Plan 1994.

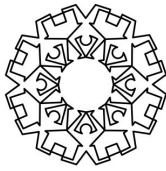
To ensure the proper management of land in close proximity to Lithgow and minimise land use conflict, Council initiated this Local Environmental Study to provide a plan for the sustainable and planned release of land at Marrangaroo.

1.2 STUDY PURPOSE

The purpose of the study is to provide a local environmental study and structure plan that will identify the 'highest and best use' of the land in terms of its suitability and capability, the community's needs and expectations, environmental impact and the efficient and economic allocation of resources to service the land.

The Brief for the project, which also includes the development of a Land Use/Structure Plan, set the following objectives:-

- To research and document the areas environmental characteristics and constraints;
- To research and document the social, political and economic characteristics that relate to the future use of the land;
- To provide an analysis of current and forecasted demand and supply of urban land in Lithgow and determine the role of the Marrangaroo locality in meeting such;
- To identify strengths, weaknesses, opportunities and threats to the future development of the area, based on a SWOT analysis;
- To engage the community and government agencies in an effective consultation program;



- Assess submissions from Government Agencies, affected land owners and the wider community to identify stakeholder issues and concerns;
- Identify alternative land use scenarios for the area and recommend a preferred 'highest and best' land use scenario;
- To develop a Land Use/Structure Plan to provide orderly planning and guide future sustainable development of the area;
- To develop general development principles for the area;
- To identify the relationship of the plan with Council's wider strategies for future growth;
- To manage the project in a timely and efficient manner.

This document deals with those objectives relevant to the Local Environmental Study.

1.3 STUDY AREA AND CONTEXT

The Study Area is known as Marrangaroo and is located 5 minutes north of Lithgow, as shown in **Figure 1**. It comprises approximately 1100ha of land split into two parts by the Great Western Highway and the Main Western Rail Line.

The eastern portion of the Study Area is predominantly zoned 2(a) Residential with the Quarry and land west of the Go Kart track being 1(a) Rural (General) under Lithgow LEP 1994. On the larger western side the land is all zoned 1(a) Rural (General), including the sliver of land between the Highway and Railway. See **Figure 2**.

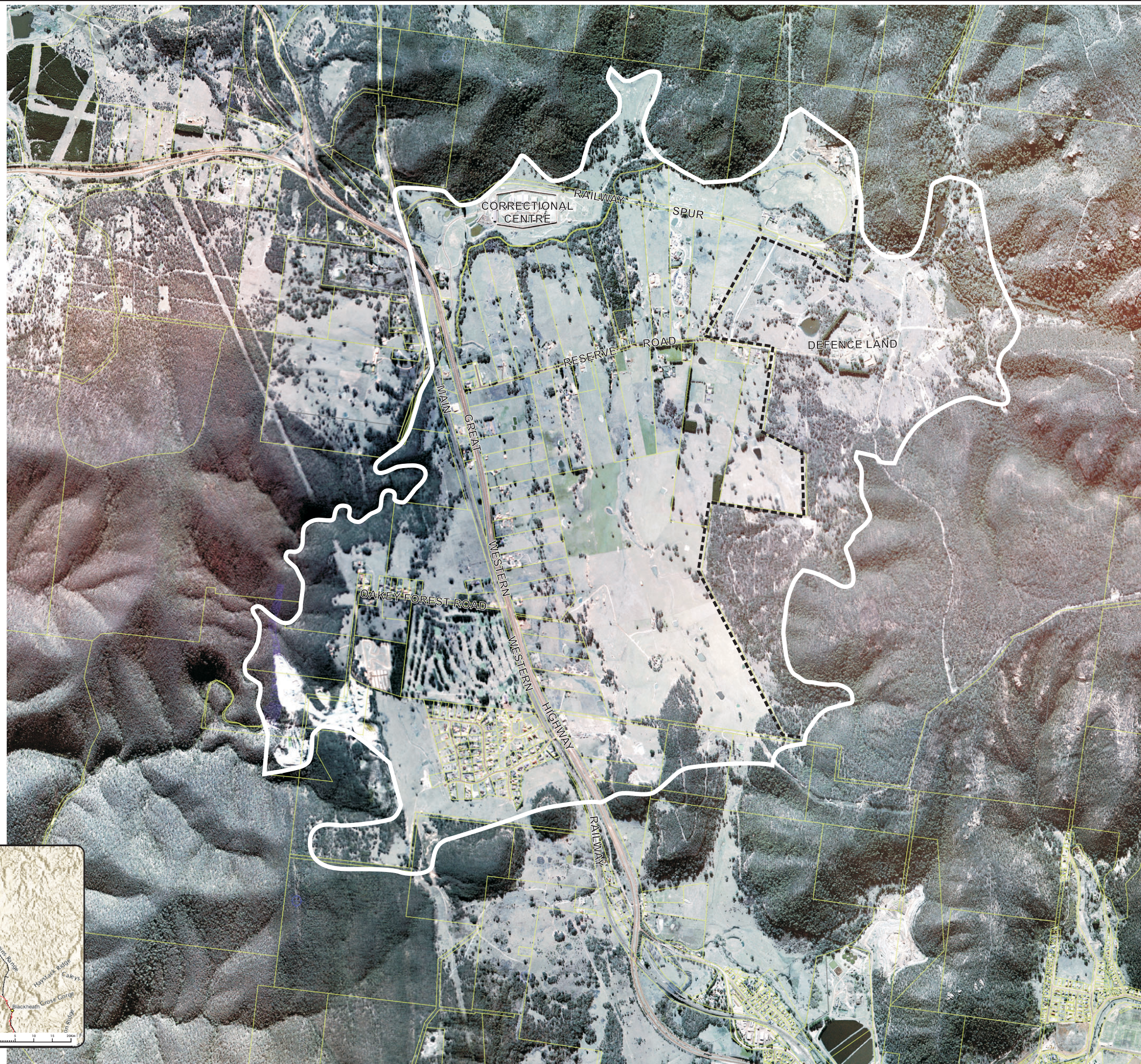
The area is characterised by its surrounding steeply vegetated slopes which enclose the area and contribute to its rural outlook.

1.4 METHODOLOGY AND SCOPE OF THIS REPORT

This Local Environmental Study investigates a range of factors necessary to inform a Land Use/Structure Plan and a possible amending Local Environmental Plan. It incorporates the principles of Ecologically Sustainable Development.

The investigation includes an analysis of existing and likely future environmental, social, political and economic issues affecting the subject land and surrounding locality. An analysis of the strengths, weaknesses, opportunities and threats relating to the future development of the site was undertaken. Alternative land use scenarios have been developed for the site and a preferred 'highest and best' land use scenario recommended.

It has been undertaken at the same time a Strategic Plan was initiated and funded under the Planning Reform Fund by the Department of Planning. Both projects are running concurrently, with this LES and subsequent Structure Plan being finalised in September ahead of the Strategy in December 2006. Both projects have firm deadlines. It is anticipated that the research, analysis and papers being

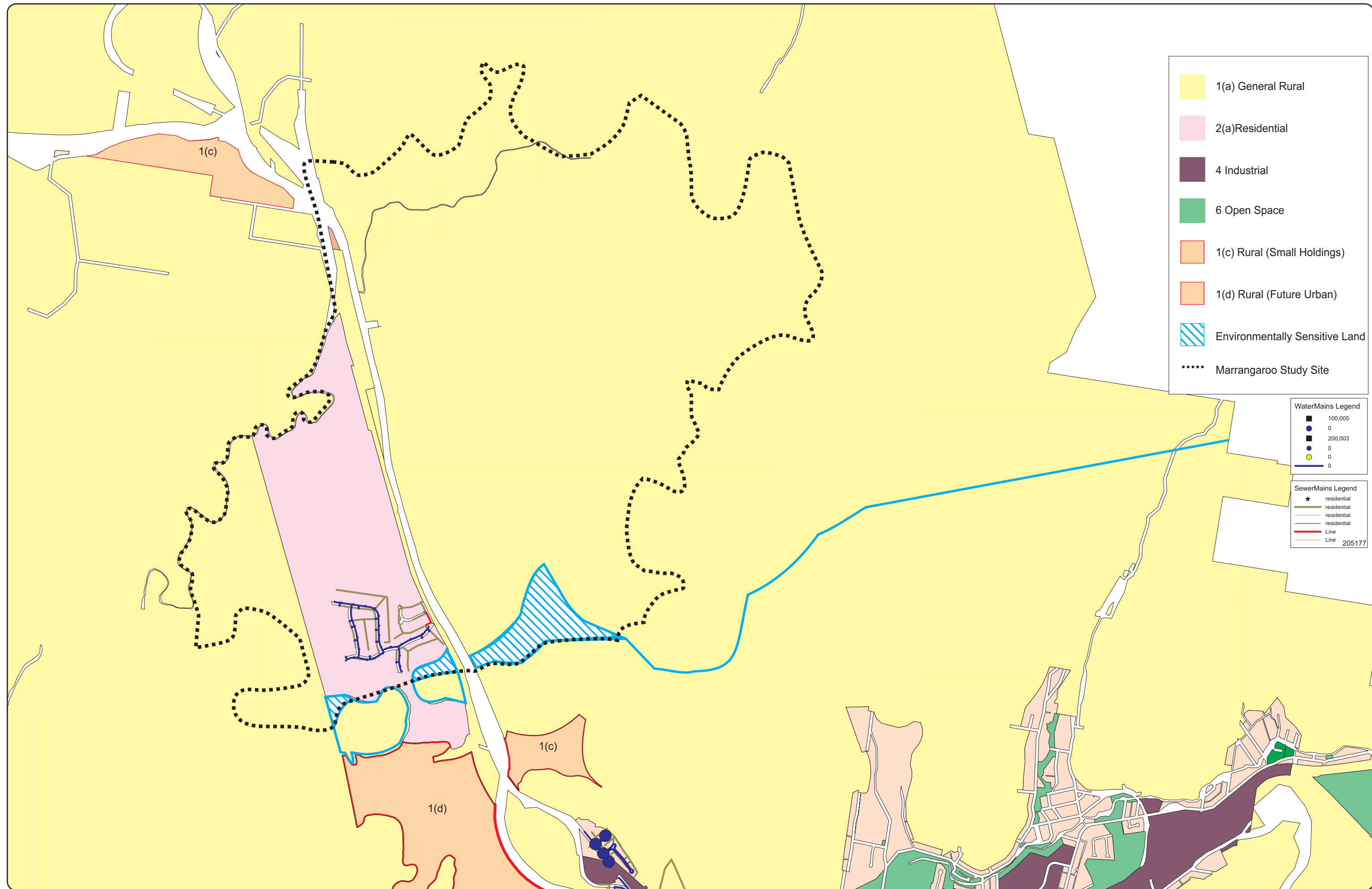


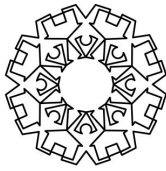
DEFENCE LAND

SITE

SITE BOUNDARY

205177





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prepared for the Local Profile of the Strategic Plan will be made available to refine this draft document prior to its scheduled exhibition in June 2006.

1.5 STUDY TEAM

The study team comprises:

- Geolyse Pty Ltd – Lead consultants undertaking the key requirements of the project for the environmental, social, economic and political analysis and engaging with the community.
- Twyford Consulting – Design of Community Engagement Program.
- Envirowest Consulting – Soil contamination, soil mapping to Greater Soils Group, salinity mapping.
- Paul Bridge Indigo Acoustics - Noise assessment.

1.6 ACKNOWLEDGEMENTS

Geolyse Pty Ltd would like to acknowledge the contribution and assistance given to the study in particular from:

- The Marrangaroo Community Group members, Lithgow City Council officers, The Mayor, Deputy Mayor and General Manager; and
- Government agencies and service providers who travelled long distances on separate occasions to attend a meeting, inspect the Study Area and participate in a workshop.



Local and Regional Context

2.1 SOCIAL AND DEMOGRAPHIC PROFILE

2.1.1 INTRODUCTION

Section 2.1 of this report provides an overview of the social and demographic profile of the Lithgow Local Government Area (LGA). It is based on information gained from a variety of sources including the Australia Bureau of Statistics (ABS), Department of Planning (DoP), and Lithgow City Council.

2.1.2 POPULATION

Current Population

From the previous three (3) census periods, it can be seen that the LGA is experiencing a slight decline in population.

Table 2.1 - Population for Greater Lithgow SLA

Year	Population	Change
1991	20,253	-
1996	19,248	- 5%
2001	19,197	- 0.3%

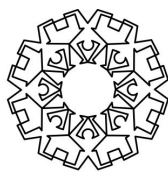
Source: ABS 2003

This trend is also reflected in the three (3) urban centres: Lithgow, Wallerawang and Portland. All three centres have experienced a decline in population between 1996 and 2001, as illustrated in **Table 2.2**.

Table 2.2 - Urban Centre Population Change

Urban Centre	1996	2001	Change
Lithgow	11441	11033	-3.6%
Wallerawang	2045	1935	-5.4%
Portland	1888	1817	-3.8%

Source: Lithgow Council 2005 & ABS 1996



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However, the Council through its rates notices and the number and type of development applications lodged has noticed a growth in the LGA warranting further investigation.

The Australia Bureau of Statistics provides details of Estimated Resident Population (ERP) as well as population projections for longer periods. ERP figures show the influence of migration in and out of the LGA

The estimated resident population for Lithgow SLA between 2000 and 2004 (**Table 2.3**) shows a 0.3 percent increase or 305 additional people at 30 June 2005.

Table 2.3 - Estimated Resident Population for Lithgow SLA

Year	Population	Change
2000	20,384	-
2004	20,835	2.2%
2005	20,889	0.3%

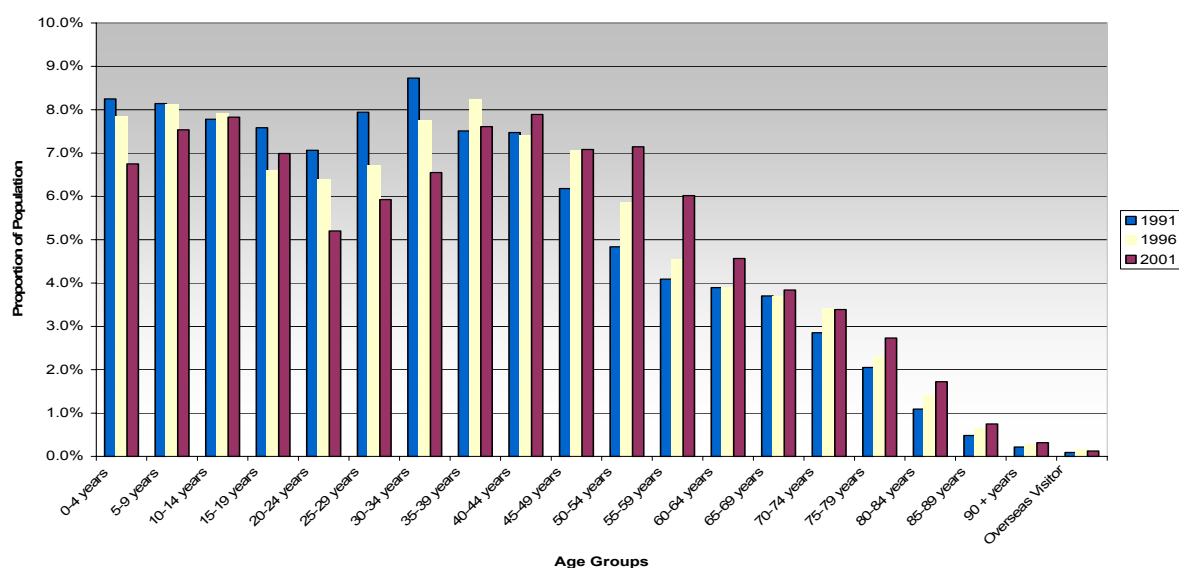
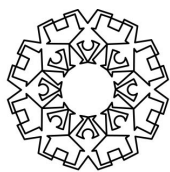
Source: ABS 2006

The increase in population between 2000 and 2004 is generally attributable to the change in SLA boundaries when Lithgow was amalgamated with parts of Evans and Rylstone Shire.

ABS (2006) states however that the annual average growth rate for Lithgow between 2000 and 2005 is 0.5% supporting Council's belief that some growth is occurring. The next ABS census is due later this year, with the results available in 2007. Once available these should provide a more accurate assessment of the dynamics of the population.

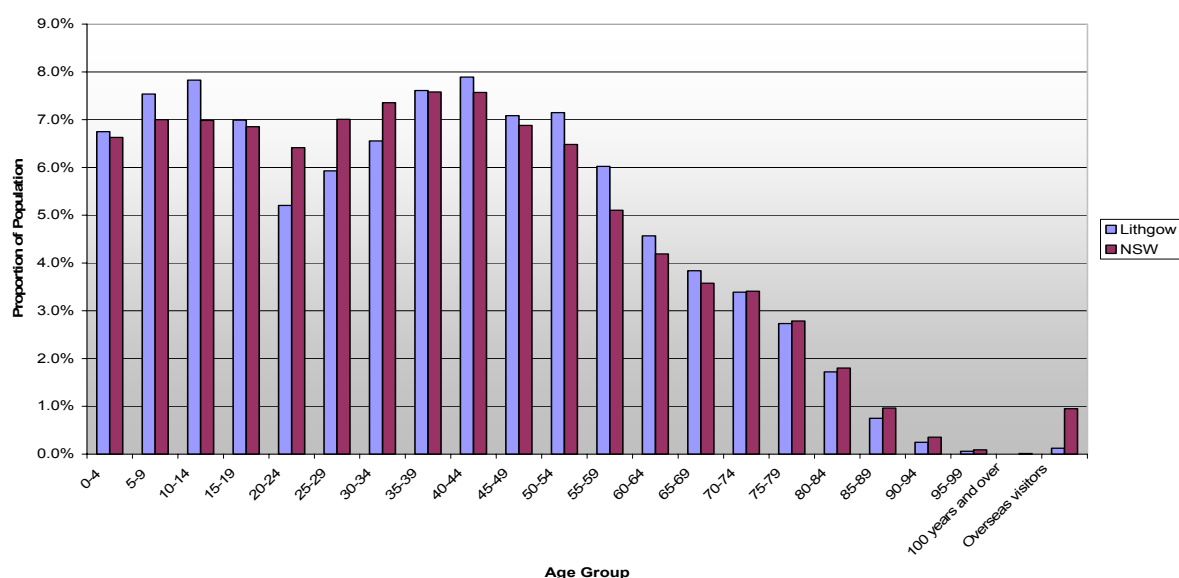
Age and Structure

Lithgow's population is more pronounced in the younger and middle age groups. The proportion of the population under 40 years of age, in particular the 25-29 and 30-34 age groups, has declined between 1991 and 2001 while the proportion over 40 has steadily grown in the same period reflecting an aging population. **Graph 1** shows the age distribution for Lithgow.

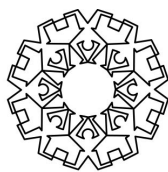


Graph 1: Age Distribution of Population

Lithgow's significant population characteristics are also evident when compared with the NSW State figures. Lithgow's 0-4, 5-9 and 10-14 age groups, as well as middle aged populations (44 to 69 age groups) are proportionally higher than NSW. There is a noticeable difference between Lithgow and the State averages for young adults between the ages of 20 to 34 years. **Graph 2** reveals Lithgow has significantly less people in this age range.



Graph 2: Age Structure Comparison



The Lithgow LGA has a larger proportion of its population in the younger age groups (0-4 to 10-14) and middle age groups (45-49 to 55-59) than the state as a whole. The trend for lower populations in the 20-34 age group is also pronounced when compared with the NSW populations.

Population Projections

The Transport and Population Centre within the Department of Planning also provides population projections. **Table 2.4** below shows that there is anticipated to be minimal change in the population through to 2031. The projections are based on 'an assessment of recent demographic trends and current settlement patterns, which reflect changes in social policy, social behaviour or economics' (DIPNR, 2004 p.1).

Table 2.4 - DIPNR Projected Population for Lithgow SLA

Year	Population	Change
2001	20,310	
2006	20,310	0%
2011	20,210	-0.5%
2016	20,180	-0.1%
2021	20,210	0.1%
2026	20,230	0.1%
2031	20,200	-0.2%

Source: DIPNR 2004

From **Table 2.4** it can be seen that overall the projected population for Lithgow is expected to decline. However the zero percentage change, between 2001 and 2006, may be incorrect given the 0.5% growth noted by ABS over the same period.

Lithgow is influenced by its proximity to Sydney which is within an easy 2 hour drive. As prices for land escalate in Sydney home buyers move into affordable areas and this may well explain the development activity in the region.

Other events, such as the construction of the Bells Line of Road, new industrial development or tourism opportunities will increase economic development in Lithgow and noticeably alter these projections. For example, Emirates Hotels (Australia) are planning a luxury eco-tourism resort in the Wolgan Valley 35 kilometres north of Lithgow. This will have direct and flow on impacts for jobs in the region (110 full time equivalent positions expected in the first year) as well as raising the profile of the area. Other proposals such as commercial development in the Pottery Estate area and the re-development of the former Gasworks Site in Mort Street, Lithgow also require consideration. Although difficult to accurately quantify at this stage, such proposals are likely to influence economic development and population. Any future actions as a result of this Local Environmental Study also



require consideration. For example, the possible future uses that may occur at Marrangaroo could have the effect of stimulating additional employment, influencing population growth and providing an increased demand for housing. Consequently, historical data and resultant projections will not provide the entire picture as population growth may also be influenced by other factors.

2.1.3 HOUSEHOLDS

Population and household size are important indicators that reflect the demand for housing and land.

Since 1991, there has been a decline in the average household size, consistent with trends across NSW. However where population change is small as is the case in Lithgow, demand for housing could be generated by falling household size and/or a demand for different housing types.

Table 2.5 - Average Household Size

Year	No. of Persons
1991	2.8
1996	2.6
2001	2.5

Source: ABS 2003

This proposition is supported by the slight increase in the total number of dwellings [includes all dwelling structures] recorded for the LGA with a corresponding increase in the number of unoccupied dwellings in the period between 1991 and 2001. With an increase in land availability in and around Lithgow, people maybe moving out of existing older stock into new larger homes.

The proportion of rented dwellings has declined over the same period.

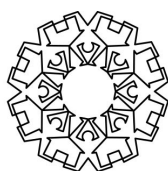
Table 2.6 - Private Dwellings

	1991	1996	2001
Total Private Dwellings	8,089	8,160	8,536
Number of Unoccupied Private Dwellings	1,020 (12.6%)	1,119 (13.7%)	1,210 (14.2%)
Number of Rented Occupied Private Dwellings	1,701 (24.1%)	1,613 (22.9%)	1,631 (22.3%)

Source: ABS 2003

2.1.4 EMPLOYMENT

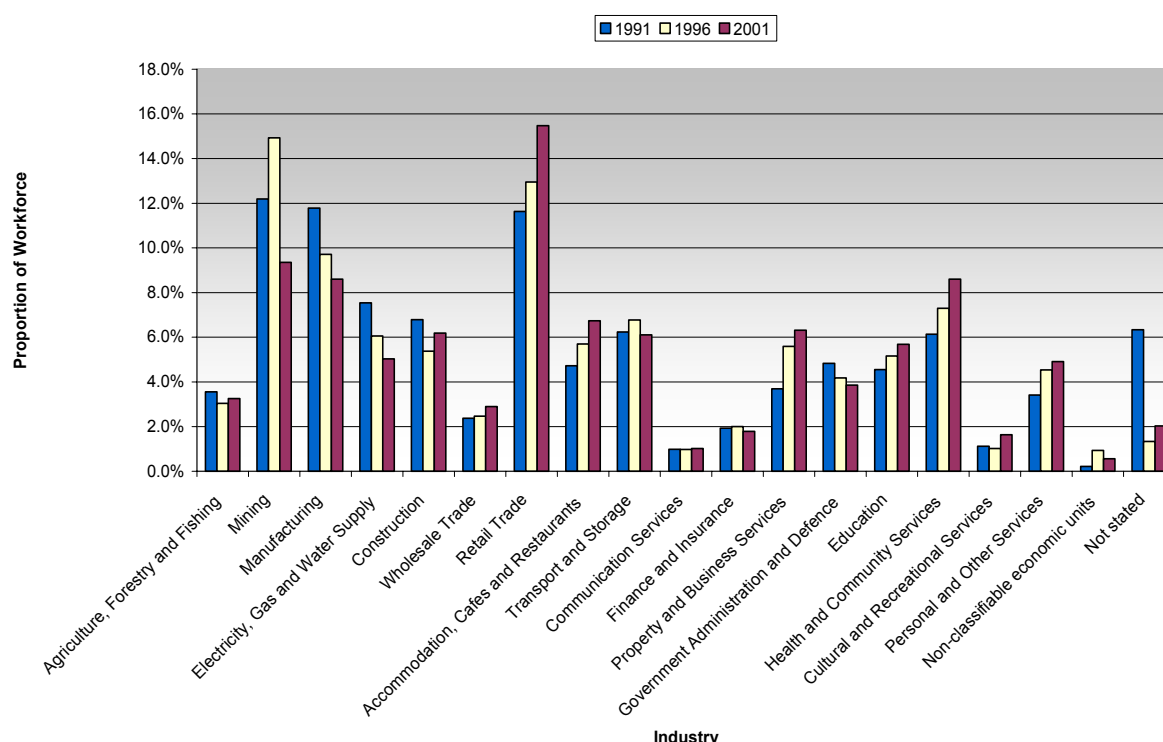
Lithgow has experienced a significant decline in mining, manufacturing, and utilities supply industries, while the service industries have increased between 1991 and 2001.



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The largest growth was in the 'Retail Trade' sector, which saw an increase of 2.5% of the population working in this industry. This was followed by the 'Health and Community Services' sector, with an increase of 1.3%.

The industry sector experiencing the largest decline in the proportion of the population was 'Mining', with a decrease of 5.5%. This was followed by both 'Manufacturing' and 'Electricity, Gas and Water Supply', each with a decline of 1.1%.

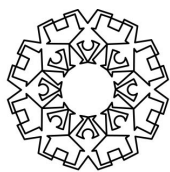


Graph 3: Change in Proportion of Workforce per Industry Sector 1991 – 2001
Source: ABS 2003

Mining and manufacturing industries provided almost one-third of workforce employment in 1991, dropping to less than one-quarter by 2001. The declines in mining, manufacturing and utilities supply industries are occurring at the same time as the young to middle age adult populations decrease. Decreasing employment prospects for the 20 – 34 years groups may be resulting in a migration out of the LGA.

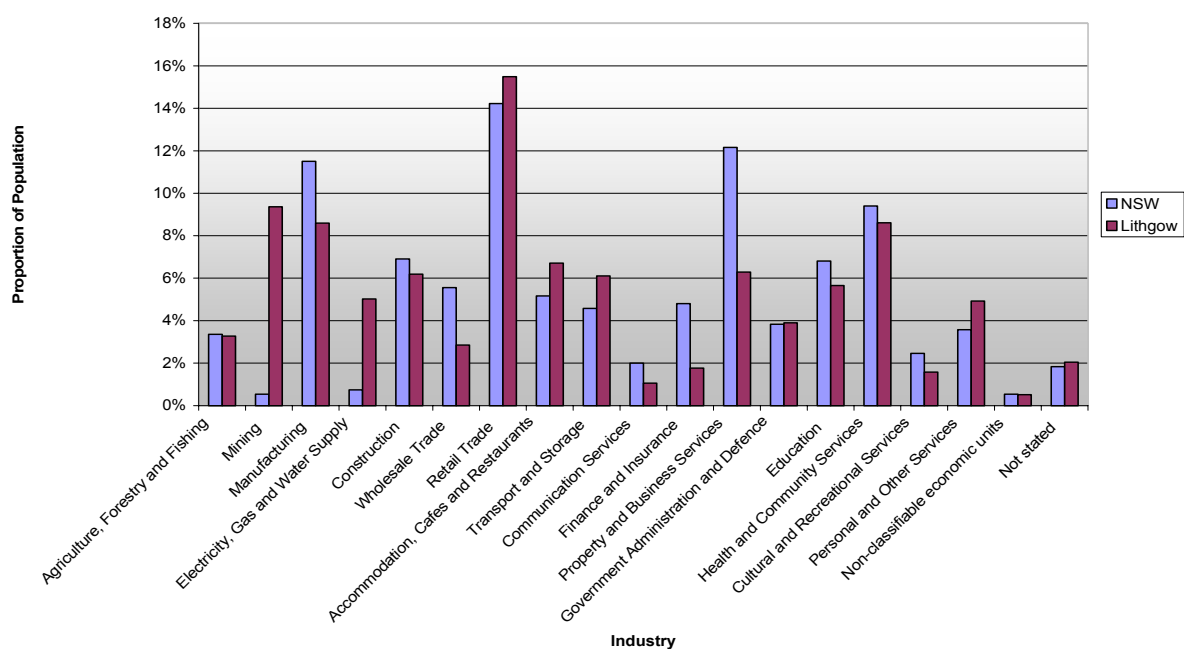
The industries experiencing most growth spread their employment across the age groups and gender, providing employment prospects to a greater range of people. The increase in service industries may also be a reflection of the higher proportions of middle to older aged populations.

Compared to NSW, the Lithgow LGA has a substantially larger proportion (8% more) of its workforce employed in the 'Mining' Sector, as well as a greater proportion employed in the 'Retail Trade', 'Accommodation, Cafes and Restaurants', 'Transport and Storage' and 'Personal and Other Services'. In comparison, the LGA has a much lower proportion of the workforce employed in the



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'Manufacturing', 'Property and Business Services', and 'Government Administration and Defence' sectors than NSW.

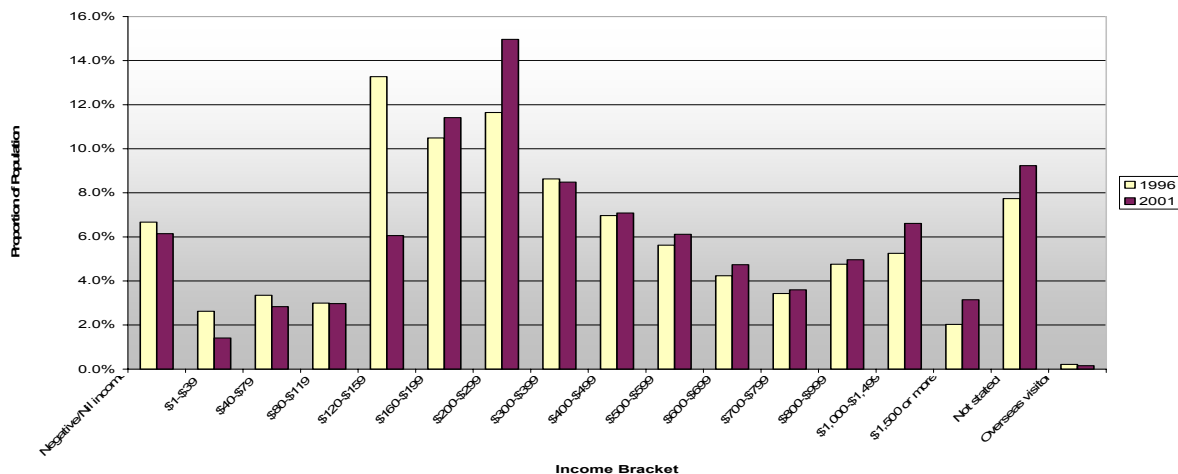
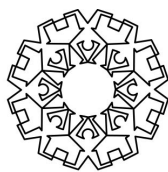


Graph 4: Workforce per Industry Sector LGA -v- NSW
Source: ABS 2003

2.1.5 INCOME

There has been a general trend to increasing weekly individual incomes. The weekly incomes in the Lithgow LGA are still relatively low compared to NSW, with a median weekly individual income of \$200-\$299 in 2001 compared to \$300-\$399 median weekly individual income for NSW.

The major income category has shifted over ten years 1996 – 2001, so that by 2001 there are more people in the \$200-\$299 category, whereas in 1996 the higher proportions were in the \$20 - \$199 category. There have been slight increases for income categories above \$80,000. **Graph 5** below portrays the weekly income group for the Lithgow Local Government Area (LGA).



Graph 5: Lithgow LGA Weekly Individual Income Group
Source: ABS 2003

2.2 SETTLEMENT PATTERN

The Lithgow Local Government Area (LGA) covers an area of approximately 4,567km², extending from Capertee and Wolgan Valley in the north, Little Hartley in the east, Hampton-Tarana in the south and Meadow Flat in the west.

It is located at the foothills of the Blue Mountains and before the plains of the Central West. **Map 1** shows its location relative to surrounding local government areas.

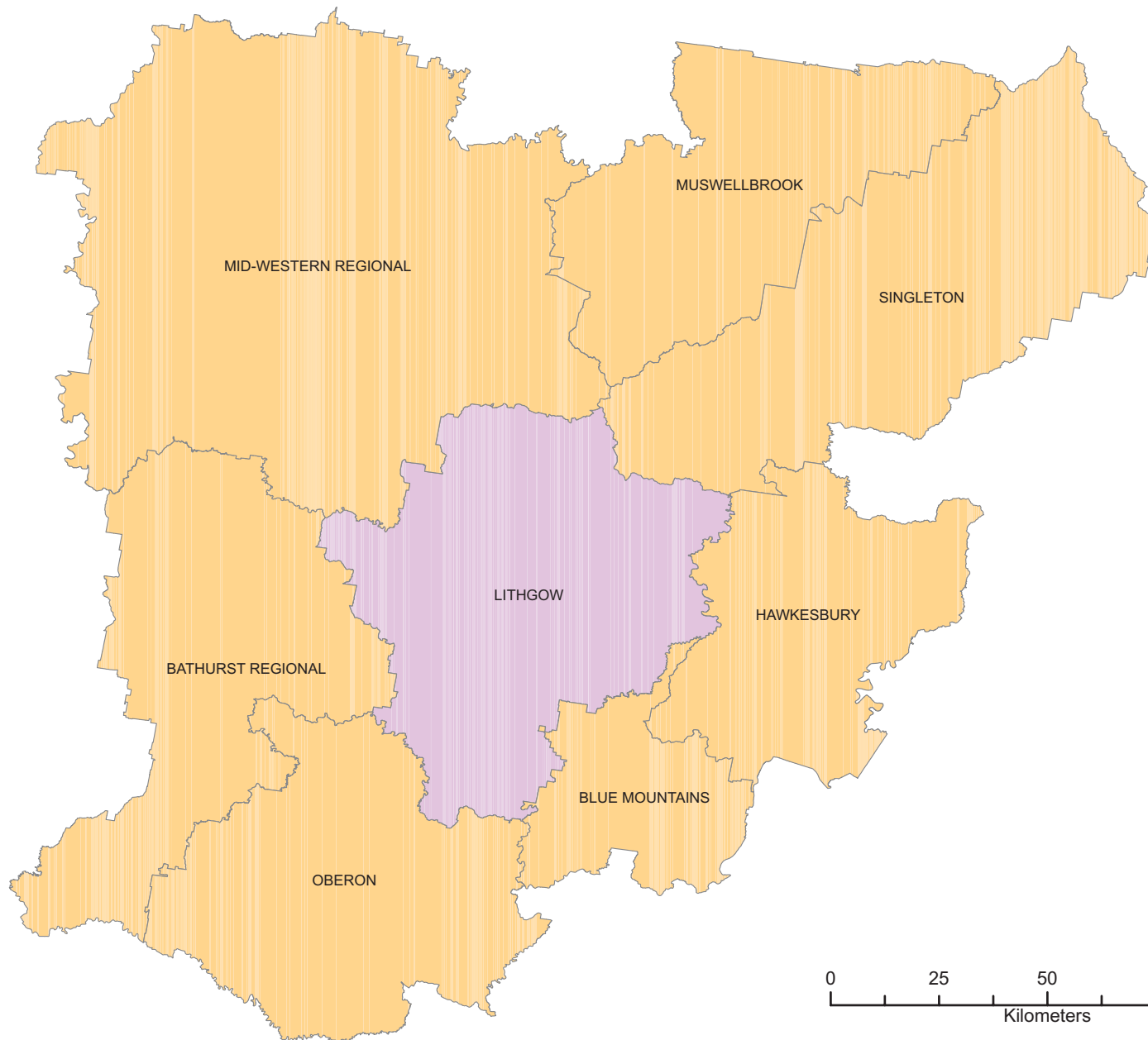
The majority of the LGA population (75%) is located in the town of Lithgow (11,033). The LGA supports two (2) other urban centres (clusters of more than one thousand people): Portland and Wallerawang, with populations of 1,817 and 1,935 respectively. Both urban centres are located north west of Lithgow, with Wallerawang being 13 km away and Portland 24 km.

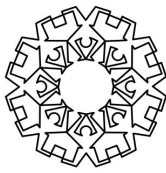
Cullen Bullen is a rural locality (having 200 – 999 people) within the LGA supporting a population of 207. A number of smaller rural populations also exist, these are: Ben Bullen, Capertee, Glen Alice, Glen Davis, Hartley, Sodwalls, Rydal, Hampton, Tarana, and Marrangaroo.

The Local Environmental Plan's 1(c) Rural (Small Holdings) zone has encouraged the migration of a population into the semi rural residential lifestyle. Although the 1(c) areas do not have services provided, such as corner stores, they do form a population grouping. This is especially the case in the Hartley area.

2.3 ECONOMY

The traditional basis of the Lithgow economy has been mining and power generation. This reliance will continue in the foreseeable future. However, both sectors have been impacted significantly by the removal of trade barriers, the privatisation of state utilities and efficiency goals of competition policy.





This is reflected in the sharp decline in the proportion of the workforce in mining and manufacturing from 1991 to 2001 (**Graph 3**).

The mines and Delta Electricity employed 788 and 302 respectively in 2005 (LCC). Lithgow lies across major road and rail corridors linking the west of NSW to Sydney. Pacific National employed 42 people in 2005 (LCC). The increased interest in developing a greater transport capacity of the Bells Line of Road gives some impetus to the long term economic prospects for Lithgow.

Lithgow maintains a small light manufacturing and engineering sector. ADI employed 110 people in 2005 and a number of new and expanding enterprises, including Howards Pyrotechnics have established. This highlights the potential for growth in this sector and the need for suitably zoned and serviced land. Ferrero Australia has established a confectionary plant at Lithgow (based on climatic conditions) employing 85 full-time staff with a floating population of 45 casuals in 2005 (LCC).

Government enterprises are an important economic base where the Lithgow Correctional Centre employed 167, Police Assistance Line 84 and State Debt Recovery Office 180 in 2005 (LCC).

Traditional agriculture has been an important industry in the past, but the emphasis on wool and beef should be reassessed to also consider smaller scale enterprises such as olives, fish farming and an emerging wine-growing industry. Softwood forestry is an ongoing industry. This possible succession into 'boutique' farming could parallel the increased demand for rural residential lifestyles in the Lithgow LGA and could be an important source of population growth (Baker 2006).

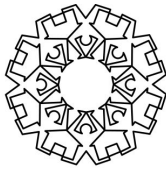
Significantly, Ivey ATP (2006) report that 93.47% of lots in the Rural 1(a) zone are less than 100 hectares and that 45.8% are less than 10 hectares. While individual holdings will comprise a number of lots these figures reflect the fragmentation of agricultural land in the local government area.

The retailing sector has experienced the largest proportional workforce growth between 1991 and 2001 and currently it is estimated that \$150 million is spent per year by residents in the trade area (Baker 2006). There is still substantial escape expenditure in non-food retailing. There is evidence encouraging the planning of a retail park to centralise bulky goods retailing, further boosting employment in this sector.

2.4 URBAN LAND SUPPLY & DEMAND

Supply and demand for urban land are affected by a variety of factors including economic, social, and governmental and physical at national, state, regional and local levels.

At national and state levels, economic and governmental factors have greatest influence. Regional and local levels factors on the demand and supply of land tend to be population growth, local trends in urban development and the amount of land currently and potentially available.



2.4.1 FACTORS INFLUENCING DEMAND

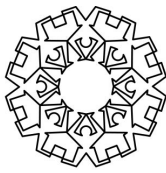
Broad External Factors

Economic Factors

- The Lithgow LGA has a substantial focus on mining and coal industries, and influences extend to commodity prices, value and stability of the Australian Dollar, interest rates and inflation, competition and technological impacts in both the primary and secondary industries, performance of exporting industries, and demand for product and produce (i.e. shifts away from coal based energy production or shifts in capital and investment to other coal areas).
- On a regional scale, land costs and surrounding land uses will influence the demand for urban land in the LGA. Lithgow's proximity to the Sydney metropolitan area and comparatively lower land prices can act as an attractant, encouraging people and businesses to relocate to the area.
- At a local level, there are a number of economic factors that influence demand for urban land. In Lithgow, traditionally, a large proportion of the population has been employed in the mining sector, the success of which is subject to variations in the wider market. ABS data indicates the concentration of employment is shifting away from mining with an increase in retail trade and community services employment.
- The composition of the population in terms of workforce/labour availability affects local demand. In Lithgow there is a concentrated population in the late teen age groups and mid to late forties age groups. This means that the traditional workforce age groups (of 20s and 30s) is not predominant in the LGA.
- Educational opportunity is another local influential economic factor. The lack of local tertiary education facilities sees those wishing to further their education having to leave the local area for this opportunity. This could be a factor in the lower proportion of 16-20 year olds and 20-25 year olds in the Lithgow LGA.
- Economic incentives to encourage businesses to relocate to an area or to stay in an area, along with the capacity of existing infrastructure and costs to extend this also influence the demand for urban land.

Governmental Factors

- Lithgow has had a reliance on the coal industry and other rural industries, and national and state government decisions will impact on the demand for urban land. Decisions affecting these industries would include subsidies, trade agreements, and other national and state taxation and duty decisions. Further, changes in legislation and policy such as the introduction of the Goods and Services Tax, Vendor's Tax, and first home owners grant all influence the demand for urban land.



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- Planning is established and regulated by State Government legislation. Therefore, changes in state government legislation and planning policy will impact on urban land demand. Recent changes to the *Environmental Planning and Assessment Act 1979*, in terms of major projects and critical infrastructure, are expected to facilitate a speedier approvals process for such projects. This is likely to have flow on effects for the demand of urban land.
- In addition, government decisions on spending for infrastructure are a catalyst for urban land demand. If the proposed Bells Line of Road upgrade were approved, it is likely that this would initiate demand for urban land in the Lithgow area as a result of its improved proximity to the Sydney market.
- At a local level, government plays a critical role in facilitating demand and controlling uses for urban land. As the facilitators of the planning system, local government councils control the amount of land zoned for urban purposes, and the approvals process for developments. The attitude of council to growth is a big factor in development of urban land. Councils that do not facilitate efficient approvals processes and do not encourage development will tend to see a lower demand for urban land.
- Other governmental factors at a local level include the costs of land rates and other development levies.

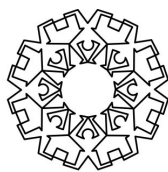
Social/Demographic Factors

- Social and demographic factors influencing urban land supply and demand are more focussed on the local and regional level than a national level compared with the other economic and governmental factors. Whilst there are some common themes between these levels, such as aging populations and declining household sizes, many of the other social/demographic factors are set as a response to the local environment.
- The demographic character of the Lithgow LGA is described in **Section 2.1** of this report. The primary social and demographic factors influencing the urban land include disposable income levels, unemployment levels, dependency on welfare and age distribution of the population.
- Other social factors influencing urban land supply and demand include lifestyle choices. In the Lithgow area these may include such things as preference for a rural residential lifestyle, and decentralisation of city dwellers due to Lithgow's proximity to the greater metropolitan area.

Physical Factors

Physical factors also influence the demand and supply of urban land. These factors include:

- Proximity to larger centres and the level of rail, road and air services to and from these centres.
- Geographical constraints such as topography (slope, soils, drainage), the escarpment of the Blue Mountains, the presence of mine subsidence areas; and being part of the Sydney Drinking Water Catchment may all impose constraints for some types of urban development which may act as a disincentive for locating in the area.



Demographic Factors

Population Growth

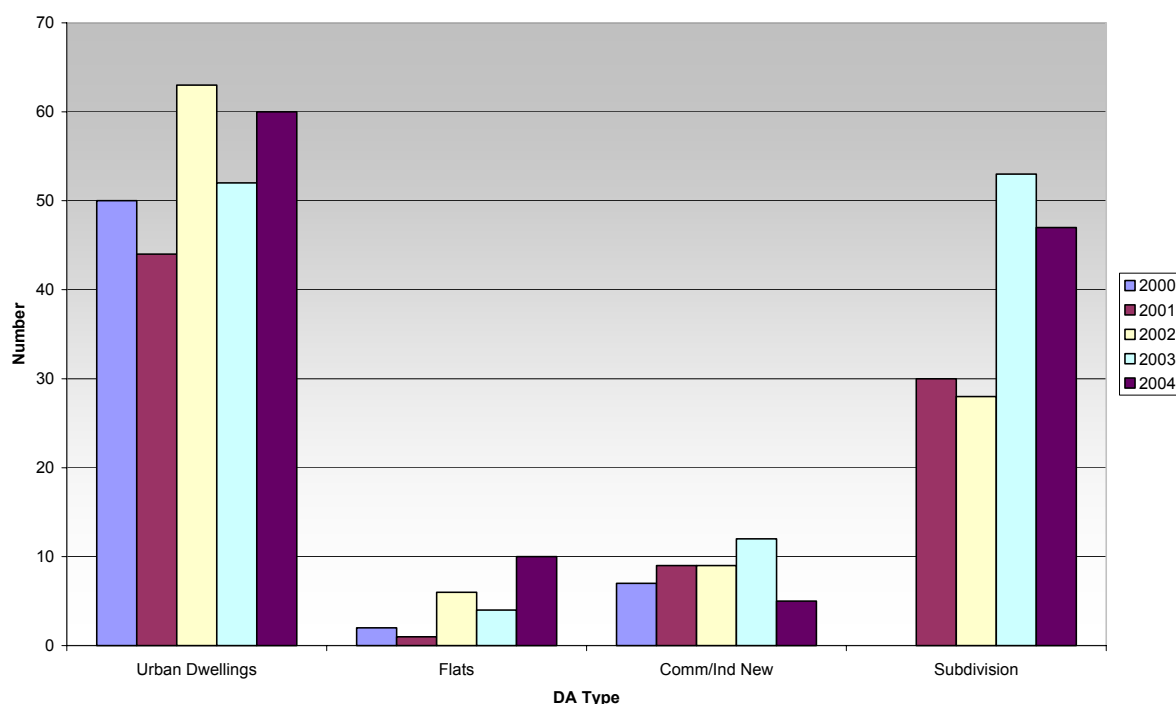
Previous and anticipated population growth will influence the demand for urban land. Population growth rates for Lithgow LGA, as outlined in **Section 2.1.2** of this report, illustrate that between 1991 and 2001 there has been a slight decline in the overall population. However, there has been some growth between 2001 and 2006. Population projections however indicate a fairly static population level. Given this, any increase in demand for urban land is unlikely to be attributed to dramatic population increases without accompanying economic growth and development in the region.

Household Occupancy Rates

Whilst there has been a slight decline in household occupancy rates (**Table 2.6**), there has also been a significant increase in total dwellings between 1996 and 2001. The importance of the declines in occupancy rates and the increases in proportions of unoccupied dwellings are lessened in light of the increase in the numbers of total dwellings.

Local Development Trends

The following graph illustrates the Development Applications (DAs) lodged with Lithgow City Council for various forms of urban development in the period 2000 to 2004.



Graph 6: Development Applications 2000-2004

There has been a slight increase in DAs for dwellings and flats, whilst there has been a much greater increase in DAs for subdivision. DAs for new commercial and industrial developments have remained



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largely static over this period although values of developments have increased. No breakdown has been provided for the purposes of the subdivisions approved (i.e. residential, commercial, industrial).

Table 2.7 - Breakdown of Private Dwellings

Year	Total Private Dwellings	Separate Houses (% of total dwellings)	Semi-detached, row or terrace, townhouse, flats, units, apartments (% of total dwellings)	Not stated and 'other' dwellings
1996	7,034	6,257 (89%)	529 (7.5%)	248 (3.5%)
2001	7,326	6,580 (89.8%)	571 (7.8%)	175 (2.4%)

Source: ABS 1996 & 2001

Note: Private dwellings do not include: a) in 1991, 'Manufactured Home Estates' and 'Accommodation for the Retired or Aged (self care)' and persons living in these dwellings have been excluded. These dwellings were Non-private dwellings in 1991. b) In 2001, Serviced Apartments and persons living in Serviced Apartments have been included. These dwellings were Non-private dwellings in 1991 and 1996.

The housing and local development trends for Lithgow show:

- There is a substantial and slightly growing preference for separated dwelling houses, as opposed to higher density dwelling styles.
- Over the five (5) year period, an annual average increase of 58.4 dwellings. This is a 4.2% growth during this period for 'total private dwellings.'
- From 1996 to 2001, an annual average increase of 64.6 separate dwellings. This average is greater than the total dwelling increase as a result of the substantial decline in 'not stated' and 'other' dwellings.

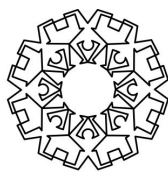
A more detailed analysis of demand is provided below. This reveals that a large portion of the dwellings being constructed in the area are in the rural area (ie. outside the urban centres of Lithgow, Wallerawang, Portland and Marrangaroo).

2.5 RESIDENTIAL SUPPLY AND DEMAND

Population and household size are important factors that reflect the demand for housing and land. Demand can also be expressed in the number of dwelling approved and constructed in an area.

The Australian Bureau of Statistics has recorded an increase of 292 private dwellings between 1996 and 2001 for Lithgow.

Lithgow City Council has a development application register which records all applications received. While it does not record determinations it is understood most applications are approved with few



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refused or withdrawn. **Table 2.8** sets out the number of dwelling applications received for the urban and rural areas of Lithgow between 2001 and 2004.

Table 2.8 - Dwellings Lithgow LGA, 2001-2004

Year	Urban Centre's	Rural	Total
2001	44	51	95
2002	63	63	126
2003	52	59	109
2004	58	40	98
TOTAL	217	211	428
Average number per year	54	53	107

Source: Lithgow City Council DA Register 2001-2004

For the local government area, between 2001 and 2004, 428 applications (combined development applications and construction certificates) were lodged with Council.

This equates to 107 per year. Of this figure approximately 49% were in the rural areas and 51% in the urban centres (recorded as Lithgow, Wallerawang, Portland and Marrangaroo). This does not give us an indication of how many dwellings have been built and issued with an occupation certificate. Council does not have this information readily available in a register.

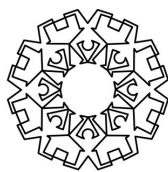
During this same period, 158 subdivision applications were also lodged. The DA register does not provide a breakdown of the number of lots requested under each application making it difficult to calculate the true number of lots created and the amount of land taken up for dwellings.

Council's register does provide a break down of dwelling numbers (DA/CC) for Lithgow and Marrangaroo between 2001 and 2004 shown in **Table 2.9**.

Table 2.9 - Combined DA/CC for Dwellings in Lithgow and Marrangaroo 2001-2004

Year	DA/CC for dwelling
2001	29
2002	37
2003	30
2004	36
TOTAL	132

Source: Lithgow City Council DA Register 2001-2004



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One hundred and thirty two (132) dwelling were approved between 2001 and 2004. More recently 247 lots were subdivided in the South Bowenfels area with subdivision work underway or completed.

2.5.1 LAND SUPPLY

To determine land supply it is proposed to use the following methodology:

- Use relevant existing zones to determine the area (hectares) of land available for development (or potentially available) in Lithgow, Wallerawang and Portland. This involves determining constraints to development and whether some areas of land cannot be readily developed (eg. land in and around the former Portland cement works), drainage corridors, bushland, mine subsidence etc.
- Of the area available for development determine whether a DA for subdivision has been issued.
- Where land has been subdivided determine the number of vacant lots and the number of vacant lots with dwelling and construction approval (DA/CC).

Both Wallerawang and Portland are covered by a Village zone. This zone does not differentiate between residential, commercial or industrial areas. However, both these centres are sufficiently distant to Lithgow that they do not form part of the same housing market. Nevertheless, despite the extent of the village zone in these two centres, the amount of suitable land for residential development is constrained by topography, drainage and past land uses.

To determine the area of land available (supply) for residential development in and around Lithgow and Marrangaroo the following table has been developed with assistance from Lithgow City Council.

Table 2.10 - Residential 2(a) Supply

Location	Area Zoned	Potential Lot Yield	Assumptions/comments
Bridge Street (between Hill and Short Streets (1))	1.7 hectares	20 approved lots as medium to high density	This is the old Hospital site and adjoins the TAFE, High School, Nursing home and Church. Land has been vacant since 2000 and remains substantially undeveloped, although a number of approvals are in place.
Ivatt Street (2)	21 hectares (excludes the creek with 50m buffer either side)	100 lots as low density between 550 sq m and 900 sq m	An ephemeral creek runs through this site which is also located in the Lithgow mine subsidence district. This area of land has been available for development since 1994 and remains substantially undeveloped due to mine subsidence, bushfire and unresolved servicing issues.

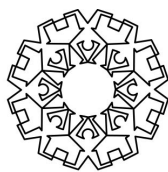


Table 2.10 - Residential 2(a) Supply

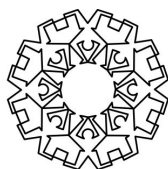
Location	Area Zoned	Potential Lot Yield	Assumptions/comments
Pottery Estate (3)	21.8 hectares	100 lots as medium to high density	Yield will be constrained by environmental factors such as mine subsidence, contamination and Bathurst Copper Butterfly.
Inch Street (4)	6.0 hectares	30 lot potential as medium to high density.	Land has remained undeveloped for many years.
South Bowenfels (5) [Includes land within both existing developed and greenfield areas]	268.1 hectares	900 lot potential. [Includes subdivision approval for 53 lots at the ADI site, 34 at Tweed Rd, 141 at Hillcrest, 61 for Zanchoy, 105 at Strathlone Estate and 45 for Shaw] Concept plans have been received for the balance of the land or are DA's currently under consideration by Council.	Based on average 700 sqm lots size adopted in the South Bowenfels Development Control Plan.
Former RSL Site (6)	1.6 hectares	75 dwellings proposed as part of Seniors Living Development	Suitable for medium to high density development.
Marrangaroo (7)	197.5 hectares	87 potential lots at Marrangaroo Fields Estate	Figure of 87 dwellings is based on the yield as set out in the Marrangaroo Fields Estate DCP. However this will be constrained due to potential buffers to the gas network and quarry.
		217 lots north of the golf course	DA approved for this number of dwellings.

Source: Lithgow City Council and Geolyse Pty Ltd

Council reports that market demand (evidenced through subdivision applications) is toward 900 sq metre lots. There is no minimum lot size in Lithgow LEP 1994. However, Council's subdivision development code (1992) recommends a minimum lot size of 550 square metres for urban lots while the more recent South Bowenfels (2005) seeks an average of 700 square metres.

To determine the area of land currently available (supply) for residential development in Lithgow and Marrangaroo, areas 1, 3 and 6 have been excluded from the calculations as these represent in-fill medium to higher density development, a different market to that likely to be provided by Marrangaroo. Ivatt Street (No. 2) because of its environmental and servicing constraints has also been removed from the calculations.

Nevertheless, there are approximately 900 lots in South Bowenfels, potentially 304 in Marrangaroo and 30 lots in established areas of Lithgow. This equates to a figure of 1,234 potential dwelling sites.



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Using this figure and the number of dwellings approved between 2001 and 2004 an indication of existing supply can be given (see **Table 2.11**) by dividing 1,234 by the number of dwellings approved.

Table 2.11 - Residential Supply and Demand

Dwellings per annum 2001 - 2004	Locations	Supply (years)
54	Urban Areas	23 years
33	Lithgow & Marrangaroo only	37 years

Source: Lithgow City Council DA/CC Register 2000-2004

If we were to discount all land other than that in South Bowenfels being 900 lots, using a take up rate of 33 dwellings per year, indicates 27 years supply of residential land.

This basic analysis however, does not provide for points of difference in the market, which require a range of housing types to provide a range of lifestyle choices in Lithgow. A number of factors influence buying choice/behaviour and these range from the location of the land (do I want to live in this area?), access to services, surrounding development, safety and road network, type of housing, lot size and cost.

Demand for housing is also influenced by the amount of land made available in different locations and how readily it can be serviced. Consumer demand will drop quickly for land in areas where it takes 2 or 3 years to provide adequate sewer and water connections or the location is constrained by traffic or access issues.

In addition, approximately 300 hectares of land is zoned Future Urban 1(d) and is referred to as West Bowenfels. It lies to the north of South Bowenfels and links to land zoned 2(a) in Marrangaroo. This land has environmental constraints and is separated from the services and facilities of Lithgow by the Main Western Line (in part) and the Great Western Highway. However, should areas of the land be suited to release for urban uses it creates the potential for further housing stock in Lithgow.

Strategically however, Marrangaroo represents an opportunity to identify good land in close proximity to services and facilities of the township of Lithgow and to protect it for future uses that support the growth of the area.

Business and Industrial Land

There is limited supply of good industrial land in Lithgow. Many enterprises and investors seek land in industrial estates or 'clusters' which are already serviced, have a high level of environmental amenity for workers and good access to arterial roads. This partially explains why the small number of 'industrial' lots in Marrangaroo has not sold. In addition, the land is zoned Rural 1(a) and offers very little security for investors or businesses wishing to relocate.

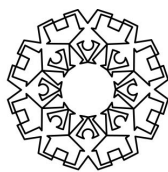


Table 2.12 - Urban Land Supply: Business and Industrial in Lithgow

Location	Zoned Land Available (area or lots) ₁	Status
3 Business (Lithgow)		
Pottery Estate	52,000m ²	Proposal for a centre to include 4 cinema complex, restaurants and large retail stores.
4 Industrial (Lithgow)		
ADI Site	Redevelopment and reuse of existing buildings 1500m ² minimum lot size	Not redeveloped at this stage
Mort Street (old gasworks site)	2 lots	Potentially a couple more with further remediation
O'Connor Street (Rail Infrastructure Corp)	3.114ha over two (2) sites	Unsubdivided

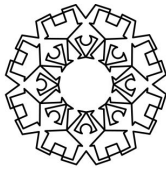
Source: 1 Lithgow City Council

Opportunities to locate light industrial uses are provided in the following zones:

- Zone No. 1(a) - Rural (General)
- Zone No. 1(c) – Rural (Small Holdings)
- Zone No. 1(d) – Rural (Future Urban)
- Zone No. 2(v) – Village (Portland, Wallerawang)
- Zone No. 3 – Business
- Zone No. 4 – Industrial

Bulky goods retailing is also potentially permissible in all zones except the Rural (General) 1(a) zone. While this would appear to provide opportunity for employment generating activities, Newplan (2004) identified that *the scope of the current land use planning provisions generally does not support the efficient delivery of infrastructure in order to create new industrial clusters.*

In effect, there is limited current opportunity to create light industrial or technology or business park development in well serviced, accessible locations in the business, industrial or future urban zones in and around Lithgow and Marrangaroo.



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Marrangaroo presents the best opportunity for this type of development and needs to be recognised and marketed under a suitable zone requiring the removal of the current Rural 1(a) from candidate areas.

Newplan (2004) identified candidate areas for industry/bulky goods clusters across the LGA. Areas of East Marrangaroo were identified as having potential as a new industrial area, further supported by this study.

2.5.2 SUMMARY

Residential

The supply of housing within a community should ideally provide a range of housing choice to match life stage and income levels. Where large areas of land are held in a range of ownerships, as is the case in Lithgow, its subdivision and release onto the market is difficult to foresee without a land release program.

Land zoned for a purpose is not available for that purpose unless it is subdivided and made available for development.

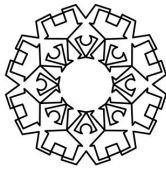
Within Lithgow there is limited supply of land for urban residential development within the established, older areas of Lithgow. Land is being developed to the south of the town, across the Great Western Highway in South Bowenfels, with some additional area zoned but yet to be subdivided while other areas have both subdivision and DA approval issued for dwellings. However, there are 900 potential dwelling lots available for future development.

At the current rate of 33 dwellings per year (extrapolated from Lithgow Council DA figures 2000-2004) for Lithgow and Marrangaroo there is 37 years supply. However, as demand in housing has steadily increased to 4.2% (1996 to 2001) it would be reasonable to add a 5% growth figure which would reduce supply to 35 years. This assessment does not include a comparative study of land values in the Central West, Blue Mountains or Sydney. Lithgow is influenced by the Sydney market and as land value rise in Sydney and the Blue Mountains alternative; affordable, well located centres such as Lithgow will become attractive to a wide range of services, industry and housing.

Mr Graham Dean of L.J. Hooker in Lithgow (5 June 2006) provided Geolyse Pty Ltd with the following advice:

- Post-boom numbers reflected a 30 per cent fall in the volume of sales of homes sold in 2005 over 2004. The market is now back to pre-boom figures.
- Previously a third of their business came directly out of the Blue Mountains while now more than half are local people looking to buy.

The provision of additional housing for the community of Lithgow needs to follow the orderly development and take up of land at South Bowenfels. Notwithstanding the apparent supply, suitable land at Marrangaroo should be protected by a zone to ensure its highest and best use in the future.



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In addition, the current Rural 1(a) zone permits a wide range of uses incompatible with future urban settlement and does not provide for the sustainable and orderly planning of the area.

The broad undulating and northern flatter parts of the Study Area provide good opportunity for a higher use of the land (other than Rural 1(a)) in such close proximity to the township of Lithgow and its services. Marrangaroo is strategically well located with known environmental parameters which can be managed.

Industrial

There appears to have been a low steady demand for well located serviced land for business or light industrial land over the last five (5) years. However, the limited supply of industrial land may have stifled some growth. Additional large areas of land need to be identified to attract development to the region.

Areas of Marrangaroo are ideally suited to this use particularly adjoining the Defence land and in proximity to the Great Western Highway. Large areas of land also provide important facilities for works depots, or joint facilities requiring space for equipment, trucks etc.

An employment or light industrial area can also provide research or education facilities (eg. TAFE annex) which require large parcels of well located land near to populations.

Given the lead time between zoning, subdivision and investment in infrastructure it is recommended that investigations proceed into the staged release of land at Marrangaroo particularly for those areas which can attract business and generate employment or educational opportunities.

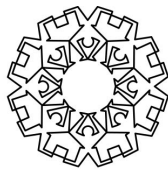
Commercial

Commercial development is largely found along the traditional Main Street, Lithgow, in the Village Plaza Shopping Centre located to the south of the CBD and an adjacent area known as Pottery Estate.

The trade area lacks any big retailers such as Big W or K Mart. Target is currently extending to a full-line store (Discount Department Store (DDS). Leyshon (2002) noted that there is a significant level of escape expenditure from the Lithgow trade area in general retail and bulky goods to areas such as Penrith and to a lesser extent Bathurst.

There is capacity for further business development along the Main Street and in nearby industrial zones for bulky goods or a discount department store or outlet such as Bunnings. A proposed rezoning at Pottery Estate will release more land in this area. However there is limited capacity for large lot industrial, business park or technology park development in these areas which are better located to the north.

Development at Marrangaroo will need to support the centre of Lithgow as the primary centre for shopping. The type of potential commercial or industrial development at Marrangaroo will need to be carefully considered to ensure it does not detract from the strength of the CBD.



Planning Controls

3.1 BACKGROUND

In New South Wales (NSW), the relevant planning legislation is the *Environmental Planning and Assessment Act 1979* (EP&A Act). The EP&A Act instituted a system of environmental planning and assessment in NSW and is administered by the Department of Planning (DOP). The objectives of the EP&A Act are:

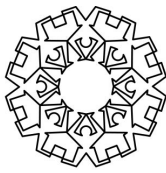
- (a) *to encourage:*
 - (i) *the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,*
 - (ii) *the promotion and co-ordination of the orderly and economic use and development of land,*
 - (iii) *the protection, provision and co-ordination of communication and utility services,*
 - (iv) *the provision of land for public purposes,*
 - (v) *the provision and co-ordination of community services and facilities,*
 - (vi) *the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats,*
 - (vii) *ecologically sustainable development,*
 - (viii) *the provision and maintenance of affordable housing, and*
- (b) *to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and*
- (c) *to provide increased opportunity for public involvement and participation in environmental planning and assessment.*

The EP&A Act facilitates the development of subordinate legislation, which consists of State Environmental Planning Policies (SEPP), Regional Environmental Plans (REP), Local Environmental Plans (LEP) and Development Control Plans (DCP). SEPPs, REPs, and LEPs are referred to as Environmental Planning Instruments (EPI).

Further documents may also be referred to in the planning and development of a site, including:

- Council codes and policies;
- Directions under Section 33A, 33B, 33C and 117(2) of the EP&A Act; and
- Department of Planning Circulars.

In the first instance, the LEP is the document to determine the zoning of a particular site. This will detail the permissible uses within the zone.



The following sections provide an outline of the planning controls applicable to the Study Area.

3.2 LITHGOW CITY LOCAL ENVIRONMENTAL PLAN 1994

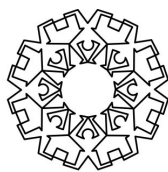
3.2.1 AIMS AND OBJECTIVES

Lithgow City Local Environmental Plan 1994 (Lithgow LEP) is the applicable local environmental planning instrument. Lithgow LEP was gazetted on 2 December 1994 and aims:

- (a) *to recognise and promote the City of Lithgow as a desirable and viable place in which to live and to visit and invest,*
- (b) *to encourage the proper management, development and conservation of natural resources and the built environment within the City of Lithgow by protecting, enhancing or conserving:*
 - (i) *prime crop and pasture land,*
 - (ii) *timber, minerals, soil, water quality, stream environment and other natural resources,*
 - (iii) *places of significance for nature or heritage conservation,*
 - (iv) *places or features of high scenic or recreational value, and*
- (c) *to replace the former local planning controls with a comprehensive local environmental plan to help facilitate growth and development of the City of Lithgow in a manner which is consistent with the aims specified in paragraph (a) and which:*
 - (i) *minimises the environmental cost to the community of fragmented and isolated development of rural land which has less than full provision of services,*
 - (ii) *facilitates the efficient and effective provision of amenities and services,*
 - (iii) *facilitates a range of residential and employment opportunities in accordance with demand,*
 - (iv) *facilitates farm adjustments,*
 - (v) *ensures that the safety and efficiency of arterial roads is not adversely affected by development on adjacent land,*
 - (vi) *minimises the impact of flooding and bushfires,*
 - (vii) *encourages the separation of conflicting land uses,*
 - (viii) *establishes measures to preserve water quality in the City's streams and waterways, and*
 - (ix) *facilitates the protection of the catchment areas within and downstream of the City area in accordance with the principles of total catchment management.*

3.2.2 ZONING

The Study Area under Lithgow LEP 1994 is zoned 1(a) Rural (General) east of the Highway and 2(a) Residential to the west with a small area of 1(a) Rural (General). Refer **Figure 2**.



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The objective of the 1(a) zone is:

To promote the proper management and utilisation of natural resources by:

- (a) *protecting, enhancing and conserving:*
 - (i) *rural land, in particular prime crop and pasture land, in a manner which sustains its efficient and effective agricultural production potential,*
 - (ii) *soil, by controlling and locating development in accordance with soil capability,*
 - (iii) *forests of existing and potential commercial value for timber production,*
 - (iv) *valuable deposits of minerals, coal and extractive materials, by controlling the location of development for other purposes in order to ensure the efficient extraction of those deposits,*
 - (v) *trees and other vegetation in environmentally sensitive areas, where the conservation of the vegetation is significant for scenic amenity or natural wildlife habitat or is likely to control land degradation,*
 - (vi) *water resources for use in the public interest, preventing the pollution of water supply catchment and major water storages,*
 - (vii) *localities of significance for nature conservation, including places with rare plants, wetlands and significant wildlife habitat, and*
 - (viii) *items of heritage significance,*
- (b) *preventing the unjustified development of prime crop and pasture land for purposes other than agriculture,*
- (c) *facilitating farm adjustments,*
- (d) *minimising the cost to the community of:*
 - (i) *fragmented and isolated development of rural land, and*
 - (ii) *providing, extending and maintaining public amenities and services,*
- (e) *providing land for other non-agricultural purposes, in accordance with the need for that development, and*
- (f) *providing for the separation of conflicting land uses.*

Within the 1(a) zone, **Table 3.1** illustrates developments that require consent, do not require consent, and that are prohibited.

Table 3.1 - Consent Requirements in the 1(a) Rural (General) zone

Without Development Consent	Only With Development Consent	Prohibited
Development for the purpose of agriculture (other than intensive livestock keeping establishments or ancillary dwellings)	Any development except that permitted without consent or prohibited	Development for the purpose of boarding houses;
Bushfire hazard reduction;		Bulky goods salesrooms and showrooms
Forestry (other than ancillary dwellings)		Commercial premises

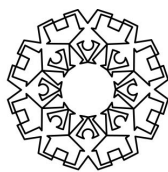


Table 3.1 - Consent Requirements in the 1(a) Rural (General) zone

Without Development Consent	Only With Development Consent	Prohibited
Home based child care		Motor showrooms
		Residential units
		Shops (other than general stores).

Source: Lithgow LEP 1994

The 1(a) Rural (General) zone permits a wide range of uses with consent. These can be anything that is not listed as 'prohibited' or can occur 'without development consent.'

The objectives of the 2(a) residential zone are:

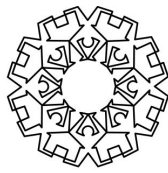
- 1. to provide for housing and associated development, where such development is feasible,*
- 2. to allow a variety of housing types,*
- 3. ensure that development does not create unreasonable demands for the provision or extension of public amenities or services, and*
- 4. to allow other uses in the zone which are compatible with housing.*

Table 3.2 lists development permissible (with and without consent) and development prohibited in this zone.

Table 3.2 - Consent Requirements in the 2(a) Residential zone

Without Development Consent	Without Development Consent	Prohibited
Development for the purpose of single dwelling-houses on serviced allotments	Any development except that permitted without consent or prohibited.	Development for the purpose of abattoirs, animal boarding or training establishments, bulk stores, extractive industries
Home based child care		Forestry, generating works
		Offensive or hazardous industries; heliports
		Industries (other than home or light industries); intensive livestock keeping establishments
		Junk yards; liquid fuel depots; mines; motor showrooms
		Saw mills; shops (other than general stores); stock and sale yards
		Timber yards; transport terminals;
		Veterinary clinics; warehouses.

Source: Lithgow LEP 1994



The 2(a) Residential zone restricts a far wider number of uses than the 1(a) Rural zone. This is to minimise land use conflict with residential housing and to ensure compatible uses are located together.

3.2.3 SUBDIVISION WITHIN RURAL 1(A) AND RESIDENTIAL 2(A)

Rural 1(a)

The minimum lot size in the 1(a) zone for subdivision of land with a dwelling entitlement is 40 hectares. However, excision of dwelling allotments (2 hectares) from existing holdings is possible, the number depending on the size of the existing holding. Temporary accommodation for workers is permissible within the 1(a) zone.

An allotment of any size can be created in the 1(a) zone if the Council is satisfied it will be used for agricultural purposes.

Residential 2(a)

No minimum lot size exists for land in the Residential 2(a) zone. However, within the Marrangaroo area the Marrangaroo and Windera Estates are affected by the Marrangaroo Fields DCP which specifies a minimum lot size of 2,000 square metres.

3.2.4 OTHER PROVISIONS APPLYING

The Study Area is subject to the following considerations of the LEP:

- Environmentally Sensitive Land, as marked on the zoning map – **Figure 2**. Clause 28 of Lithgow LEP applies and prohibits certain development and restricts the destruction of trees.
- The Study Area is identified as Bush Fire Prone. Clause 30 of Lithgow LEP requires Council to not grant consent to either subdivision or erection of a building unless the following has been addressed:
 - (a) *adequate provision is made for access for fire fighting vehicles,*
 - (b) *adequate safeguards are adopted in the form of fire breaks, reserves and fire radiation zones, and*
 - (c) *adequate supplies are available for fire fighting purposes.*
- Bed and Breakfast Establishments and Dual Occupancies are permissible in the 1(a) and 2(a) zones, subject to a number of requirements.
- The Study Area contains a number of heritage items and potential archaeological sites. Clauses 39 to 43 of the Lithgow LEP are to be considered in the development of, or in the vicinity of, these items.



The Study Area does not contain land that is mapped as flood liable under the LEP. However, land along Marrangaroo Creek is subject to flooding and is covered in **Section 4.11** of this report.

There are no sites within the subject area identified on the DEC's register of notices under Section 58 of the *Contaminated Land Management Act 1997* hence Clause of 37 of the LEP is not triggered.

3.3 REGIONAL ENVIRONMENTAL PLANS

Regional Environmental Plans (REPs) cover issues such as urban growth, commercial centres, extractive industries, recreational needs, rural lands, and heritage and conservation. REPs provide the framework for detailed local planning by councils.

3.3.1 DRAFT DRINKING WATER CATCHMENTS REGIONAL ENVIRONMENTAL PLAN NO. 1

The Draft Drinking Water Catchments Regional Environmental Plan No. 1 (Draft REP) was developed and a first draft exhibited in October 2000. The plan was revised following extensive community consultation. The revised draft of *Sustaining the Catchments — the Regional Plan for the Drinking Water Catchments of Sydney and Adjacent Regional Centres* was on exhibition for public comment from 29 March until 30 July 2004.

Once gazetted, the Draft REP will replace State Environmental Planning Policy No. 58 – Protecting Sydney's Water Supply, which has been operating in the catchment areas as an interim measure.

The Draft REP:

- Sets water quality objectives for the catchments;
- Requires the development of rectification action plans (RAPs);
- Contains requirements for the preparation and review of LEPs; and
- Contains requirements for assessing and approving new developments and activities within the catchments.

The Study Area is located within the Upper Cox's River Sub Catchment and is currently subject to both the draft REP and SEPP 58.

3.4 STATE ENVIRONMENTAL PLANNING POLICIES

There are a number of State Environmental Planning Policies (SEPPs) that apply to the Study Area relevant to its future planning. These SEPPs are set out in **Table 3.3**.

Table 3.3 - State Environmental Planning Policies Potentially Applying to the Study Area

SEPP No.	Title
4	Development Without Consent and Miscellaneous Exempt and Complying Development
11	Traffic Generating Developments
33	Hazardous and Offensive Development
44	Koala Habitat Protection
55	Remediation of Land
58	Protecting Sydney's Water Supply
60	Exempt and Complying Development
64	Advertising and Signage
65	Design Quality of Residential Flat Development
	(ARTC Rail Infrastructure) 2004
	(Building Sustainability Index: BASIX) 2004
	(Major Projects) 2005
	(Seniors Living) 2004
	(Sydney Metropolitan Water Supply) 2004

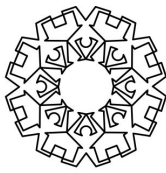
Key policies are further explained below.

3.4.1 STATE ENVIRONMENTAL PLANNING POLICY 55 (SEPP 55) – REMEDIATION OF LAND

SEPP 55 promotes a consistent State-wide approach to the remediation of contaminated land to reduce the risk of harm to human health and the environment. This requires knowledge and identification of any contaminated land so it may be remediated prior to its use as permitted under the zone or any new zone.

Council may include certain provisions in an environmental planning instrument to ensure remediation occurs. However, before including land (potentially contaminated) in a particular zone, Council must consider a report specifying the findings of a preliminary investigation of the land carried out in accordance with the Contaminated Land Planning Guidelines.

Potential sources of contamination have been identified and assessed in **Section 4.9** of this report.



3.4.2 STATE ENVIRONMENTAL PLANNING POLICY 58 (SEPP 58) – PROTECTING SYDNEY’S WATER SUPPLY

This Policy is discussed in **Section 4** of this report. It is understood that once *Sustaining the Catchments* REP is gazetted (in the near future) it will replace SEPP 58 and have more rigorous requirements.

3.4.3 STATE ENVIRONMENTAL PLANNING POLICY 11 (SEPP 11) – TRAFFIC GENERATING DEVELOPMENTS

SEPP 11 ensures that the Traffic Authority (RTA) is made aware of, and is given an opportunity to, make representation in respect to traffic issues for development listed in two schedules. A copy of the policy and schedules are included in **Appendix A**.

Schedule 1 lists development which must be referred to the Traffic Authority. Schedule 2 requires notification only where that development on or of land has direct vehicular or pedestrian access to an arterial road, or a road connecting with an arterial road, if the access is within 90 metres of the alignment of the arterial road.

Referral to the RTA may be required once a clearer understanding is obtained of the type of development likely to proceed on the land.

3.4.4 STATE ENVIRONMENTAL PLANNING POLICY 33 (SEPP 33) - HAZARDOUS AND OFFENSIVE DEVELOPMENT

An assessment under this policy of potentially hazardous and potentially offensive development will only be required if such development is likely to establish itself in the area.

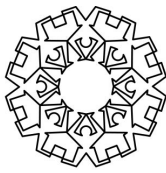
Potentially hazardous and potentially offensive industry are defined in SEPP 33 as:

potentially hazardous industry means a development for the purposes of any industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would pose a significant risk in relation to the locality:

- (a) to human health, life or property, or
- (b) to the biophysical environment,

and includes a hazardous industry and a hazardous storage establishment.

potentially offensive industry means a development for the purposes of an industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would emit a polluting discharge (including for example, noise) in a manner which would have a significant adverse impact in the locality or on the



existing or likely future development on other land, and includes an offensive industry and an offensive storage establishment.

These definitions provide some guidance for potential uses on the site however they do not represent the fullness of the entire policy. The full policy can be viewed at www.legislation.nsw.gov.au and follow the prompts for In Force: Environmental Planning Instruments.

3.4.5 STATE ENVIRONMENTAL PLANNING POLICY 44 (SEPP 44) – KOALA HABITAT PROTECTION

Lithgow City Council is listed as one of the areas to which this policy applies. Evans and Rylstone are also covered by the policy, areas of which were amalgamated with Lithgow in a recent local government boundary change.

The Policy requires Council to consider potential koala habitat with an area of more than 1 hectare whether or not the development application applies to the whole, or only part, of the land.

Where land is identified as core koala habitat Council must be amend its LEP to protect it and consider preparing a development control plan for land that adjoins it.

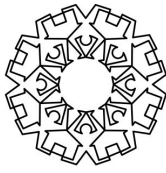
An assessment of remaining vegetation across the Study Area for potential koala habitat was completed as part of the fauna and flora assessment. See **Appendix B**.

Some woodland areas within the study area provide koalas with potential habitat. Potential koala habitat, as defined in *State Environmental Planning Policy No. 44 - Koala Habitat Protection* (SEPP No. 44), includes: *'Areas of native vegetation where trees of the types listed in Schedule 2 of the Policy constitute at least 15 percent of the total number of trees in the upper or lower strata of the tree component'*.

Core koala habitat is defined as *'an area of land with a resident population of koalas, evidenced by attributes such as breeding females (i.e. females with young) and recent sightings of and historical records of a population'*.

The fauna and flora assessment concluded:

- While the floristic composition of the tree stratum within the communities flanking the study area may potentially provide foraging resources for koalas, no previous recordings or known evidence of presence has been recorded from the vicinity of the study site.
- There is no record of breeding females or evidence of a resident population in the immediate vicinity of the study area.
- Less accessible woodland communities containing preferred feed trees are linked to the study area.
- The woodlands present in the vicinity of the study area may provide koala populations with habitat.



3.4.6 STATE ENVIRONMENTAL PLANNING POLICY NO 64 (SEPP 64) – ADVERTISING AND SIGNAGE

State Environmental Planning Policy No 64 prohibits advertising within any of the following zones or descriptions:

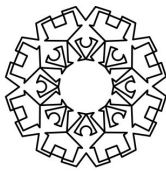
- environmentally sensitive area
- heritage area
- natural or other conservation area
- open space
- waterway
- residential (but not including a mixed residential and business zone, or similar zones)
- scenic protection area
- national park
- nature reserve

Zone descriptions will need to be considered when determining the best options for protecting significant water, vegetation, geological and landscape features in the Study Area.

Under SEPP 64 consent is required for advertisement greater than 20 sq m and within 250 metres of, and visible from, the Great Western Highway. The concurrence of the Roads and Traffic Authority (RTA) is required who must consider the following:

- (a) *the impact of the display of the advertisement on traffic safety, and*
- (b) *the environmental character and quality of the classified road and views from the classified road, and*
- (c) *any guidelines prepared by the RTA in consultation with the Outdoor Advertising Association of Australia.*

Importantly, if Council decides to prepare a draft local plan for Marrangaroo and include provisions that relate to signage they must consult with the advertising industry and the Roads and Traffic Authority.



3.4.7 STATE ENVIRONMENTAL PLANNING POLICY NO 65 – DESIGN QUALITY OF RESIDENTIAL FLAT DEVELOPMENT

This policy aims to improve the design quality of residential flat development in New South Wales and aims:

- (a) *to ensure that it contributes to the sustainable development of New South Wales:*
 - (i) *by providing sustainable housing in social and environmental terms, and*
 - (ii) *by being a long-term asset to its neighbourhood, and*
 - (iii) *by achieving the urban planning policies for its regional and local contexts, and*
- (b) *to achieve better built form and aesthetics of buildings and of the streetscapes and the public spaces they define, and*
- (c) *to better satisfy the increasing demand, the changing social and demographic profile of the community, and the needs of the widest range of people from childhood to old age, including those with disabilities, and*
- (d) *to maximise amenity, safety and security for the benefit of its occupants and the wider community, and*
- (e) *to minimise the consumption of energy from non-renewable resources, to conserve the environment and to reduce greenhouse gas emissions.*

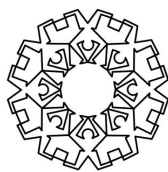
In preparing:

- (a) an environmental planning instrument, or
- (b) a development control plan, or
- (c) a master plan or similar plan,

that provides for residential flat development it should include provisions to ensure the achievement of design quality to accord with the design quality principles of this Policy and have regard to the publication *Residential Flat Design Code* (a publication of the Department of Planning, September 2002).

The Minister in consultation with Council may constitute a design panel to give independent advice on development applications, draft LEPs, development control plans, masterplans or similar plans.

Residential flat development (does not include villas or townhouses) may occur in the future development of Marrangaroo. If a masterplan or similar detailed document is prepared it will need to be consistent with this Policy.



3.5 DEVELOPMENT CONTROL PLANS

Section 74C(1) of the EP& A Act states (*inter alia*) that Development Control Plans (DCPs) may be prepared:

- (a) *to make more detailed provision with respect to development to achieve the purpose of an environmental planning instrument applying to the land concerned...*

Table 3.4 outlines the DCPs that apply to the City of Lithgow Local Government Area. These DCPs are potentially relevant to the Study Area, for permissible development, in the attainment of Development Consent.

Table 3.4 - Development Control Plans

Plan	Relevance
Development Control Plan No. 4 – “Rural Residential Development Control Plan”	This plan applies to land zone 1(c) Rural (Small Holdings) and provides guidance to developers of rural/residential development.
Development Control Plan No. 6 – “Industrial Development”	This plan applies to land zoned industrial and land within rural zones in which industrial development is permissible.
Poultry Development Control Plan	This plan applies to the entire Lithgow LGA.
Off Street Car Parking Development Control Plan	This plan applies to the entire Lithgow LGA.
Outdoor Advertising Development Control Plan	This plan applies to the entire Lithgow LGA.
Development Control Plan No. 5 – “Lithgow Escarpment Protection”	This plan applies to the view shed of Lithgow, excepting Lithgow and State Forests.
Development Control Plan No. 8 – “Bed & Breakfast Accommodation”	This plan applies to all land within the Lithgow LGA on which a dwelling house is permissible.
Animal Boarding and Training Establishments Development Control Plan	This plan applies to the entire Lithgow LGA, and in particular those zones where animal boarding and training establishments are permissible, including Rural 1(a), 2(v) village and Industrial 4 zones.
Marrangaroo Fields Estate Development Control Plan	This plan applies to the areas known as the Marrangaroo Fields Estate and Windera Estate.

3.6 COUNCIL CODES/POLICIES

There are a number of Council codes and policies that may need to be considered depending on the type of development that will be permissible in the area.

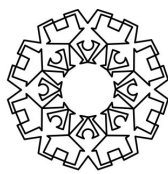


Table 3.5 - Council Codes and Policies

Code/Policy	Relevance
Subdivision and Development Code	This policy provides controls for subdivision and other development.
Interim Policy for Flood Liable Land	This policy applies to land which is defined as "Flood Development Affected", which is not more than 500mm above the standard flood (i.e. 1% AEP).
Policy for Re-sited Dwellings	This policy applies to dwellings that are to be resited.
Footpath Trading & Outdoor Eateries Policy	This policy applies to commercial premises within the Lithgow, Portland and Wallerawang Central Business Districts.
Standards for Constructing Special Footpath Crossing	This policy applies to footpath crossings.
Guidelines for Outdoor Eateries	This policy provides guidelines for outdoor eateries throughout the LGA.

3.7 SECTION 117 DIRECTIONS

Section 117(2) of the EP&A Act enables the Minister for Planning to issue a Direction requiring Council/s to prepare a draft LEP in accordance with the contents of the specific direction. **Table 3.6** illustrates the Section 117 Directions applicable to, or potentially applicable to, the Study Area in consideration of rezoning.

Table 3.6 - Applicable 117 Directions

Direction	Relevance	Response
Direction No. 3 – Business Zones	This Direction applies when preparing a Draft LEP that creates, removes or alters a Business Zone Boundary or a Business Zone provision.	A draft LEP for the Study Area will increase the area of land zoned for Business and not seek to alter the location, area or provisions of existing Business zonings elsewhere in the LGA, consistent with this direction.
Direction No. 5 – Coal, Other Minerals, Petroleum and Extractive Resources	This Direction applies when preparing a Draft LEP that either introduces a prohibition on mining activities or is likely to restrict current or future mining activities.	DPI has advised that the existing quarry in the south western corner of the Study Area is a significant state resource. Any draft LEP prepared will not prohibit, restrict or create land use conflict as required by this direction.

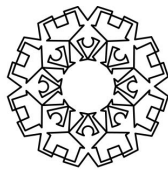
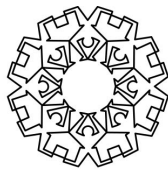


Table 3.6 - Applicable 117 Directions

Direction	Relevance	Response
Direction No. 9 – Conservation Management of Environmental Indigenous Heritage	This Direction applies when preparing a Draft LEP that applies to items of heritage significance, or Aboriginal objects, or areas of Aboriginal heritage significance, or Aboriginal places.	Where existing heritage provisions facilitate the conservation of an item of heritage significance and an Aboriginal object, the area of Aboriginal heritage significance or Aboriginal place then the draft LEP will evaluate them and ensure they are adequate to achieve the objectives of this direction.
Direction No. 11 – Development in Mine Subsidence District or on Unstable Land	This Direction applies when preparing a Draft LEP that permits development in a mine subsidence district or on unstable land.	This direction does not permit development on unstable land and a draft LEP must be strictly consistent with it. The Study Area is not located in a Mine Subsidence District. To comply with this direction further consultation is needed with the Mine Subsidence Board to define unstable land and verify whether there is any in the Study Area.
Direction No. 13 – Environmental Protection Zones	This Direction applies when preparing a Draft LEP that creates, removes or alters an Environmental Protection Zone boundary or an Environmental Protection Zone provision.	If this zone is applied within the Study Area it will be justified by this environmental study and be consistent with this direction.
Direction No. 15 – Flood Prone Land	This Direction applies when preparing a Draft LEP that creates, removes or alters a zone or provision that affects flood prone land.	To identify and rezone flood prone land along Marrangaroo creek from the 1(a) rural zone to a business, residential, industrial or special area zone may require a flood study to ensure development satisfies this direction.
Direction No. 16 – Industrial Zones	This Direction applies when preparing a Draft LEP that creates, removes or alters an Industrial Zone boundary or an Industrial Zone provision.	A draft LEP for the Study Area may increase the area of land zoned primarily for industrial purposes and is unlikely to remove or alter such boundary or provision existing in the LEP.
Direction No. 17 – Integrating Land Use and Transport	This Direction applies when preparing a Draft LEP that creates, removes or alters a zone or a provision relating to urban land, such as for residential, business or industrial purposes.	Any inconsistencies with this direction and the aims, objectives and principles of Improving Transport Choice and The Right Place for Business and Services will be considered in any rezoning proposal. The Structure Plan will consider and reflect these requirements.



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Table 3.6 - Applicable 117 Directions

Direction	Relevance	Response
Direction No. 18 – Manufactured Home Estates and Caravan Parks	This Direction applies when preparing a Draft LEP to ensure that Council's provide for manufactured home estates and caravan parks.	In considering potential zones for this area Council will need to identify suitable zones and locations for caravan parks and manufactured home estates.
Direction No. 19 – Planning for Bushfire Protection	This Direction applies when preparing a Draft LEP that affects, or is in proximity to land mapped as bushfire prone land.	To comply with this direction a draft LEP will: have regard to planning for Bushfire Protection 2001, introduce controls that avoid placing inappropriate development in hazardous areas, and ensure that bushfire hazard reduction is not prohibited within the APZ. Appropriate asset protection zone/s will need to be established with each DA. The Structure Plan will provide a road hierarchy with alternative egress, and contain provisions for adequate water supply for fire fighting. The choice of land uses will seek to minimise the perimeter for the area of land interfacing the hazard which may be developed.
Direction No.21 – Residential Zones	This Direction applies when preparing a Draft LEP that creates, removes or alters a Residential Zone boundary or Residential Zone provision.	To be consistent with this direction a draft LEP shall:- (a) require land to be adequately serviced before it is released for residential development; (b) retain provisions enabling a dwelling to be erected on an existing lot; (c) not reduce the permissible residential density; and (d) provide a variety of housing forms (where practical and compatible with environmental quality). In regional areas it may also permit dual occupancy.

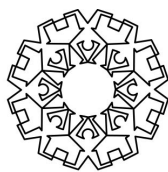
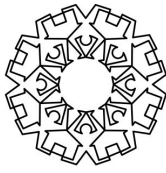


Table 3.6 - Applicable 117 Directions

Direction	Relevance	Response
Direction No. 22 – Rural Zones	This Direction applies when preparing a Draft LEP that creates, removes or alters a Rural Zone boundary or a Rural Zone provision. The objective of this direction is to protect the agricultural production value of existing rural land.	To rezone rural land to urban purposes (including residential, business or industrial) it must be identified in a strategy (approved by the Director-General) or justified by an environmental study or be of minor significance. The agricultural production value of land in Marrangaroo has already been compromised by fragmentation and adjoining land uses. This environmental study will need to satisfy this direction.
Direction No. 25 – Site Specific Zoning	This Direction applies when preparing a Draft LEP to allow a particular development proposal to be carried out. It aims to make the range of uses permissible in zones as flexible as possible.	In determining what zones and provisions should apply to the Study Area Council will need to apply those already existing in the LEP unless the rezoning is justified by an environmental study.
Direction No. 26 – Special Area Zones and Recreation Zones	This Direction applies when preparing a Draft LEP that creates, alters or removes a zoning or provision for any public purpose.	To create zones or reservations for public open space requires the consent of the relevant public authority and the Director-General. If requested by a public authority to zone land for a public purpose it must be done. Consultation with the DG must occur prior to issue of an s65 certificate.
Direction No. 28 – Water Catchment Areas – Sydney Catchment Authority	This Direction applies when preparing a Draft LEP to areas affected by SEPP 58 – Protecting Sydney's Water Supply. It aims, <i>inter alia</i>, to protect the quality of stored waters in Sydney's Catchment Authority's water storages.	Council must consult under s62 with the Sydney Catchment Authority (SCA) to find out whether they object to the draft LEP and the reasons for the objection; and to identify the likely impact of the DLEP on the quality of stored waters in the SCA's water storages.

3.8 DEPARTMENT OF PLANNING CIRCULARS

The Department of Planning issues Circulars to local Councils. Generally these circulars offer guidance as to interpretation and implementation of legislation. Circulars have no legal force.



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3.9 OTHER LEGISLATION AFFECTING THE PLANNING SYSTEM

Section 91 of the EP&A Act relates to Integrated Development. Integrated Development is development that requires an approval from another authority as well as Development Consent. The approvals potentially required relating to development in the Study Area are:

- Fisheries Management Act 1994
- Heritage Act 1977
- Mine Subsidence Compensation Act 1961
- National Parks and Wildlife Act 1974
- Protection of the Environment Operation Act 1997
- Roads Act 1993
- Rural Fires Act 1997
- Water Management Act 2000

Other legislation potentially affecting the Study Area, apart from those relating to Integrated Development are listed below.

- Contaminated Lands Management Act 1997
- Crown Lands Act 1989
- Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)
- Mining Act 1992
- Native Vegetation Act 2003
- Native Vegetation Conservation Act 1997
- Noxious Weeds Act 1993
- Threatened Species Conservation Act 1995
- Rural Lands Protection Act 1998
- Water Act 1912

The Existing Environment

4.1 LOCATION AND DESCRIPTION

The locality of Marrangaroo falls within the Local Government Area (LGA) of Lithgow. It is situated in the Central Tablelands of New South Wales and forms part of the western foothills of the Blue Mountains. The Marrangaroo Study Area is positioned between the urban centres of Lithgow and Wallerawang, approximately 145 kilometres west-north-west of Sydney (refer **Figure 3**) located at an approximate grid reference (232000mE, 6295000mN) in Australia Map Grid Zone 56 (150°-156°) coordinates, AGD66 Datum in New South Wales.

The Study Area spans approximately 4.5 kilometres in a north-south direction and 3.5 kilometres in an east-west direction and comprises an area of approximately 1,100 hectares. The topography of the Study Area is diverse, ranging from level floodplains in the north to very steep side-slopes in areas abutting the Study Area boundary. Site elevation varies between 850mAHD to 1060mAHD. The highest point is located along the southern boundary of the Study Area.

4.2 LANDUSE

The Study Area includes 116 individual lots to the west and 68 lots to the east. Of these there are 100 holdings and 9 others in the west and 45 holdings, 4 Government holdings and 5 unidentified to the east representing a fragmented holding pattern. See **Figure 4**.

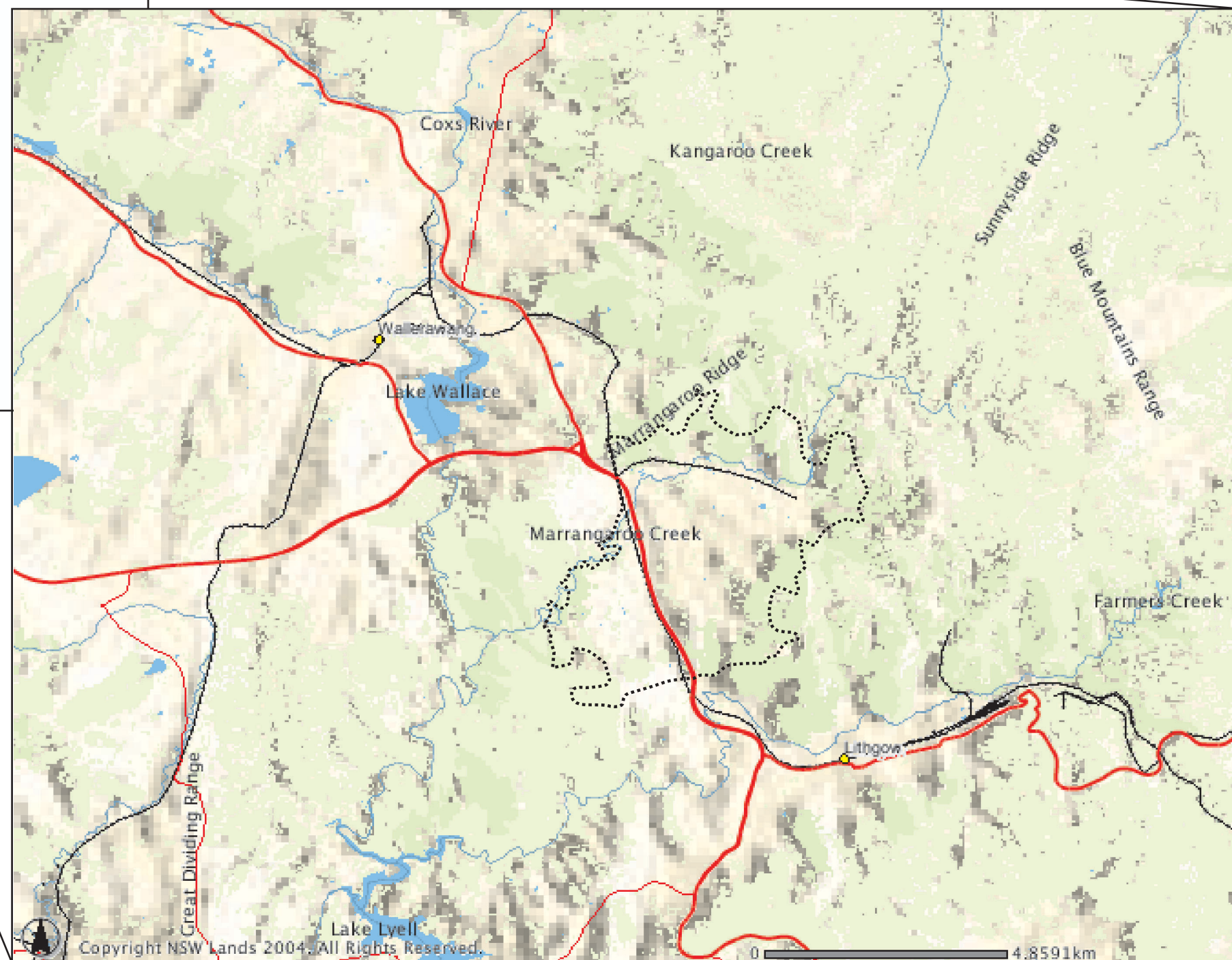
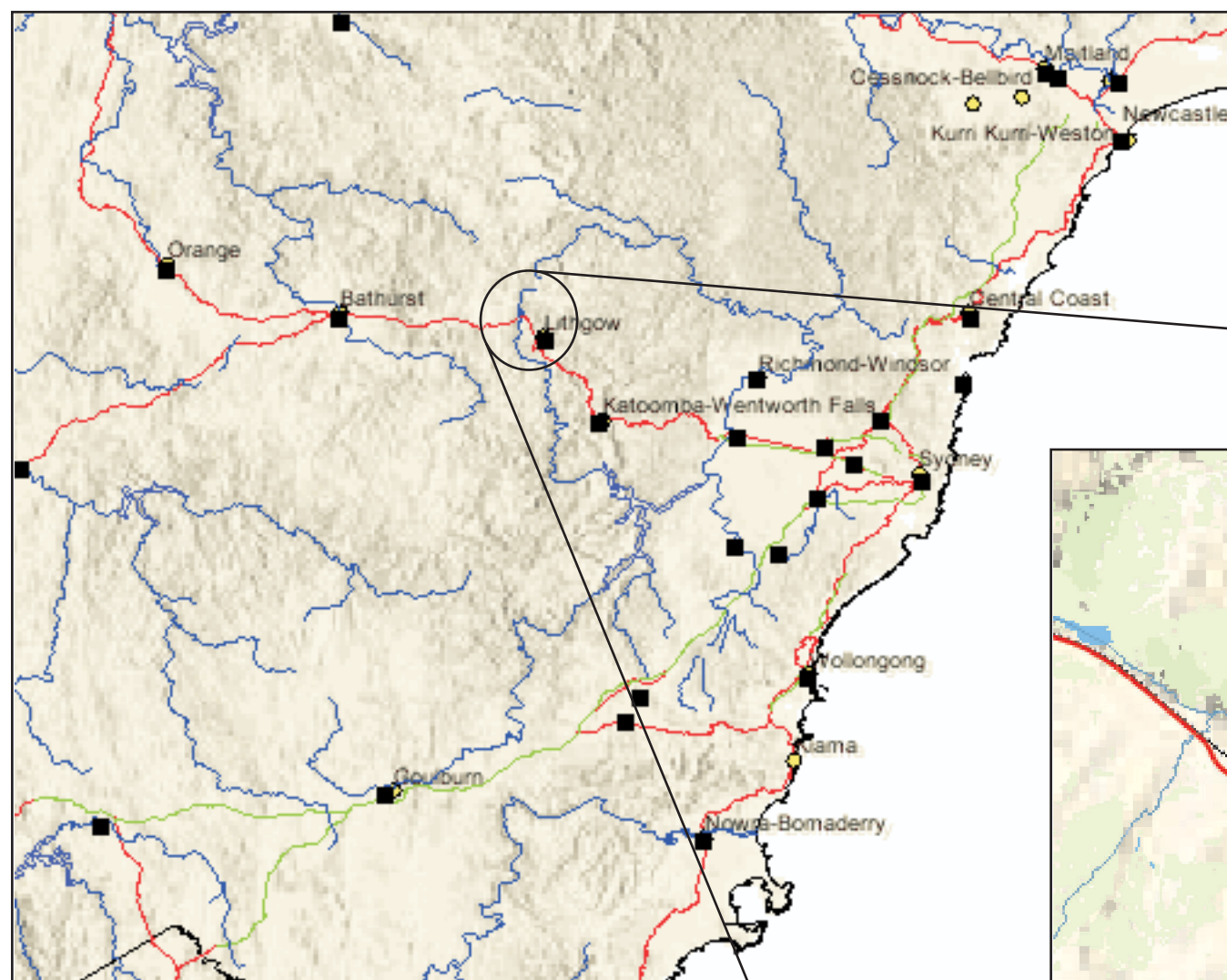
The area comprises approximately 1,100 hectares of mixed land uses including residential, rural pursuits, recreational facilities, motel accommodation, service station, Defence activities, correctional facility, trout farm, light industrial and quarrying. **Figure 5** maps the distribution of land uses across the Study Area.

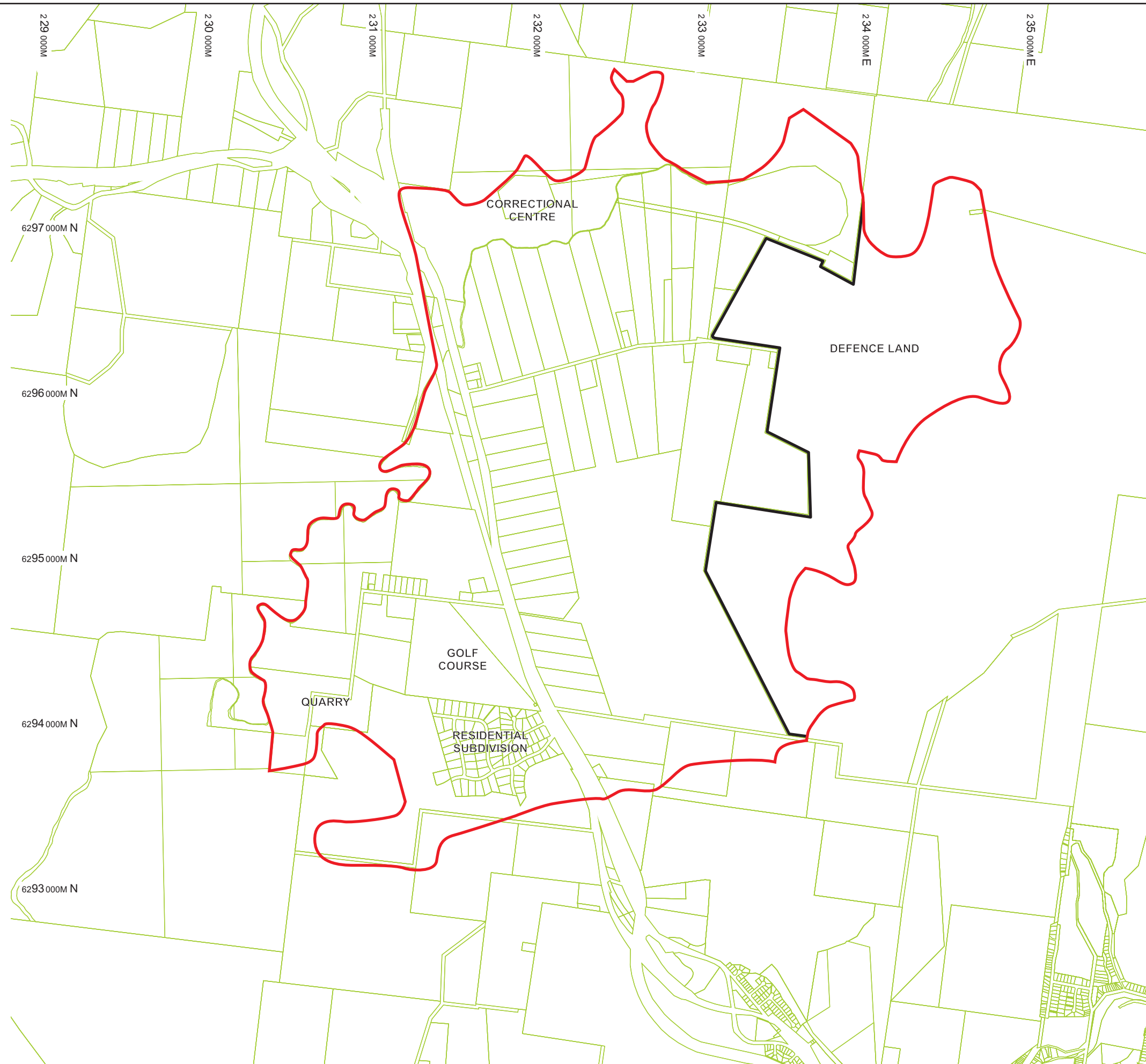
Notable land uses are the Correctional Centre to the north, Commonwealth Defence land to the east, Lithgow Golf Course and Metromix Quarry to the south west of the area. Marrangaroo Fields Estate and Windera Estate are large lot residential subdivisions south of the Golf Course with approximately 81 lots and are the only developed urban land in the Study Area. Consent however has been granted for a 217 lot residential subdivision north of the Golf Course. Subdivision works have not yet commenced which will entail the construction of a bridge over the railway line from the Highway.

The Arch Vale Trout Farm borders the study area and is an important adjoining land use as it is dependent on Marrangaroo Creek for its operation.

On the eastern part of the Study Area, which is zoned 1(a) Rural (General), the biggest single holding is used for agriculture and is located in the middle of the study area and adjoins Defence land to the east. Small scale farming and rural residential comprise the next largest land use in this part.

While there is a high number of land uses occurring in the Study Area, the highest proportion are located along the Great Western Highway and Reserve Road.



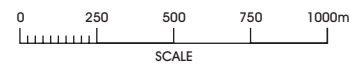


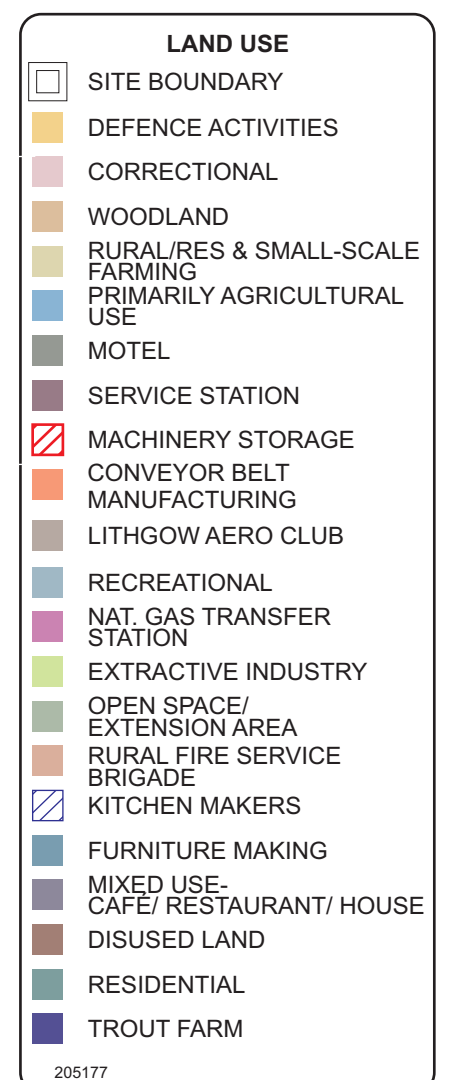
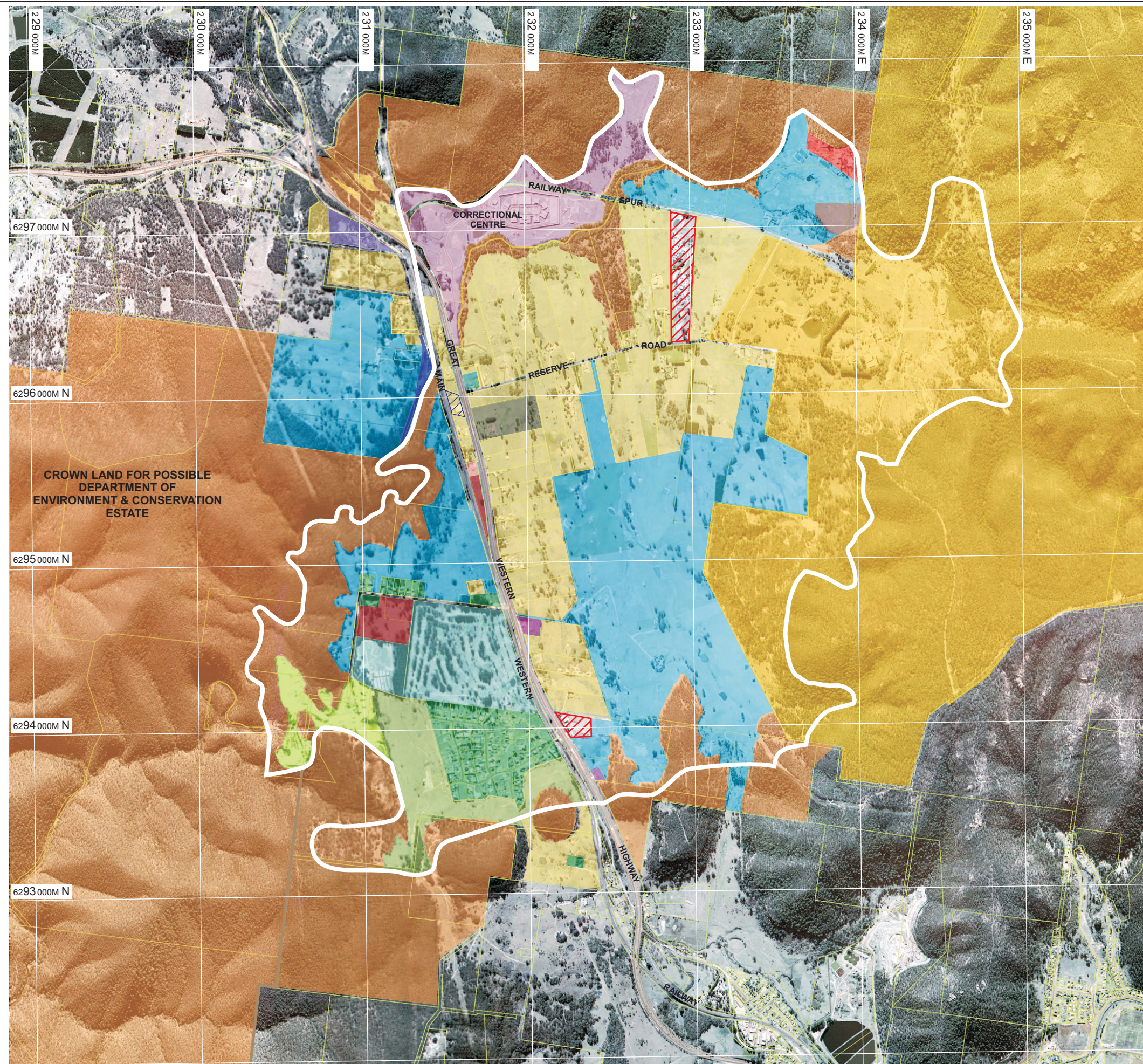
SITE BOUNDARY

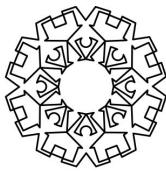
LOT BOUNDARIES

DEFENCE LAND

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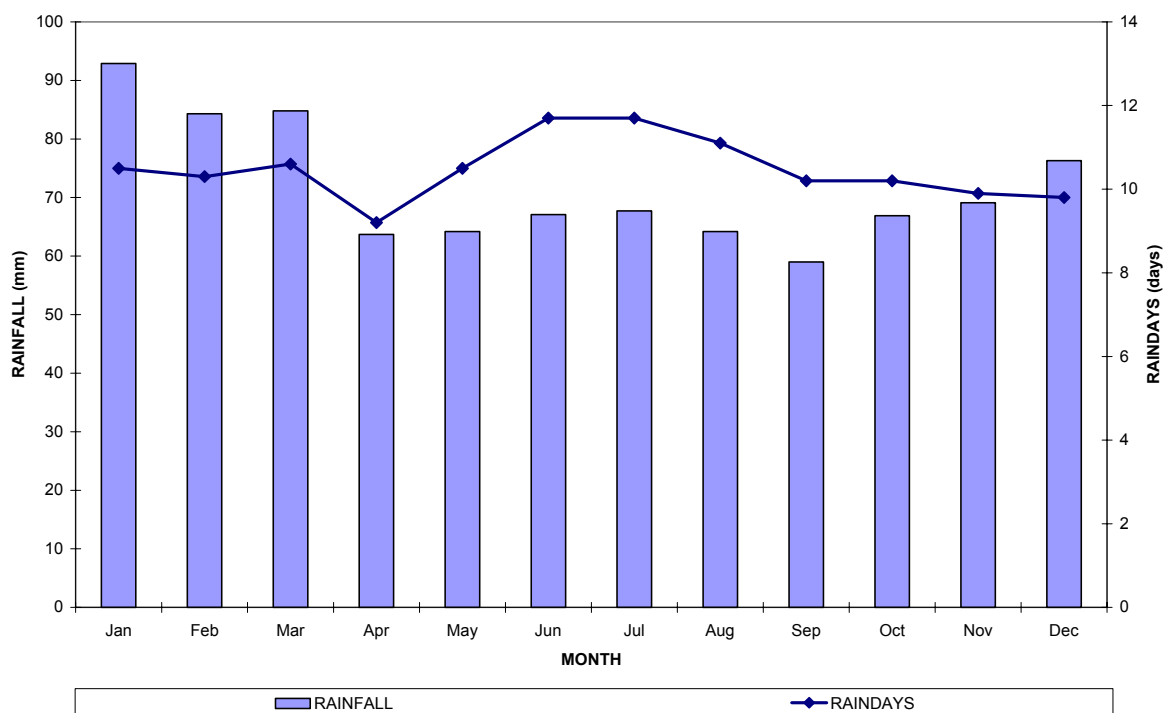
The area is ringed by steeply vegetated hills which are a strong landscape feature. Department of Primary Industries have verbally advised that the valley floor has never been mined. The former colliery to the north east of the site worked back into the surrounding hills.

The Railway Spur to the north has been dismantled and sold off, however its form remains.

4.3 CLIMATE

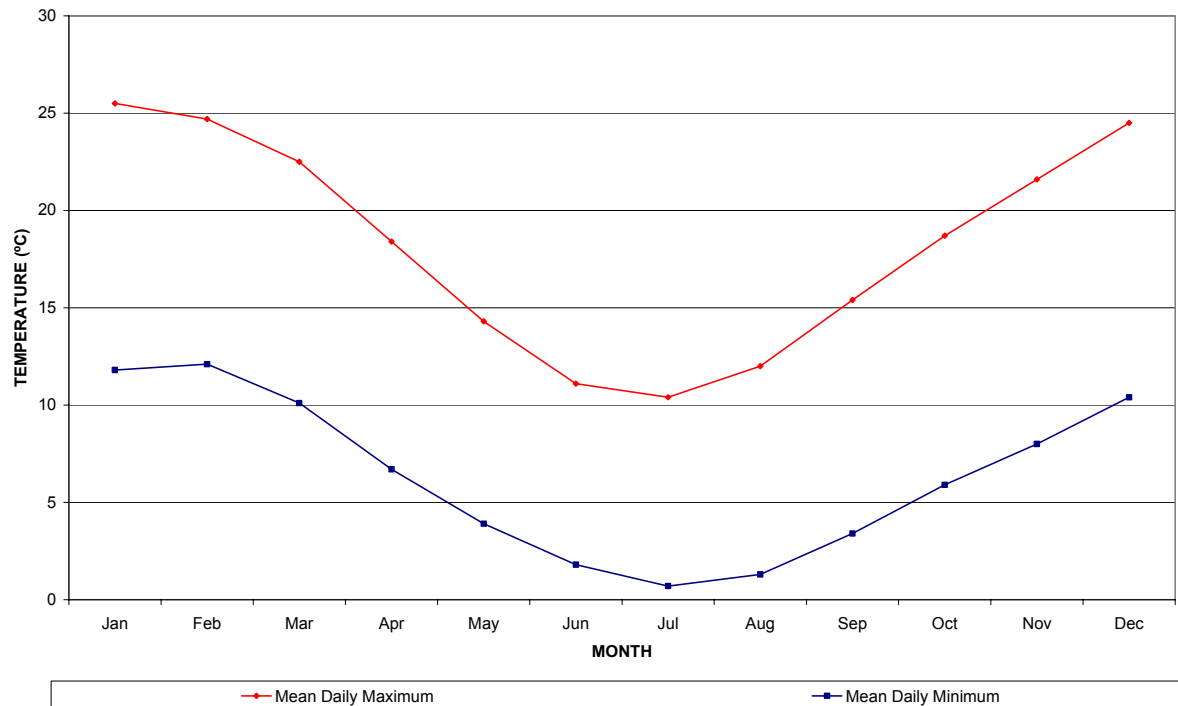
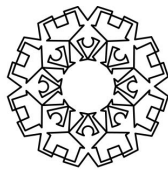
4.3.1 RAINFALL AND TEMPERATURE

Weather data for the Lithgow (Birdwood Street) meteorological station (located approximately 5 kilometres south-east of the Study Area) has been recorded over a period of 115 years extending from 1889 to 2004. The average annual rainfall recorded at this station is 860 mm. This is received over an average 126 rain days, with average monthly falls ranging from 59mm in September to 93mm in January. Although more rainfall tends to occur in summer and early spring, slightly more consistent falls of rain occur over the winter months.



Graph 7: Mean historical rainfall and raindays recorded at the Lithgow (Birdwood Street) meteorological station – 63224

Source: (Bureau of Meteorology, 2005).



Graph 8: Mean daily maximum and minimum temperatures recorded at the Lithgow (Birdwood Street) meteorological station – 63224
Source: (Bureau of Meteorology, 2005).

The area experiences a temperate mountain climate with warm summers and cool winters. Average maximum temperatures range from 10.4°C in winter to 25.5°C in summer (**Graph 8**). Average minimum temperatures range from 0.7°C in winter to 12.1°C in summer.

4.3.2 WIND SPEED AND DIRECTION

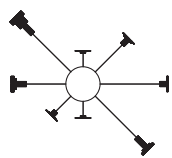
Wind speed and direction data for the period 1965 to 2005 is illustrated in **Figure 6**. From this data, it can be seen that predominant winds are from the west in both the morning and afternoon periods throughout the year.

4.3.3 CONCLUSION

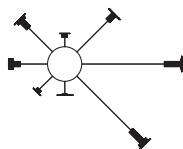
Marrangaroo experiences westerly winds all year round. Temperatures can be cold in winter dropping to 7 degrees C and moderate in summer (12- 25.5 degrees C). The average annual rainfall is 860 mm.

4.4 TOPOGRAPHY

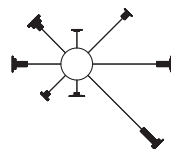
The Study Area is positioned in the western foothills of the Blue Mountains with elevations ranging from 850mAHD to 1060mAHD and slopes generally falling to the north-west at a gradient of approximately 5 percent.



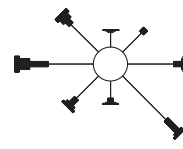
January 9 am
1159 observations



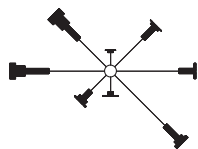
February 9 am
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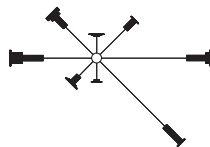
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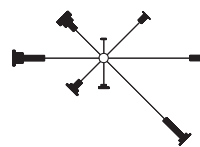
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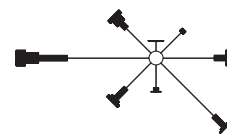
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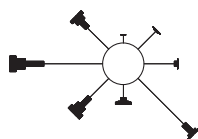
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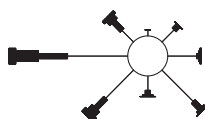
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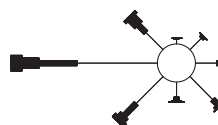
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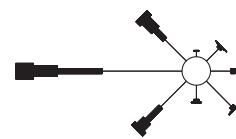
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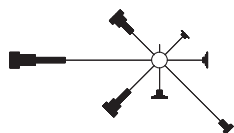
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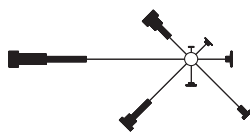
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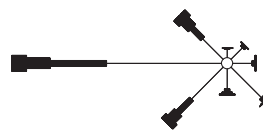
August 9 am
1202 observations



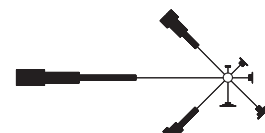
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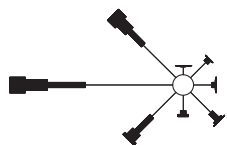
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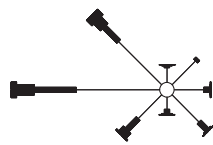
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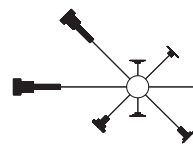
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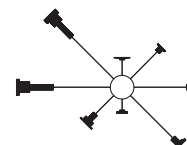
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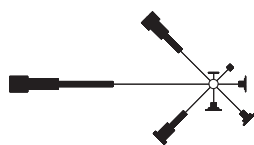
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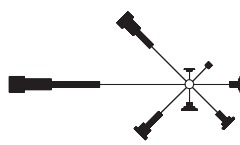
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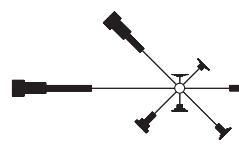
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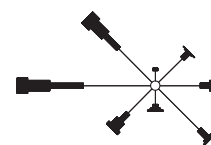
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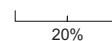
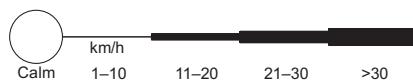
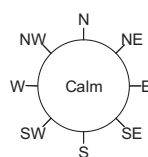
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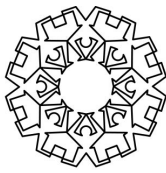
November 3 pm
1118 observations



December 3 pm
1157 observations



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The area is characterised by six main topographic areas including:

1. Flat to gently inclined rises on broad valley floors away from major drainage lines (approximately 70 percent of Study Area).
2. Broad rolling low hills (approximately 20 percent of Study Area).
3. Very narrow rounded crests.
4. Level to very gently undulating drainage depressions and floodplains associated with Marrangaroo Creek and its tributaries.
5. Narrow, steep sided re-entrant valley floors associated with the Marrangaroo Creek and its tributaries.
6. Steep to very steep side-slopes in areas abutting the Study Area boundary.

The highest elevation point in the area is represented by a steep vegetated rise along the southern boundary at a height of 1060mAHD (GR: 232950mE, 6393725mN). The lowest lying areas occur along the western boundary of the Study Area where Marrangaroo Creek falls to an elevation of 850mAHD (GR: 230375mE, 6294025mN).

Approximately 10 percent of the site is elevated and rugged or steep. The more accessible areas comprise approximately 90 percent of the remaining total area.

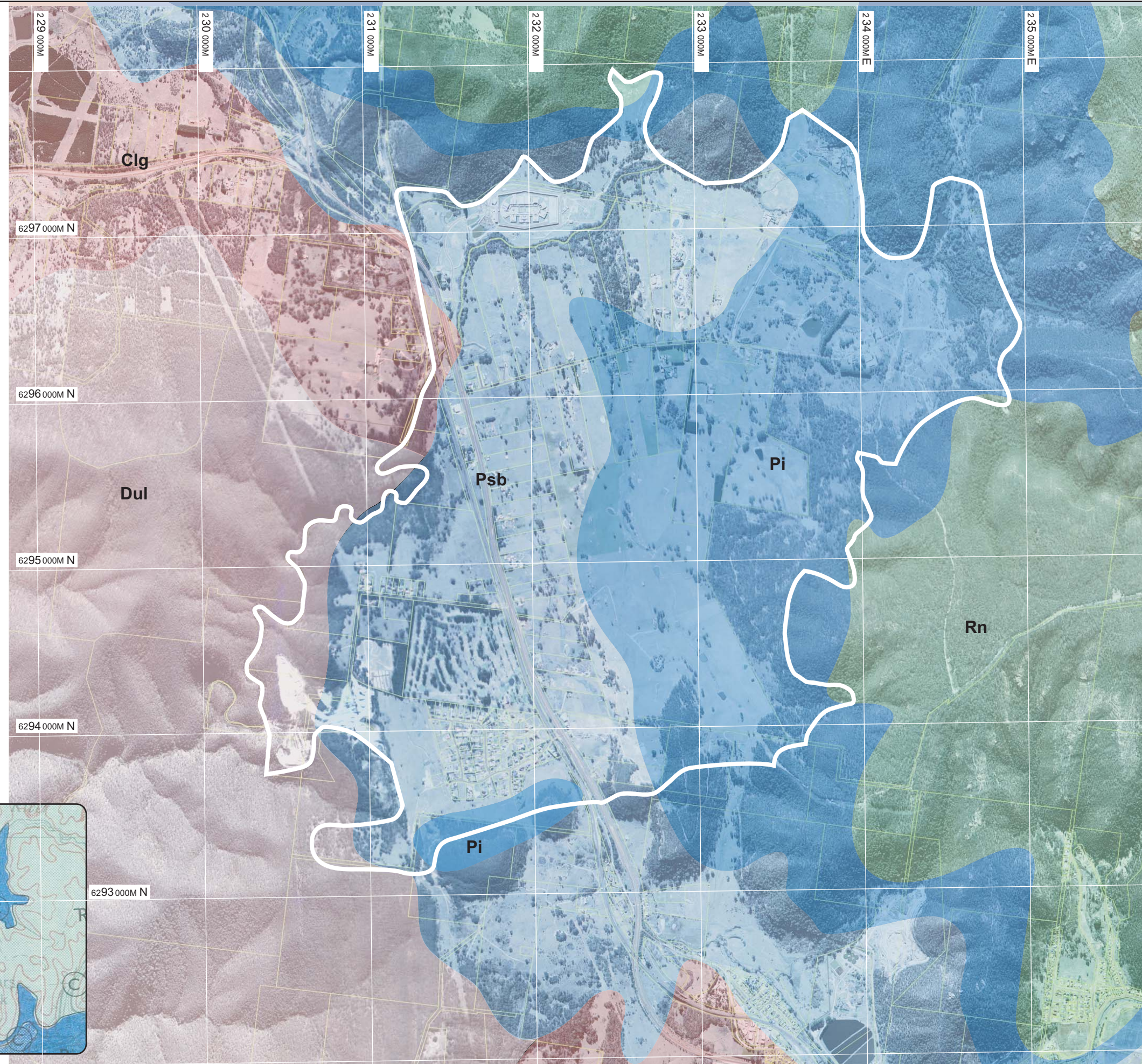
4.5 GEOLOGY

The regional geological setting is characteristic of the flat-lying and relatively underformed upper Palaeozoic and Mesozoic-age sedimentary strata which form the western margin of the Sydney Basin. These rocks, which host the Western Coalfields, are unconformably underlain by Ordovician to Lower Carboniferous metamorphosed sedimentary formations and igneous intrusions and extrusions of the Lachlan Fold Belt.

A review of the Sydney 1:250,000 scale geological map indicates that the Study Area is underlain predominantly by the Permian age Shoalhaven Group and Illawarra Coal Measures (**Figure 7**). The Shoalhaven group is dominated by shale, conglomerate and sandstone. The Illawarra Coal Measures are similar in lithology, with the difference that numerous coal seams are present. Within the region underground mining of these coal seams has occurred in the Lithgow and Mount Victoria areas and further to the east at Katoomba and Leura. The Shoalhaven Group and the Illawarra Coal Measures have a combined thickness of approximately 500m.

4.5.1 MINERAL RESOURCES

Metromix Quarries Pty Ltd currently mine a quartzite deposit in the south-western corner of the Study Area and hold a number of adjoining mining leases which cover this area (**Figure 8**). A geological survey report was undertaken for an area which includes Marrangaroo in 2000 and identifies this quartzite deposit to be of sufficiently high chemical purity and uniformity (SiO₂ 96.6-98.1) to be used in

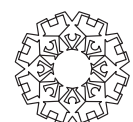


GEOLOGY

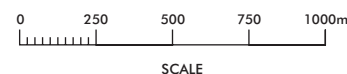
- Clg**
Unconformity
Adamellite, granite and granodiorite.
- Dul**
Lambie Group
Quartzite, sandstone, siltstone and claystone.
- Pi**
Illawarra Coal Measures
Shale, sandstone, conglomerate and chert with coal and torbanite seams.
- Psb**
Shoalhaven Group
Shale, conglomerate and sandstone, including lenticular development of the Megalong Conglomerate.
- Rn**
Narrabeen Group. Undifferentiated
Sandstone, shale and tuff.

SITE BOUNDARY

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GEOLYSE



SOURCE:

AERIAL PHOTOGRAPH & CADASTRE - © LAND AND PROPERTY INFORMATION (2005)
SYDNEY 1:250 000 GEOLOGICAL SERIES SHEETS S1 56-5 - GEOLOGICAL SURVEY OF NSW & NSW DEPARTMENT OF MINES (1961)

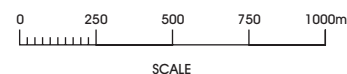
FIGURE 7:
MARRANGAROO
GEOLOGY

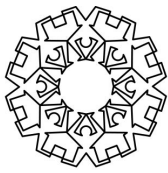


MINING & EXPLORATION TITLES

- CURRENT HOLDING
- SITE BOUNDARY

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metallurgical applications such as steel making (Department of Mineral Resources, 2001). It is also mechanically sound and can be used as hard rock aggregate in high strength concrete and other applications. In 2000, the quarry was producing about 110,000 tonne of material per annum of which about 15 percent was used in steel making by BHP. The rest was used as coarse aggregate, mainly in Greater Lithgow and Blue Mountains City Local Government Areas. In 2006, the expected life of the quarry was estimated to be about 50 years (DPI Mineral Resources).

4.5.2 MINE SUBSIDENCE

Mine subsidence is the lowering or settling down of the surface or the substrata of the land caused by excavation of a layer or underlying rock or coal seam (King, 1992). The Mine Subsidence Board controls surface developments on land overlying coal resources so as to ensure maximum compatibility between surface movements and underground mining. This is achieved through proclamation of Mine Subsidence Districts. A large part of the Lithgow LGA falls within the Lithgow Mine Subsidence District. However, the Marrangaroo Study Area does not fall within any Mine Subsidence District (letter received from DPI – Minerals dated 24 February 2006). See **Appendix C** for all agency correspondence.

4.6 SOILS

The soil distribution across the Marrangaroo Study Area was determined through review of the Soil Landscapes of the Wallerawang 1:100,000 sheet (King, 1993) and associated report. Site inspection of the topography, roadside cuttings, eroded areas, cultivated fields and topographic maps enabled classification into Great Soil Groups.

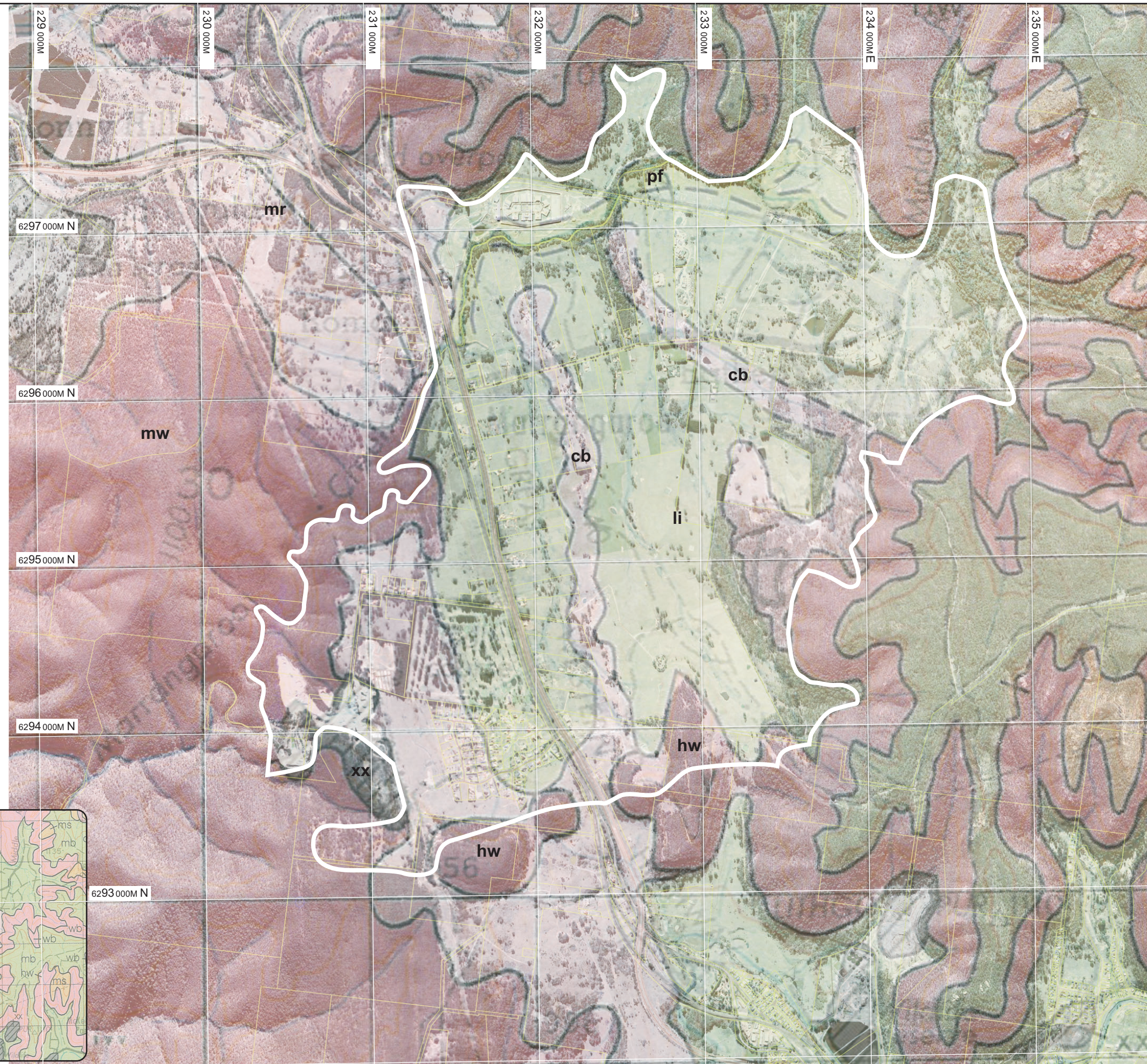
Additional information on soil profiles was obtained from a soil investigation of Lithgow Golf Course in 2003 by Envirowest Consulting.

An overview of the compiled information is included in the following sections.

4.6.1 SOIL LANDSCAPES

The soils of the Study Area are predominantly derived from the insitu weathering of underlying parent materials on the flats and broader valley areas, and from colluvial material from the mass movement of the escarpment faces and steep sideslopes.

Seven soil landscapes have been identified and mapped over the Marrangaroo Study Area. These include Cullen Bullen (cb), Hassans Walls (hw), Lithgow (li), Marrangaroo (mr), Mount Walker (mw), Pipers Flat (pf), and Disturbed Terrain (xx) soil landscape units. The distribution of soil types across the Study Area is shown on **Figure 9** while general descriptions of the two dominant Landscapes are provided below.



SOIL LANDSCAPES

	SITE BOUNDARY
	mw MOUNT WALKER
	hw HASSANS WALLS
	mr MARRANGAROO
	xx DISTURBED TERRAIN
	li LITHGOW
	pf PIPERS FLAT
	cb CULLEN BULLEN

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FIGURE 9:
MARRANGAROO
SOIL LANDSCAPES



GEOLYSE

Lithgow (li)

The Lithgow landscape is a residual landscape formed from in-situ weathering of parent material to form undulating elevated topography comprising summits, plateaux and terrace plains. Parent materials include horizontally bedded shale, sandstone, siltstone, mudstone, claystone, limestone, coal, torbanite and conglomerate of the Illawarra Coal Measures and the Berry Formation.

This soil landscape comprises moderately deep (<120 cm) red podzolic soils, yellow podzolic soils and yellow leached earths on upper slopes and well-drained areas. Moderately deep to deep (>170 cm) yellow solodic soil occur on lower slopes and in areas of poor drainage. Shallow soils comprising yellow earths and lithosol areas are associated with low scarps and rock outcrops. Localised rock outcrop forms a dominant feature of this landscape within the Study Area.

Cullen Bullen (cb)

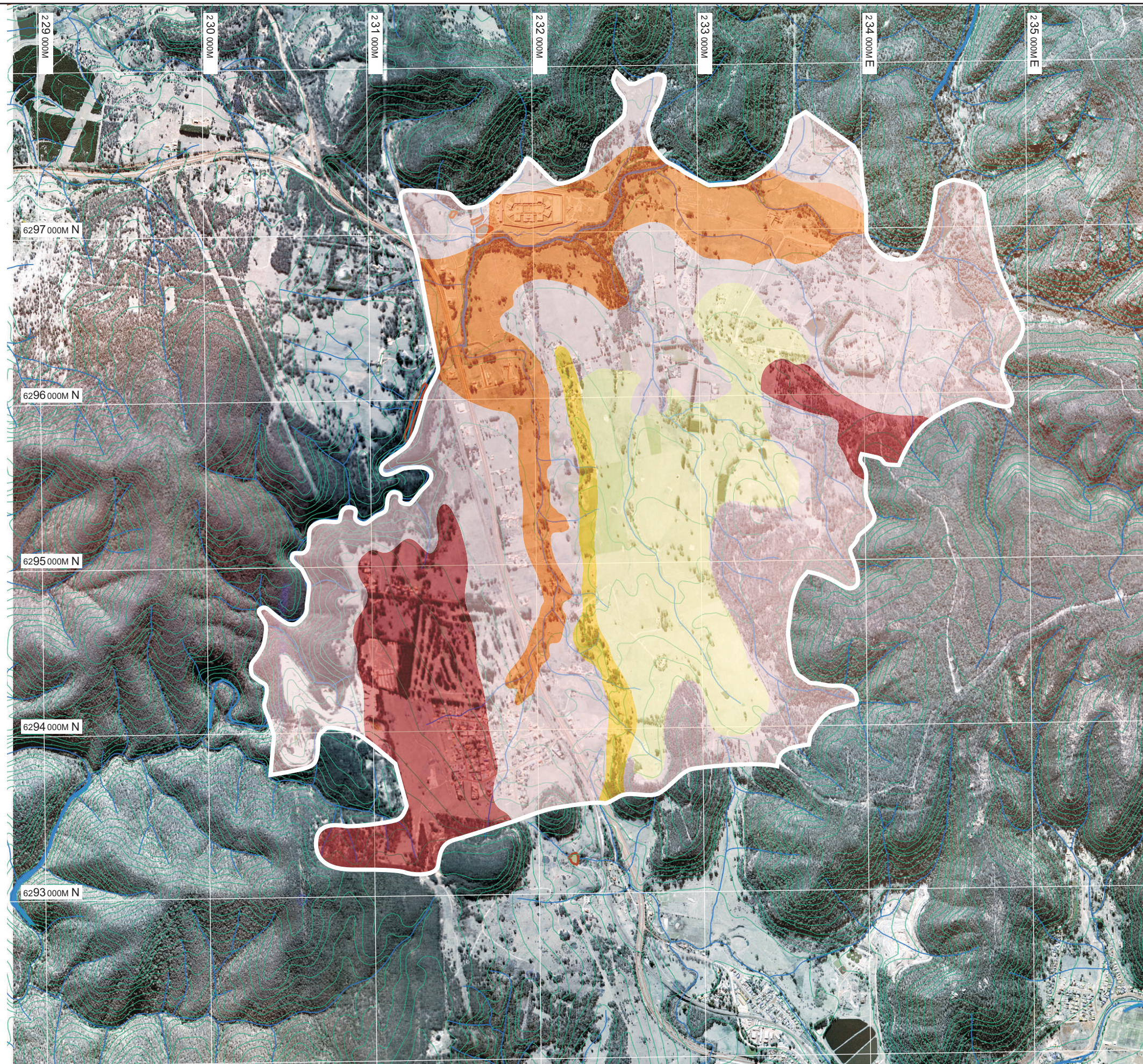
The Cullen Bullen landscape is an erosional landscape sculpted by the action of water. Soil depth is commonly shallow. Parent materials include shale, sandstone, conglomerate, limestone, dolomite, claystone, mudstone, coal and torbanite of the Illawarra Coal Measures and grey siltstone, limestone and sandstone of the Berry Formation. The topography of this soil landscape includes broad rolling low hills and rises with slopes of 10 – 25 percent. Local relief is less than 50m. Upper slopes are often strewn with cobbles and gravels with localised rock outcrop as small rock benches and ramps forming low scarps (<5m) on upper slopes.

This soil landscape comprises shallow (<80 cm) to moderately deep (<100 cm) yellow podzolic soils and yellow earths on crests, moderately deep yellow podzolic soils, soloths and yellow leached earths on upper and midslopes, moderately deep to deep yellow solodic soil and yellow podzolic soil on lower slopes near and along drainage lines and shallow yellow earths and lithosols associated with low scarps.

4.6.2 SOILS SPECIFIC TO THE STUDY AREA

The soil investigations undertaken as part of this study identified five major Great Soil Groups (See **Figure 10**) occurring within the Study Area comprising:

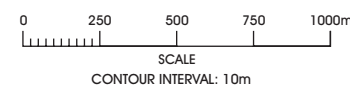
- Yellow solodics – along drainage lines;
- Yellow podzolics – mid and upper slopes;
- Yellow earths – mid and upper slopes;
- Red podzolics– mid and upper slopes; and
- Shallow soil and rock outcrop.



GREAT SOIL GROUPS

- YELLOW LEACHED EARTHS
- YELLOW SOLODIC
- SHALLOW SOILS
ROCK OUTCROP
- RED PODZOLIC
- YELLOW PODZOLIC
- SITE BOUNDARY

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SOURCE:

AERIAL PHOTOGRAPH, CONTOURS & DRAINAGE - © LAND AND PROPERTY INFORMATION (2005)

FIGURE 10:
MARRANGAROO
GREAT SOIL GROUPS



Table 4.1 - Great Soil Groups Occurring within the Study Area

Soil Code	Depth (cm)	Colour	Texture	Limitations
Yellow Solodics – Drainage lines				
li1	Topsoil (0-30)	Dull yellowish brown	Sandy loam	High erodibility
li3	Subsoil (30-60)	Yellowish brown	Fine sandy clay loam	Hardsetting, dispersible, erodible, low fertility
li4	Subsoil (60-150)	Yellowish brown, white/grey mottles	Medium clay	Moderate shrink-swell potential, low permeability, very low fertility
Yellow Podzolics – mid and upper slopes				
li2	Topsoil (0-20)	Yellowish brown	Clay loam to fine sandy clay loam	Hardsetting, acidic
li3	Subsoil (20-60)	Yellowish brown, reddish brown	Fine sandy clay loam	Hardsetting, dispersible, erodible, low fertility
li4	Subsoil (60-110)	Yellowish brown, white/grey mottles	Medium clay	Moderate shrink-swell potential, low permeability, very low fertility
Yellow Earths – mid and upper slopes				
li3	Subsoil (0-20)	Yellowish brown, reddish brown	Fine sandy clay loam	Hardsetting, dispersible, erodible, low fertility
li4	Subsoil (20-100)	Yellowish brown, white grey mottles	Medium Clay	Moderate shrink-swell potential, low permeability, very low fertility
Red Podzolics – mid and upper slopes				
li1	Topsoil (0-20)	Reddish brown	Clay Loam to fine sandy clay loam	Hardsetting, acidic
li3	Subsoil (20-60)	Reddish brown	Fine sandy clay loam	Hardsetting, dispersible, erodible, low fertility
li4	Subsoil (60-100)	Reddish brown	Medium clay	Moderate shrink-swell potential, low permeability, very low fertility
Shallow soil, rock outcrop				
li1	Topsoil (0-20)	Reddish Brown	Clay loam to fine sandy loam	Hardsetting, acidic



4.6.3 SOIL LIMITATIONS

The site and soil attributes may be limitations to development. Soil physical properties, soil chemical properties and landscape attributes are listed in **Table 4.2** along with indications for potential impacts. Attributes forming potential impacts may require additional investigation as part of any future development.

Table 4.2 - Soil Limitations to Development

Attribute	Description	Limitation
Physical properties		
Texture	Loam to clay loams	No
Soil Depth	Variable generally greater than 1 metre. Shallow soil and rock outcrops over the site	Yes in some areas
Course fragments	Few, cobbles to boulders	In some location
Bulk density	Satisfactory	No
Permeability	Long term infiltration is low to moderate. Soil is prone to water repellence for initial wetting, hardsetting surface	Limitation to wastewater application. Increase runoff and potential erosion
Water holding capacity	Low to moderate	No
Dispersion	Common is subsoil resulting in high soil erodibility	Yes
Plasticity	High clay soil effect engineering behaviour	Yes
Shrink-swell	Subsoils may be high, affects foundation	Yes
Shear strength	Silty soil have low wet strength	Yes
Structure	Poor structure, prone to erosion	Yes
Chemical properties		
Salinity	Non saline, potential to develop	No
PH	Low, affects plant growth	Yes, requires lime
Organic carbon	High (localized, affects water holding and soil structure)	Yes
Nitrate	Low, affects plant growth	Yes

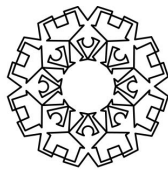


Table 4.2 - Soil Limitations to Development

Attribute	Description	Limitation
Phosphorus	Low, affects plant growth	Yes
Phosphorus sorption	Moderate, affects plant growth	Yes
Cations	Low cation exchange ratio and generally infertile soil	Yes
Micronutrients	Adequate	No
Sodicity	Subsoil are expected to be sodic and dispersive	Yes, erosion prone
Toxicity	Important in potentially contaminated areas and Defence site	Yes
Landscape Properties		
Landform element	Crests, upper slopes, midslopes, lower slopes, drainage depressions	Yes, flooding
Slope gradient	2 to 30 percent	Steeper areas only
Slope length	50-300m	Low
Site drainage	Some poorly drained areas	Yes
Moss movement and foundation instability	Possible localized mine subsidence. Fernbrook coal mine located in north of site now Endless Belt. Steel works and Hermitage mines are located in Defence land. All three mines are abandoned.	Yes
Height of water table	Seasonal elevated water tables in drainage depressions and flats	Yes
Rock	A rocky ridge traverses the site	Yes

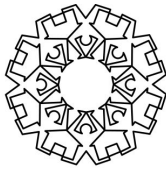
4.6.4 CONCLUSIONS AND RECOMMENDATIONS - SOILS

Soil Erosion

The soils of the Study Area are dispersive, have poor structure and are prone to erosion if disturbed or surface vegetation is removed. Impacts can be reduced with adequate mitigation techniques.

Plant Growth

The limitations in the physical and chemical soil properties can be improved by management. Plant growth is not considered a major limitation within the Study Area.



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Urban Capability

Physical limitations to urban development include the rocky scarp that traverses the site and drainage depression adjacent to the seasonal streams. The shallow rock may present difficulties for underground services, foundations and roads. Development should be excluded from riparian zones adjacent to the seasonal streams and drainage depression areas (yellow solodic soils). Development in the depressions and flats will require drainage of soil or introduced fill to prevent elevated water table problems.

Rural Capability

The soils of the Study Area create moderate limitations of cultivation and low limitations for grazing. Productivity is low due to soil and climatic factors.

Engineering Behaviour

The soil is expected to have low foundation hazard. Some subsoils have moderate shrinkage or swell potential and low bearing capacity under wet conditions which would necessitate detailed investigation as part of any potential future development within the Study Area.

The risk of mass movement hazard and mining subsidence is low across the Study Area.

4.7 SALINITY

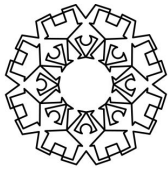
4.7.1 SALINITY ASSESSMENT

A desktop study was undertaken to establish the status of soil and groundwater salinity at the site. A site walkover was undertaken to determine visual evidence of soil salinity.

The soils of the Study Area are not naturally saline and no evidence of salinity was observed through visual inspection of the site, local knowledge or from available soil data (King 1993 and Envirowest Consulting Pty Ltd, 2003). Standing water levels in several registered bores has been noted to occur, at times, less than one metre from the surface indicating seasonally elevated water tables and waterlogging. The potentially waterlogged areas are adjacent to the tributaries of Marrangaroo Creek. Water samples collected from the dam, streams and bore on the golf course contained salinity of around 500 mg/L which is considered good quality drinking water.

4.7.2 CONCLUSION - SALINITY

The underlying geology contains sandstone and any change in the hydrological regime has the potential to result in leaching of salt to seepage areas. Increasing infiltration has the potential to result in rising water tables and localised salinity. Potential impacts are possible and dependant on the future use of the land and these factors would need to be assessed in more detail.



4.8 AGRICULTURAL LAND SUITABILITY AND CAPABILITY

A study of the suitability of agricultural lands in the city of Greater Lithgow was undertaken by the Department of Agriculture New South Wales in 1983. From this study and accompanying map, the Marrangaroo Study Area is identified as falling predominantly within land Class 3. Class 3 lands are generally considered suitable for grazing. According to the report, these lands are well suited to pasture improvement and can be cultivated for an occasional cash crop or forage crop in conjunction with pasture management. Overall level of production is moderate as a result of high environmental costs which limit the frequency of ground disturbance. Class 3 lands have a moderate capability for high levels of production, although conservation measures may be required (Department of Agriculture NSW, 1983).

Agricultural Land Capability has been mapped at a scale of 1:100,000 for the Eastern and Central Divisions of New South Wales (including the Study Area) using climate, soils, geology, soil erosion, site and soil drainage characteristics and current land use attributes (DLWC, 1986). This mapping aims to delineate the various classes of rural land on the basis of the capability of the land to remain stable under particular land uses.

The agricultural Land Capability of the Marrangaroo Study Area has been mapped based on the *Wallerawang 1:100,000 Land Capability Series Sheet 8931*. The boundaries of each land capability unit were refined for those areas falling within the Study Area through a combination of aerial photograph interpretation and field ground-truthing and are presented in **Figure 11**.

The majority of the Marrangaroo Study Area has been mapped as 'suitable for grazing with occasional cultivation'. From an agricultural perspective, these areas necessitate soil conservation practices such as pasture improvement, stock control, application of fertilizer and minimal cultivation for the establishment or re-establishment of permanent pasture. Other land capability classes occurring within the Study Area include areas 'suitable for grazing without cultivation', areas 'best suited to timber' and 'other', which in the context of the Study Area includes low lying areas not well suited to agriculture.

4.8.1 CONCLUSION - AGRICULTURE

The suitability of the area for grazing and occasional cultivation is being eroded by a change in adjoining land uses, the general small size of lots within the area and high ownership pattern. The area is ideally located close to urban services and now represents a far more valuable resource for wider urban uses. Its contribution and significance to agriculture in the local government area is minor.

4.9 LAND CONTAMINATION

A preliminary contamination site investigation was undertaken for the Study Area by Envirowest Consulting Pty Ltd as part of this study. The methodology, results, discussion, conclusion and recommendations from this assessment are included in the following sections.



LAND CAPABILITY

SUITABLE FOR GRAZING WITH OCCASIONAL CULTIVATION

Soil conservation practices such as pasture improvement, stock control, application of fertiliser and minimal cultivation for the establishment or reestablishment of permanent pasture.

SUITABLE FOR GRAZING WITHOUT CULTIVATION

Soil conservation practices including limitation of stock, broadcasting of seed and fertilizer, prevention of fire and destructive vermin. May include some isolated structural works.

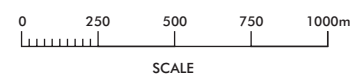
BEST SUITED TO TIMBER

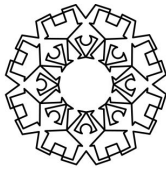
Land best suited for green timber. Generally stock should be excluded

OTHER

Cliffs, lakes or swamps.

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4.9.1 METHODOLOGY

The preliminary contamination site investigation comprised both field and desktop components as detailed below.

Site Inspection

Local Resident Liaison

A number of residents were interviewed and asked to supply information on past landuses and potentially contaminating activities.

Field survey

The site was inspected from the existing roads and farm tracks. Landuses and potentially contaminating activities were identified.

Desktop study

Review of aerial photographs

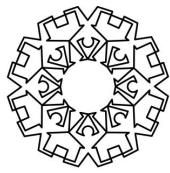
Historical aerial photograph interpretation was conducted on photographs from the years 1940, 1968 and 1991 (**Plates 1, 2 and 3**). The photographs enable past landuses and potential contaminating activities to be identified.

Review of topographic map

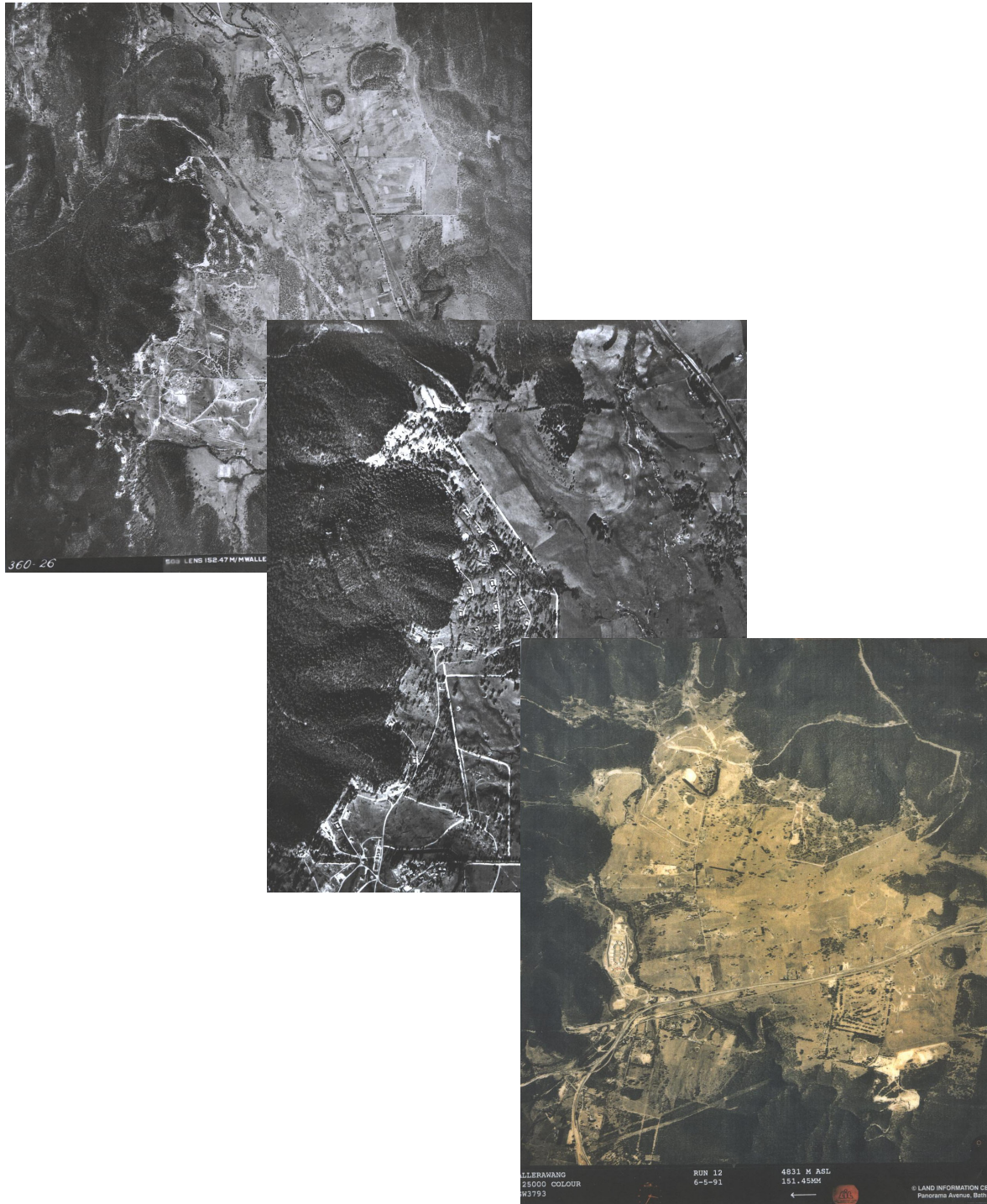
The Lithgow 1:25,000 topographic map was used to identify buildings and structures that may have resulted in contaminating activities.

Review of past studies

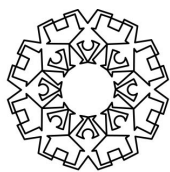
Two contamination studies have been conducted on parts of the Marrangaroo site in the past. These studies were for the Proposed Golf Links Gardens Development (Envirowest Consulting Pty Ltd report number R2264c1) and Marrangaroo Contamination Survey and Remediation Strategy (CMPS&F Environmental and ADI Services – Environmental). Lithgow Council were aware of no other contamination investigations undertaken in the Study Area.



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Plates 1, 2 and 3: Aerial photographs of the Study Area (or parts thereof) taken in 1940, 1968 and 1991, respectively.



4.9.2 RESULTS AND DISCUSSIONS

Review of past studies

Proposed Golf Links Gardens Development (Envirowest Consulting Pty Ltd report number R2264c1)

This study was undertaken on the area of land bordered by the Main Western Railway Line and Oakey Forest Road in the north-western section of the Marrangaroo Study Area (**Figure 1**). Farmyard stockpiles of old machinery and building materials were identified. Soil sampling over the site and analysis for metals and pesticides did not detect elevated substances.

Marrangaroo Contamination Survey and Remediation Strategy (CMPS&F Environmental and ADI Services – Environmental)

Activities undertaken at the Marrangaroo Department of Defence site have resulted in contamination of the site with explosives, heavy metals, cyanide, asbestos, pyrotechnics, chemical warfare, preservatives, herbicides, pesticides, propellants, casing packaging, incendiaries, other residues and fuel and oil.

Contamination was identified in soil, surface water and groundwater in the Defence land. Off-site contamination of surface and groundwater was suspected.

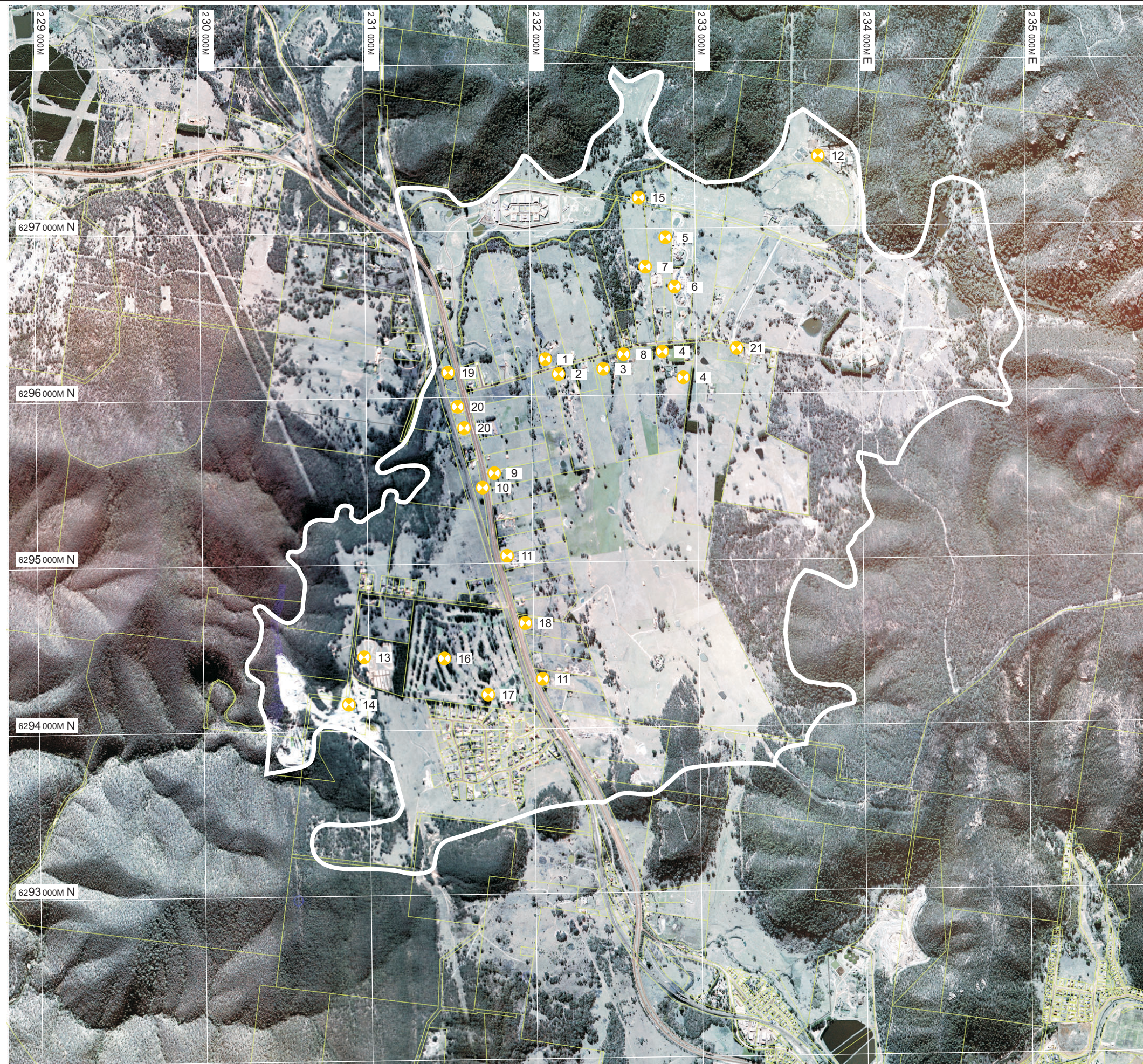
A remediation plan and strategy was proposed by CMPS&F Environmental and ADI Services. The status of the remediation strategy is not known. The range and extent of contamination on the Defence land is expected to prevent more sensitive landuses from being economically practical. The site is currently utilised by the Defence force for training activities.

Potentially contaminated locations

The Study Area has a diverse range of land uses and for many land uses potential exists for contamination. Potentially contaminated locations are presented in **Table 4.3** and **Figure 12**.

Table 4.3 - Potentially Contaminated Locations

Location	Landuse	Possible Contaminant Sources	Associated Chemicals
1	Motor mechanics	Oils, fuels	BTEX, PAH, lead, hydrocarbons
2	Equine centre	Manure	Heavy metals
3	Poultry sheds	Manure	Heavy metals
4	Possible horticulture	Fertilisers, insecticides, herbicides	Heavy metals, OCP
5	Earthmoving equipment	Oils, fuels, tyres	BTEX, PAH, phenols, lead, hydrocarbons, metals



-  POTENTIAL CONTAMINATION
-  SITE BOUNDARY

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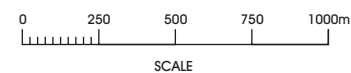




Table 4.3 - Potentially Contaminated Locations

Location	Landuse	Possible Contaminant Sources	Associated Chemicals
6	Machinery, coal stockpile, old tyres	Oils, fuels, tyres	BTEX, PAH, phenols, lead, hydrocarbons, metals
7	Oil drums	Oils	BTEX, PAH, phenols, lead, hydrocarbons
8	Fuel tank, potential horticulture	Fuels, insecticides, fertilisers	BTEX, PAH, phenols, lead, heavy metals, OCP, hydrocarbons
9	Possible dairy	Manure, fertilisers	Heavy metals, OCP
10	Possible nursery	Fertilisers	OCP, heavy metals
11	Machinery disposal	Machinery	Hydrocarbons, metals
12	Endless Belt (formerly Fernbrook Colliery)	Oils, fuel tanks, transformers, fill, coal waste	BTEX, PAH, phenols, lead, PCB, heavy metals
13	Go Kart Track	Oils, fuel	BTEX, PAH, phenols, lead, hydrocarbons
14	Quarry	Transformers, oils, fuels, explosives	PCB, BTEX, PAH, lead, explosives
15	Railway line	Fill, preservatives	Hydrocarbons, phenolics, heavy metals
16	Golf course	Fertilisers, pesticides	Heavy metals, OCP
17	Golf Club workshop	Oils, fuels, pesticides	BTEX, PAH, phenols, lead, hydrocarbons, pesticides
18	United 24 Service Station	Oils, fuels, fill	BTEX, PAH, phenols, lead, hydrocarbons, heavy metals
19	Greater City Kitchens	Sawdust, paints, glues, laminates	Heavy metals, solvents
20	Bush Fire Brigade depot & Department of Lands works depot	Oils, fuels	BTEX, PAH, phenols, lead, hydrocarbons
21	Farm sheds and tanks	Farm activities, oils, fuels, pesticides, fertilisers, herbicides	BTEX, PAH, phenols, lead, hydrocarbons, heavy metals, OCP
Various locations	Houses, sheds	Fibro	Asbestos



Table 4.3 - Potentially Contaminated Locations

Location	Landuse	Possible Contaminant Sources	Associated Chemicals
Various locations	Agricultural infrastructure including chemical storage areas and mixing points	Oil, fuels, pesticides	BTEX, PAH, phenols, lead, hydrocarbons, pesticides
Various locations	Agricultural land	Fertilisers, pesticides	Metals, OCP
Various locations	Roadways, building pads	Fill material	BTEX, PAH, phenols, lead, hydrocarbons, heavy metals
Various locations	On-site effluent systems	Sewage, accidental disposal of substances	Metals, pathogens, hydrocarbons
Various locations	Dams	Fertilisers, pesticides, oils, fuels	Metals, OCP, BTEX, PAH, phenols, lead hydrocarbons
Various locations	Streams	From Defence	Several possible
Various locations	Groundwater	From Defence	Several possible

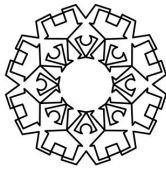
Notes:
 BTEX – Benzene, Toluene, Ethylbenzene and Xylene
 PAH – Polycyclic Aromatic Hydrocarbons
 OCP – Organophosphorus Pesticides
 PCB – Polychlorinated Biphenyl

4.9.3 CONCLUSIONS – LAND CONTAMINATION

The Marrangaroo Study Area has a diverse range of landuses including agriculture, commercial, mining, industrial, recreational and residential. All of these landuses have the potential to cause contamination.

Most of the investigation area supports livestock grazing landuse with little or no contamination expected. Twenty-nine specific locations, areas or landuses have been listed as containing potential contamination. These twenty-nine areas would require additional investigation and sampling to determine the contamination significance prior to any further development. A more detailed investigation may also determine other areas potentially contaminated not listed in this report. The Defence land has been identified as containing many areas of contamination from past activities and is unlikely to be considered suitable for other landuse activities.

Further investigation will be required to determine the contamination significance of the identified areas prior to any future development. Investigation of individual sites would include site specific history, identification of signs of contamination and a sampling program according to EPA sampling guidelines. The scope of such investigations would be dependant on proposed landuse.



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4.10 GROUNDWATER

4.10.1 STATE POLICY

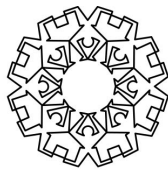
The NSW Government and the community recognise the need for a coordinated approach to the improved management of groundwater. This can be achieved through implementation of *The NSW State Groundwater Policy Framework Document* and its component policies which includes *The NSW Groundwater Quality Protection Policy* (DLWC, 1998).

The goal for management of groundwater resources in New South Wales is to manage the State's groundwater resources so that they can sustain environmental, social and economic uses for the people of NSW. It is the policy of the NSW Government to encourage the ecologically sustainable management of the State's groundwater resources, so as to:

- slow and halt, or reverse any degradation of groundwater resources;
- ensure sustainability of groundwater dependent ecosystems;
- maintain the full range of beneficial uses of these resources; and
- maximise economic benefit to the Region, State and Nation.

The Groundwater Quality Protection Policy adopts nine principles in relation to groundwater quality protection. Those considered relevant to the Marrangaroo study area include the following:

- All groundwater systems should be managed so that the most sensitive identified use (or environmental value) is maintained.
- Groundwater pollution should be prevented so that future remediation is not required.
- For new developments, the scale and scope of work required to demonstrate adequate groundwater protection shall be commensurate with the risk the development poses to a groundwater system and the value of the resource.
- Groundwater dependent ecosystems will be afforded protection.
- Groundwater quality protection should be integrated with the management of groundwater quantity.
- The cumulative impacts of developments on groundwater quality should be recognised by all those who manage, use, or impact the resource.



4.10.2 REGIONAL CONTEXT

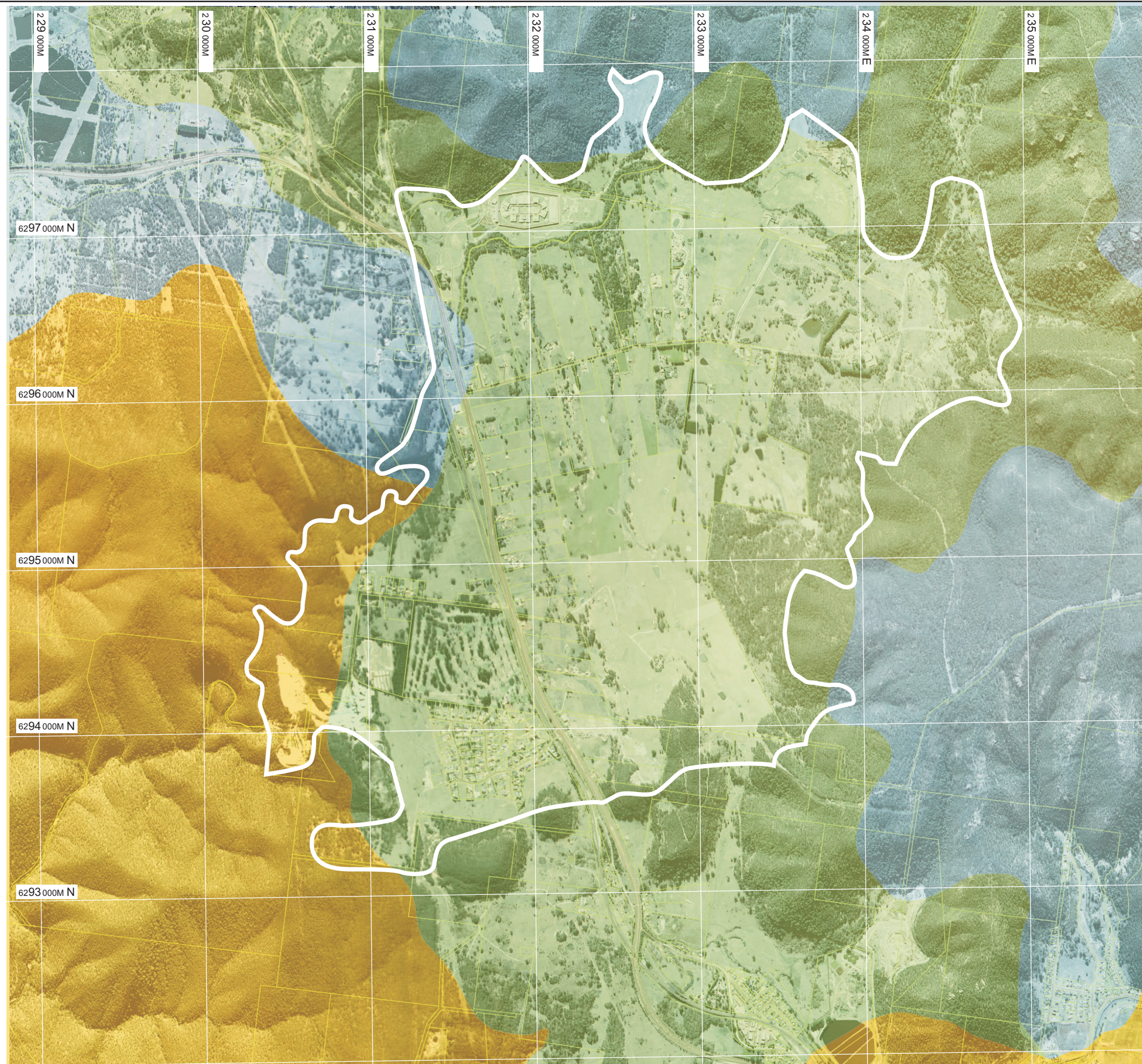
Reference to the *Groundwater Flow Systems of Australia* (2000) map indicates that the Study Area comprises areas of both 'intermediate' and 'local' flow systems. Local flow systems entail recharge and discharge areas within a few kilometres of one another. They tend to occur in areas of higher relief within individual sub-catchments and groundwater flow paths are generally less than 5 kilometres long. Intermediate flow systems occur within individual catchments but also sometimes flow between smaller sub-catchments. They tend to occur in valleys, and typically occur over a horizontal scale of ten to fifty kilometres. The Study Area does not fall within a system of regional flow.

The Hawkesbury-Nepean Groundwater Availability Map (Hawkesbury-Nepean Catchment Management Trust, Department of Land and Water Conservation, 1998) indicates that the groundwater beneath the Study Area can generally be classified as 'Brackish' (i.e. a salinity typically ranging from 1500 mg/L to 5000 mg/L total salts). Groundwater classified as 'Marginal' (i.e. a salinity typically ranging from 500 mg/L to 1500 mg/L total salts) has been mapped as occurring within the south-west sector of the Study Area. 'Fresh' groundwater (i.e. <500 mg/L total salts) has been mapped as occurring in the vicinity of the northern and north-western limits of the Study Area (**Figure 13**).

The vulnerability of groundwater in the Hawkesbury-Nepean Catchment has been mapped by the Department of Land and Water Conservation (now DNR) at the catchment scale. This mapping is based on features including depth to watertable, recharge, aquifer media, soil media, topography and impact of Vadose Zone (the zone above the watertable which is unsaturated or discontinuously saturated). The vulnerability ranking describes the relative assessment of the probability of a groundwater resource being susceptible to contamination. Reference to the Groundwater Vulnerability map for the Hawkesbury-Nepean catchment indicates that the Study Area falls predominantly within an area mapped as having a 'moderately high' vulnerability rating (**Figure 14**). Approximately 10 percent of the Study Area is mapped to a 'moderate' vulnerability rating.

4.10.3 LOCAL HYDROGEOLOGY

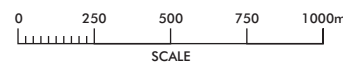
A search of the DIPNR borehole database indicates a total of 19 registered boreholes within an area extending 2 kilometres beyond the Study Area boundary. These bores are used for several purposes including domestic, general use, industrial, irrigation, monitoring, recreation (irrigation) and stock. **Table 4.4** provides a summary of borehole locations, authorised and intended purpose (usage), yield, salinity and standing water level. The distribution of these bores relative to the site is shown in **Figure 15**.

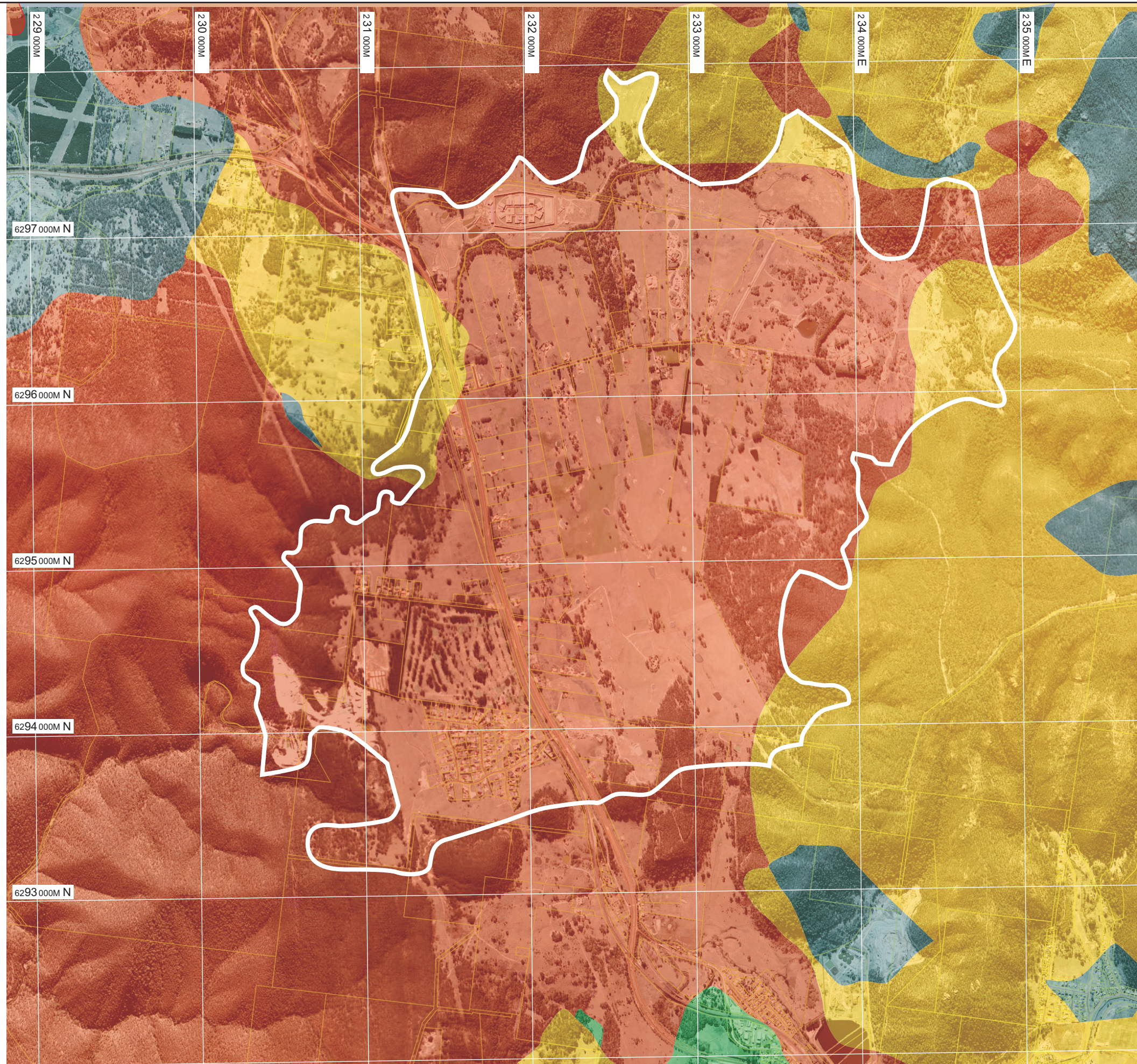


GROUNDWATER AVAILABILITY

- FRESH (TDS<500mg/L)
- MARGINAL (TDS 501-1500mg/L)
- BRACKISH (TDS 1501-5000mg/L)
- SALINE (TDS > 5000mg/l)
- SITE BOUNDARY

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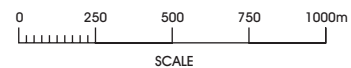




VULNERABILITY RATING

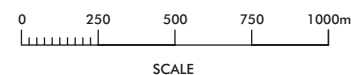
- MODERATELY HIGH
- MODERATE
- LOW MODERATE
- LOW
- SITE BOUNDARY

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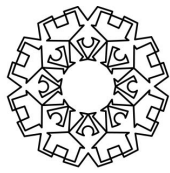


 GROUNDWATER BOREHOLES
 SITE BOUNDARY
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SOURCE:
 AERIAL PHOTOGRAPH & CADASTRE - © LAND AND PROPERTY INFORMATION (2005)
 REGISTERED GROUNDWATER BORES - DEPARTMENT OF NATURAL RESOURCES [ONLINE] (2005)

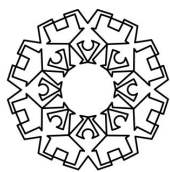
FIGURE 15:
 MARRANGAROO
 REGISTERED GROUNDWATER
 BOREHOLES



GEOLYSE

Table 4.4 - Registered Boreholes

Name	Easting	Northing	Usage	Yield (L/s)	Salinity (ppm)	Standing Water Level (m)	Water Bearing Zones (m)
GW011892	232455	6296160	Domestic/ Stock				
GW039443	231840	6297135	Industrial/ Recreation/ Irrigation				18.5-18.5 23.5-23.5 32.0-32.0 35.9-35.9 36.7-36.7 41.8-41.8 44.0-44.0 48.0-48.0 52.0-52.0 57.4-57.4 59.7-59.7 64.8-64.8
GW053081	231950	6295250	Domestic/ Irrigation	0.10 0.10 2.00		0.3	4.5-5.0 10.6-11.0 13.7-14.0
GW054781	232370	6296220	Domestic/ General Use	0.25 0.13		1.5	6.1-7.9 33.5-33.5
GW055053	231970	6294980	Domestic/ Stock/ General Use	0.38		6.1	12.2-13.7
GW055055	231950	6295860	Domestic/ General Use	0.38 4.10 4.50		7.6	10.6-10.9 16.7-17.0 18.2-18.6
GW057365	232620	6296220	Domestic/ Stock	17.50		0.0	24.4-25.0
GW057399	231745	6296137	Domestic/ Stock	0.63		4.6	15.2-16.7
GW058108	232460	6296265	Domestic/ Stock	17.50		0.0	25.9-27.4
GW058554	232370	6296325	Domestic	0.63	'Good'	9.1	27.4-28.9
GW059292	233374	6292228	Industrial	6.25	501-1000	30.5	44.2-44.5
GW060112	231955	6294240	Recreation	9.09		12.2	21.1-21.1 22.3-22.3 25.6-27.4 29.0-29.0
GW060113	231365	6294285	Recreation				

**Table 4.4 - Registered Boreholes**

Name	Easting	Northing	Usage	Yield (L/s)	Salinity (ppm)	Standing Water Level (m)	Water Bearing Zones (m)
GW060428	231065	6296710	Domestic/ Stock/ Irrigation				
GW063721	233040	6292375	Domestic/ Industrial	0.50 1.26	'Good' 'Good'	10.0	21.3-21.9 35.0-35.6
GW102428	232028	6293923	Domestic/ Stock	1.26		28.9	33.5-33.8
GW104218	234029	6292636	Monitoring Bore				8.2-9.0 14.8-17.3
GW104220	234068	6292610	Monitoring Bore				18.3-21.3
GW104222	233937	6292293	Monitoring Bore				14.0-17.0

Notes:

ppm = parts per million (equivalent to milligrams per litre)

L/s = litres per second

Source: DIPNR, 2005

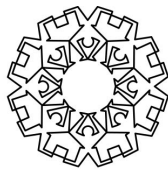
A review of the borehole summary worksheets indicates that the most common use for groundwater abstracted from the local groundwater table includes that for domestic purposes. Each borehole registered for domestic purposes is also registered for either stock, irrigation, general use or industrial purposes. The yields of these bores generally range from low to moderate (i.e. 0.1 to 17.5 L/s), whilst the groundwater quality has been described as 'Moderate' (i.e. 500 mg/L to 1500 mg/L) or 'Good'.

4.10.4 CONCLUSIONS AND RECOMMENDATIONS - GROUNDWATER

This investigation has been based on a brief desk-top review with the intent of identifying groundwater uses within a 2 kilometre radius of the Study Area and to determine the sensitivity of the groundwater resource to potential contamination within the locality.

There is limited available data regarding the quality of groundwater within each of these bores, although the groundwater beneath the Study Area has generally been described as 'brackish' (Hawkesbury-Nepean Catchment Management Trust, Department of Land and Water Conservation, 1998).

Despite any salinity status of this groundwater resource, the sensitivity of contamination is assessed as being high. This is based on the use of the local groundwater resource for domestic purposes. Furthermore, the groundwater vulnerability map identifies the Study Area as falling within an area in



GEOLYSE

which contamination to groundwater cannot be tolerated (Hawkesbury-Nepean Catchment Management Trust, Department of Land and Water Conservation, 1998).

Subsequently, detailed groundwater investigations would need to be undertaken prior to the establishment of any potentially contaminating activities (see below) within the Study Area. Groundwater protection systems would need to be implemented and an on-going monitoring and assessment program would need to be developed prior to the establishment of potentially polluting industry, consistent with the groundwater vulnerability mapping undertaken by DLWC in 1997.

Any future changes in landuse would need to be consistent with *The NSW Groundwater Quality Protection Policy*.

Some activities that may cause contamination

- Acid/alkali plant and formulation
- Agricultural/horticultural activities
- Airports
- Asbestos production and disposal
- Chemicals manufacture and formulation
- Defence works
- Drum re-conditioning works
- Dry cleaning establishments
- Electrical manufacturing (transformers)
- Electroplating and heat treatment premises
- Engine works
- Explosive industry
- Gas works
- Iron and steel works
- Landfill sites
- Metal treatment
- Mining and extractive industries
- Oil production and storage
- Paint formulation and manufacture



GEOLYSE

- Pesticide manufacture and formulation
- Power stations
- Railway yards
- Scrap yards
- Service stations
- Sheep and cattle dips
- Smelting and refining
- Tanning and associated trades
- Waste storage and treatment

Source: ANZECC & NHMRC (1992) cited in DUAP & EPA (1998)

4.11 SURFACE WATER

4.11.1 REGIONAL CONTEXT

The Marrangaroo Study Area lies within the Sydney drinking water catchment. Five catchments contribute to Sydney's drinking water supplies – Warragamba, Upper Nepean, Woronora, Shoalhaven and Blue Mountains – which cover almost 16,000 square kilometres, extending from the headwaters of the Coxs River north of Lithgow to the Shoalhaven River south of Braidwood.

The Study Area falls within the Upper Coxs River subcatchment, which forms part of the Blue Mountains catchment. The Coxs River is the primary waterway draining the Blue Mountains catchment. The Coxs River flows into Lake Burragorang which is formed by Warragamba Dam and is the major water supply for Sydney.

4.11.2 LOCAL HYDROLOGY

The local hydrology and site drainage features are shown on **Figure 16**.

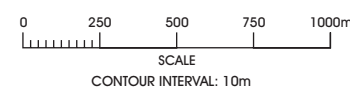
The majority of the Study Area lies within the catchment of Marrangaroo Creek (also referred to as Middle River). This catchment covers about 55 square kilometres in its entirety. The upper headwaters of Marrangaroo Creek begin approximately 9 kilometres upstream of the Study Area. Marrangaroo Creek enters the Study Area from the north and forms the western boundary of this area. A small portion (approximately 3 percent of the Study Area) in the southern part of the Study Area falls within the catchment of Farmer's Creek, which is also a tributary of the Coxs River.

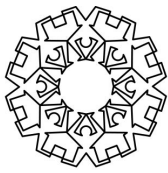


DRAINAGE & CONTOURS

- EPHEMERAL FEEDER STREAMS
20m BUFFER EACH SIDE
- MARRANGAROO CREEK
50m BUFFER EACH SIDE
- IDENTIFIED SPRINGS
- WATER QUALITY SAMPLING POINT
- 100 YEAR FLOOD ZONE
- DRAINAGE LINE
- 10m CONTOUR LINE
- SITE BOUNDARY

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Both Marrangaroo Creek and Farmers Creek are defined as perennial watercourses on the Lithgow 1:25,000 topographic map. Apart from Marrangaroo Creek, all drainage lines occurring in the Study Area are ephemeral and generally only flow following heavy or prolonged rainfall. However, some springs were identified during the site visits and are also presented in **Figure 16**.

4.11.3 FLOODING

The Study Area comprises landforms ranging from level floodplains in the north to very steep side-slopes in areas abutting the Study Area boundary. A flood study was undertaken by Tierney & Partners Pty Ltd in 1988 for a section of Marrangaroo Creek that passes through the Study Area. This study was commissioned by the NSW Department of Public Works as part of the initial proposal to establish the Lithgow Correctional Centre at its current location. The study established the 100 year average recurrence interval (ARI 100 year) runoff from the catchment of Marrangaroo Creek upstream of the Highway Bridge. The maximum probable 1 in 100 year flood zone established through this study is indicated in **Figure 16**.

A Development Application (DA) for an industrial subdivision was approved by Lithgow City Council in 2003. The DA included redirecting of an ephemeral drainage line which runs parallel and immediately east of the Great Western Highway. It is understood that the redirecting took place immediately upstream of this stream's confluence with Marrangaroo Creek and that the flood levels indicated by Tierney & Partners Pty Ltd (1988) have now changed in the vicinity of this development. No flood study could be made available to Geolyse at the time of compiling this report to confirm alternate flood levels.

4.11.4 WATER QUALITY

Warragamba Catchment Blueprint

The Warragamba Catchment Blueprint (DLWC, 2003) seeks to achieve an improvement on both the quality and quantity of the catchments surface and groundwater systems over a period of ten years beginning 2002/03. Specific to river health, the Blueprint specifies the following Catchment Target:

"By 2012 improvement in river health is indicated by a higher rating at a minimum of 5 of the 9 AUSRIVAS (Australian River Assessment System) sites currently rated as 'well below reference' or 'impoverished' and maintenance of the rating at each of the other 15 sites."

This is to be achieved through the development and implementation of water plans, including statutory plans under the *Water Management Act 2000*, addressing diffuse and point source pollution, improving native fish habitat, and conserving and restoring riparian habitat. The achievement of this target is also supported through the implementation of the Regional Plan for Sydney's drinking water catchments.



Regional Plan for Sydney's Drinking Water Catchments

The Regional Plan titled: *Sustaining the Catchments – The Regional Plan for the drinking water catchments of Sydney and adjacent regional centres*, sets water quality objectives for the catchments based on the recommendations of the Healthy Rivers Commission (HRC) inquiries into the Hawkesbury-Nepean, Shoalhaven and Georges Rivers.

The HRC process identified environmental values based on community aspirations and identified water quality objectives according to the 1992 version of the national water quality guidelines. The NSW Government has endorsed the water quality objectives identified by this inquiry process.

Since the HRC inquiry process identified environmental values, the national water quality guidelines that identify the indicators and the numerical criteria required to meet those values have been updated. The current national water quality guidelines, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000), provide the numerical criteria for environmental values relating to aquatic ecosystems, recreation and primary industry.

For drinking water the national water quality guidelines refer to the Australian Drinking Water Guidelines (NHMRC & ARMCANZ, 2004) which identify numerical values for raw water quality, such that after treatment water will be suitable for drinking. Water quality objectives set by the Regional Plan for the catchments are, therefore, based on the recommendations of the HRC inquiries and updated to reflect the changes in the national water quality guidelines.

Water quality is a widely used indicator of the health of a catchment. A measure of the quality of water provides some indication of the downstream impacts that all the activities and land uses within the catchment are having.

No water quality data could be sourced for the Marrangaroo study to complement this study. Sydney Catchment Authority monitor water quality in the catchment of Warragamba Dam, however the nearest site is located much lower in the catchment, on the Cocks River in the vicinity of its confluence with the Kowmung River.

Physico-chemical water quality parameters were obtained for Marrangaroo Creek on 30 January 2006, 28 February 2006 and 3 April 2006 as part of this study. Measurements were obtained at the boundary of the Defence land (SW1) and both upstream (SW2) and downstream (SW3) of the trout farm. These locations are marked on **Figure 16**. Water quality samples were also obtained from each of these three sites and analysed for concentrations of total nitrogen, oxidised nitrogen, total phosphorus, total suspended solids, faecal coliforms and turbidity by a NATA endorsed laboratory. Results are provided in **Table 4.5** and are compared with the Water Quality Objectives set by the Regional Plan.

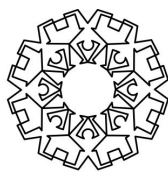


Table 4.5 - Stream Water Quality – Marrangaroo Creek

Parameter	Unit	Guideline Value	Site								
			30 th January 2006			28 th February 2006			3 rd April 2006		
			SW1	SW2	SW3	SW1	SW2	SW3	SW1	SW2	SW3
Temperature (field)	°C	NA	14.0	13.7	14.8	17.1	18.7	24.3	22.5	21.0	21.0
pH (field)	pH units	6.5 - 7.5 ¹ 6.5 - 8.5 ⁴	6.8	6.7	6.9	7.1	6.8	6.9	7.0	7.0	6.8
Electrical Conductivity	µS/cm	30 - 350 ¹ 800 ⁴	34	48	58	26	42	64	43	42	28
Suspended Solids	mg/L	NA	<1	2	1	2	2	6	5	14	4
Turbidity	NTU	2 - 25 ¹ 5 ⁴	1.4	2.8	1.6	2.2	2.4	3.1	2.7	2.7	1.4
Dissolved Oxygen (field)	mg/L	NA	14.4	13.9	12.0	14.6	13.8	11.5	14.3	14.1	15.1
Nitrate + Nitrite	mgN/L	0.015 ¹ 11 ⁴	<0.010	0.034	0.299	<0.010	0.013	0.226	0.096	0.091	0.038
Total Nitrogen	mg/L	0.25 ¹	0.3	0.4	1.0	0.1	0.2	0.8	1.0	0.8	1.8
Total Phosphorus	mg/L	0.02 ¹	0.02	<0.01	0.03	0.04	0.1	0.14	0.02	0.02	0.01
Faecal Coliforms	CFU/100mL	Median 150 (4 out of 5 samples <600) ² , Median 1000 (4 out of 5 samples <4000) ³	7	260	9	<1	<1	<1	49	33	33

Guideline Source:

Australian & New Zealand Guidelines for Fresh & Marine Water Quality and the Agriculture and Resource Management Council of Australia & New Zealand (2000). *Australian and New Zealand Guidelines for Marine Water Quality*.

1. Slightly disturbed aquatic ecosystems in south-east Australia
2. Recreational water – primary contact
3. Recreational water – secondary contact

4. National Health & Medical Research Council and the Natural Resource Management Ministerial Council (2004). *Australian Drinking Water Guidelines*.

Values indicated in **bold** text exceed the indicated guideline value.

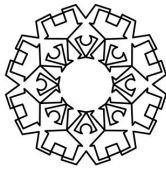


The relevant water quality observations from these results are as follows:

- pH levels fell within the desired range for both aquatic ecosystems and drinking water on all three occasions.
- Electrical Conductivity levels fell favourably below the upper ANZECC & ARMCANZ guideline value of 350 $\mu\text{S}/\text{cm}$ at each sampling site on all three sampling occasions.
- Concentrations of total phosphorus exceeded the ANZECC & ARMCANZ guideline value of 0.02 mg/L on at least one occasion at each sampling site with exceedences ranging from 0.01 mg/L to 0.12 mg/L above the guideline value.
- Concentrations of total nitrogen exceeded the ANZECC & ARMCANZ guideline value of 0.25 mg/L on at least two occasions at each of the three sampling sites. The highest levels of total nitrogen were detected at the downstream monitoring site SW3 in each sampling round.
- Concentrations of oxidised nitrogen exceeded the ANZECC & ARMCANZ value of 0.015 mg/L on at least two occasions at each of the three sampling sites.
- Although samples have only been collected and analysed on three occasions, median faecal coliform counts at each monitoring station fell favourably below the ANZECC & ARMCANZ values for both primary and secondary contact recreation. Faecal coliform levels were below the laboratory detection limit of 1 CFU/100mL in samples collected from each site in February 2006.
- Although the diurnal range was not established, dissolved oxygen (DO) levels (obtained around midday) remained favourably high at each of the three sampling sites.
- Turbidity levels fall favourably below the NHMRC & NRMMC limit for drinking water quality and the ANZECC & ARMCANZ upper limit for slightly disturbed aquatic ecosystems in south-east Australia with high clarity (<5 NTU) detected at each sampling site.

The water quality testing provides indicative baseline data for three points in time. Importantly, this sampling is not intended to be a comprehensive water sampling program.

Environmental stress ratings and priority issues for the drinking water catchments are provided in *Sustaining the Catchments – The Regional Plan for the drinking water catchments and adjacent regional centres – Draft* (Sydney Catchment Authority and the Department of Infrastructure, Planning and Natural Resources, 2004). The Upper Cocks River is given a high environmental stress rating due to nutrients from sewage treatment plants, disturbance to water flow due to dams for power supply, barriers to fish passage and geomorphological disturbance from mining. Potential future pressures arise from increased urban and rural residential development and associated infrastructure including increased discharge from sewage treatment plants.



4.11.5 CONCLUSIONS AND RECOMMENDATIONS – SURFACE WATER

Riparian Buffers

The Wentworth Group of Scientists (2003) suggest the following standards for native vegetation should be adopted across NSW to assist in maintaining water quality:

“Conserving and restoring riparian vegetation 50m to 100m either side of major rivers and wetlands; 20m to 50m either side of creeks and 10m to 20m either side of streams.”

Within the context of the Study Area, Geolyse recommends a minimum 50m buffer either side of Marrangaroo Creek and a 20m buffer either side of the ephemeral feeder streams be maintained and/or improved as part of any future changes in landuse across the Study Area (**Figure 16**). This would help ensure that not only the quality of water draining from the Study Area be maintained, but also that the ecological integrity of downstream receiving environments would not be adversely affected as part of any future change in landuse.

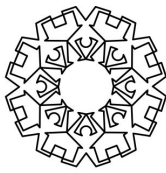
The Department of Natural Resources advised Council that the streams and drainage courses in the Study Area must be classified. Ideally this would inform a strategic approach to water/stream management along these watercourses. This process is underway but is incomplete. Further discussion on this matter is advanced in Section 8.

River Flow Objectives

River Flow Objectives (RFO's) have been developed for NSW catchments, including the Hawkesbury-Nepean catchment (pers. comm. Chris Marshall, DEC, 5 June 2006). The RFO's have been developed to guide plans and actions to achieve healthy waterways. Eleven RFO's have been established. Each objective deals with how water moves down rivers and streams. Each objective aims to improve river health by recognising the importance of natural river flow patterns. The objectives are based on achieving improved environmental results for managing the riverine system. The RFO's relevant to the study are as follows:

- Protect pools in dry times
- Protect natural low flows
- Protect important rises in water levels
- Maintain wetland and floodplain inundation
- Mimic natural drying in temporary waterways
- Maintain natural rates of change in water levels

Notwithstanding specific legislative requirements, changes in runoff and infiltrations by development across the site would impact on stream flows and groundwater to some extent. Increasing infiltration has the potential to increase water tables. Decreased infiltration, such as through an increase in hard



surfaces, has the potential to modify natural stream flows. The extent of any change would depend on the landuse, surface cover and vegetation across the site.

Any future changes in land use at Marrangaroo should demonstrate a commitment to maintaining or improving river health through achievement of the RFO's.

Protecting Sydney's Water Supply

The Study Area is in the Sydney Drinking Water Catchment and as such development within this area would require consideration under *State Environmental Planning Policy No 58 – Protecting Sydney's Water Supply* (SEPP 58). The aims of SEPP 58 are to:

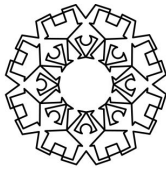
- Ensure that development in the catchment areas from which Sydney's drinking water is drawn does not have an adverse impact on water quality;
- Provide concurrence or notification roles for the Chief Executive of the Sydney Catchment Authority (SCA) in relation to certain listed developments that could have an adverse impact on water quality; and
- Ensure that there is a consistent approach when assessing the possible impact of development proposals on water quality within the catchments.

SEPP 58 requires any proposed change in land use to demonstrate a neutral or beneficial effect on water quality.

4.12 AIR QUALITY

The Study Area comprises an array of uses including residential, rural pursuits, recreational facilities, motel accommodation, service station, correctional facility, trout farm, light industrial, quarrying and Defence activities including explosive demolition. There is one licensed facility under the *Protection of the Environment Operations Act, 1997* which is the Metromix Pty Limited quarry. No air quality monitoring is required by this licence. There are no substance emitting facilities located immediately within the Study Area that are likely to be significant point sources of particulate matter or odour. It is noted that the *Lithgow State of the Environment Report* (2005) recognises the use of coal and wood heaters as the main pressure on local air quality in Lithgow. However emissions from solid fuel heaters are considerably lower than other emission sources. The National Pollutant Inventory records emissions generated by industry type with power generation being a significant contributor.

Seasonal agricultural activity and bushfires are the likely primary sources of temporary emissions of particulate matter within the Study Area. The National Pollutant Inventory (NPI) [online] lists seven emitting (to air) facilities within the Lithgow LGA. This includes five collieries and both the Wallerawang and Mount Piper power stations. The various substances emitted to the atmosphere from these facilities include sulphur dioxide, oxides of nitrogen, hydrochloric acid, fluoride compounds, volatile organic compounds, metals, particulate matter and carbon monoxide. The power stations are reported to be medium level emitters of a number of these substances who monitor air emissions as part of their operating license. The collieries are reported to be low level emitters. Contribution to air quality



degradation within the immediate Study Area is likely to be in the form of hydrocarbons from vehicles utilising the Great Western Highway and from trains using the Main Western Railway. In the absence of any empirical data for air quality within the Study Area, the quality of air is therefore assumed to be good.

4.12.1 CONCLUSION – AIR QUALITY

Existing impacts on air quality within the Study Area are unlikely to limit the area available for any potential future development. Any future development within the Study Area would need to ensure that existing air quality conditions are not degraded.

4.13 NOISE

4.13.1 RELEVANCE OF ACOUSTIC AMENITY

Development in the Study Area, such as that for industrial purposes, has implications for acoustic amenity. Appropriate site selection and effective noise management and planning controls are fundamental requirements for providing operational flexibility for any future industry, while ensuring adequate protection of the acoustic environment for existing landholders.

As a general planning principle, any development such as that of industrial land should not compromise local acoustic amenity values or generate intrusive or offensive noise. Development must therefore be planned for in a manner that will avoid potential land use conflicts and operational constraints.

4.13.2 SCOPE OF ACOUSTIC INVESTIGATIONS

No noise monitoring was undertaken as part of this environmental overview. Rather, noise sources and noise sensitive receptors were identified and typical buffers for major noise sources established by a qualified acoustic specialist (**Figure 17**).

4.13.3 RELEVANT NOISE POLICIES AND GUIDELINES

The determination of appropriate noise performance criteria is based on consideration of three different Environment Protection Authority policies and one interim guideline. These include the:

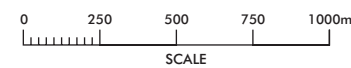
- *New South Wales Industrial Noise Policy (2000);*
- *Noise Guide for Local Government (2000);*
- *Environmental Criteria for Road Traffic Noise (1999); and*
- *Interim Guidelines for Councils: Consideration of Rail Noise and Vibration in the Planning Process (2003).*

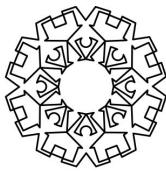


MAJOR NOISE BUFFERS FOR RESIDENTIAL DWELLINGS

- BELLS LINE OF ROAD (APPROXIMATE LOCATION)
- HIGHWAY BUFFER 280m (100 kph)
- RAILWAY LINE BUFFER 100m (subject to acoustic assessment in DA stage)
- QUARRY HAUL ROAD 15m
- QUARRY (blast induced vibrations) 400m
- NOISE SOURCES
- NOISE SENSITIVE RECEPTORS
- SITE BOUNDARY

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Industrial Noise Policy

This policy covers noise from industrial or commercial premises and includes noise from associated traffic generated on-site, but not on public roads. Under this policy noise must meet both an amenity as well as an intrusiveness criteria.

Noise Guide for Local Government

The Environment Protection Authority's *Noise Guide for Local Government* specifies noise performance criteria relevant to sleep arousal.

Environmental Criteria for Road Traffic Noise

The Environment Protection Authority's *Environmental Criteria for Road Traffic Noise* establishes noise criteria from traffic generated by a new or existing development or noise generated from a new road.

Interim Guidelines for Councils

The *Interim Guidelines for Councils: Consideration of Rail Noise and Vibration in the Planning Process (2003)* describes a process for Council's to adopt when assessing development proposals near a rail corridor.

4.13.4 NOISE CONSTRAINTS AND MANAGEMENT ISSUES

Railway Line

The Rail Infrastructure Corporation developed the *Interim Guidelines for Councils* titled *Consideration of Rail Noise and Vibration in the Planning Process* dated November 2003. This document states: *to assist Councils in assessing and determining development applications, it is recommended that all residential and other noise-sensitive proposals located within 60m of an operational railway line be subject to an acoustic assessment.*

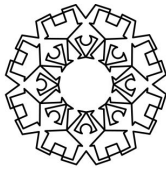
However, as fast trains are known to pass through the section of track within the Study Area it is recommended that a 100m buffer be established for residential development.

No limit generally applies to commercial or industrial developments however, ARTC advise that acoustic assessment maybe required for development located within 60m of an operational rail corridor.

Great Western Highway

Guidelines are set in the Environmental Criteria for Road Traffic Noise (ECRTN). The Great Western Highway would be considered as a "Freeway or Arterial Road". For new residential land use developments affected by freeway/arterial traffic noise the noise goals at the building facade are:

- $L_{Aeq,15hr}$ (daytime 7am-10pm) 55dBA



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- $L_{Aeq,9hr}$ (night time 10pm-7am) 50dBA

The L_{Aeq} descriptors refer to the equivalent continuous noise level over the whole daytime and night time periods.

Traffic noise levels have been predicted using the Calculation of Road Traffic Noise (CORTN) model developed by the Welsh Office of the UK Department of Transport, 1988.

Based on 17,186 vehicles per day two-way traffic flow and 15 percent of traffic at night, 10 percent heavy vehicles during the day, 15 percent heavy vehicles at night and a speed of 100kph, a buffer zone of 280m would be required to the closest residence.

There are no limits for commercial or industrial developments which may provide an opportunity for such a buffer zone along the Great Western Highway to incorporate future commercial or industrial use.

Quarry

Blasting

The NSW Government's recommended criteria for overpressure and vibration from blasting are based on guidelines promulgated by the Australian and New Zealand Environment and Conservation Council (ANZECC). These provide recommended maximum levels of blast overpressure and ground vibration to maintain the amenity of residents.

Where blasting is restricted to the hours of 9am to 5pm, Monday to Saturday, these guidelines are:

- Maximum blast overpressure: 115dBL
- Maximum peak particle vibration velocity: 5mm/sec

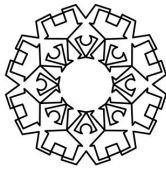
These should be met for all but 5 percent of blasts, and in no case should the blast overpressure exceed 120dBL or the peak particle velocity exceed 10mm/sec. The guidelines also provide a long-term goal of 2mm/sec for peak particle vibration velocity.

The criterion for ground vibration is designed to preserve amenity, and is more stringent than relevant criteria designed to protect against structural damage for most structures. However, for "*structures which may be particularly susceptible to ground vibration*", Australian Standard 2187.2 1983 *Explosives – Storage Transport and Use* recommends a criterion of 5mm/sec peak particle velocity.

The blast monitoring carried out by the Metromix Pty Limited quarry show that a 400m buffer zone is adequate to comply with the relevant criteria.

Operational Noise

Operational noise is covered by the NSW Industrial Noise Policy. The controlling limit will be the intrusiveness limit of background +5dBA. It is expected that this standard is being met at existing nearby houses.



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Haul Road

The access road to the quarry is a public road. It is also designated as a haul road with a 40kph speed limit for quarry trucks. There are typically 38 quarry trucks per operational day between 7am and 6:30pm.

Guidelines are set in the EPA Environmental Criteria for Road Traffic Noise (ECRTN). This road would be considered as a “Local Road”. However, when also used as a haul road it is designated as a “Collector Road”. For new residential land use developments affected by a collector road, the goal for traffic noise at building facade is:

- $L_{Aeq,1hr}$ (daytime 7am-10pm) 60dBA

The quarry has advised that there are typically 38 quarry trucks per day which are limited to 40kph. That is typically 7 per hour. An additional 10 cars per hour have been assumed.

The CORTN traffic noise model has been used to predict traffic noise levels. The predicted traffic noise level at a residence facade set 15m from the road edge is a $L_{Aeq,1hr}$ noise level of 57dBA. This meets the noise limit.

Defence Site

It is understood that this area has historically been used for storage of explosives requiring a safety zone. This is no longer the case so no buffer zone is required for safety.

The area is still used for Defence activities which occur infrequently and may be at night. This does present some potential noise impact on adjacent users. This is addressed in the section ‘Industry Generally’ below.

Further discussion on Defence lands is found in **Section 8**.

Industry Generally

There are two industrial operations near the Defence site. These include a manufacturing plant in a disused colliery and a machinery storage/repair facility. *NSW Industrial Noise Policy* would apply to these operations.

There are some residences in this area for which these industries currently need to meet INP limits. The Lithgow Correctional Centre is also regarded as a residence for the purposes of the Industrial Noise Policy.

From an acoustics perspective, the area in the north-east would be considered suitable for future industrial use as it contains the only two industries and would provide a buffer zone between the Defence site and residences.



4.14 FLORA, FAUNA AND BIODIVERSITY

Ecological surveys were undertaken over the Marrangaroo Study Area and surrounding lands to provide an overview of existing flora and fauna, communities and their habitats. The overview provides a description of the plant species and vegetation communities occurring at the site and describes distribution and significance of these communities throughout the locality. Recorded and potentially occurring flora species of significance are identified and existing habitat of the Study Area is assessed for these species.

The overview also assesses the significance of resident and migratory fauna and their habitats present across the Study Area. Existing, recorded and predicted species of significance are identified. The potential of the Study Area in providing important habitat for these species is assessed.

Based on this assessment, the overview aims to provide future planning considerations and identify areas of ecological constraint for any future change in land use.

Appendix B provides the Ecological Overview in its entirety.

4.14.1 ECOLOGICAL SETTING

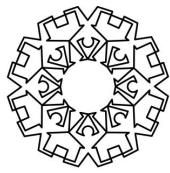
Due to the long history of agricultural use on the flatter more arable lands of the Study Area the dominant vegetation community is agriculturally modified grassland. The balance of the area is dominated by modified eucalypt woodland associations which exhibit a distinctive edge abutting the grassland community. These woodland areas often provide a buffer region between previously cleared agricultural and residential land and more intact native woodland and forest present on the surrounding slopes, ridges and escarpments.

All community types across the Study Area have been impacted in some way by prior grazing or human associated landuse regimes and these impacts have substantially modified both the structure and composition of the understorey stratum. Only very small pockets of steep inaccessible terrain have escaped more intense impacts resulting from grazing, however these areas are typically located deep within the Marrangaroo Creek gully and have been subject to past mining disturbances and weed infestation.

4.14.2 FLORA

The Study Area is a predominantly cleared landscape dominated by exotic ground species and robust natives. Two vegetation communities occur in the area. These include:

- Modified Grasslands (Pastureland) (**Plate 4**)
- Modified Eucalypt Woodland Associations – comprising open forest, woodland and open-woodland structure. (**Plate 5**)



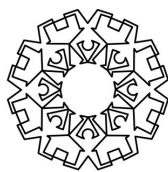
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Plate 4 – Example of modified grassland (pastureland) in the Study Area.



Plate 5 – Example of open woodland/modified grassland fringe in the Study Area.



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Broad structural vegetation types occurring within the Study Area are provided in **Figure 18**.

Benson and Keith (1990) identify four natural vegetation units occurring on or immediately adjacent to the Study Area. However, due to the large areas of previously disturbed and cleared native communities, most of these mapped vegetation units exist around the perimeter of the Study Area. These include:

- Mount Walker Complex
- Tablelands Grassy Woodland Complex
- Blue Mountains Sandstone Plateau Forest
- Montane Gully Forest

The woodland communities flanking the Study Area have been heavily disturbed and are often not representative of the original 'natural' structure. The native vegetation units described by Benson and Keith (1990) are often broadly merged or altered by past clearing, grazing and modified fire regimes. Subsequently, these units do not always have clearly defined boundaries or characteristic compositions typical of their natural structure.

Table 4.6 provides a listing of all flora species detected in the Study Area.

Table 4.6 - Observed Flora List

Family Name	Botanical Name	Common Name
ADIANTACEAE	<i>Adiantaceae aethiopicum</i>	Common Maidenhair Fern
SINOPTERIDACEAE	<i>Cheilanthes sp.</i>	Rock Fern
GLEICHENIACEAE	<i>Gleichenia dicarpa</i>	Pouched Coral Fern
DENNSTAEDTIACEAE	<i>Pteridium esculentum</i>	Bracken
BLECHNACEAE	<i>Blechnum nudum</i>	Fishbone Water Fern
PINACEAE	<i>Pinus radiata</i>	Radiata Pine
LAURACEAE	<i>Cassytha glabella</i>	Dodder
CARYOPHYLLACEAE	<i>Stellaria pungus</i>	Prickly Starwort
POLYGONACEAE	<i>Rumex crispus</i> *	Curled Dock
DILLENIACEAE	<i>Hibbertia obusifolia</i>	Hoary Guinea Flower
	<i>Hibbertia linearis</i>	Guinea-flower
MALVACEAE	<i>Modiola caroliniana</i> *	Redflowered Mallow
URTICACEAE	<i>Urtica incisa</i>	Scrub Nettle
EUPHORBIACEAE	<i>Chamaesyce drummondii</i>	Caustic Weed
VIOLACEAE	<i>Viola betonicifolia</i>	Showy Violet
SALICACEAE	<i>Populus alba</i> *	White Poplar
	<i>Salix alba</i> *	White Willow
CLUSIACEAE	<i>Hypericum gramineum</i> *	Small St. John's Wort
CASUARINACEAE	<i>Casuarina cunninghamiana</i>	River She-oak
ROSACEAE	<i>Rubus parvifolius</i>	Small leaf Bramble/ Native Raspberry



THREATENED SPECIES SIGHTINGS

- GANG GANG COCKATOO
- COPPER BUTTERFLY
- SPOTTED TAIL QUOLL
- POWERFUL OWL
- EASTERN BENT WING BAT

**VEGETATION COMPOSITION
STRUCTURAL CLASSIFICATION**

- WOODLAND
- RIPARIAN WOODLAND CORRIDOR
- OPEN WOODLAND
- PASTURELAND / AGRICULTURALLY MODIFIED GRASSLAND
- SITE BOUNDARY

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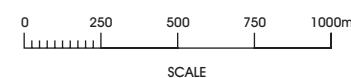




Table 4.6 - Observed Flora List

Family Name	Botanical Name	Common Name
MALACEAE	<i>Rubus discolor</i> *	Blackberry
	<i>Rosa rubiginosa</i> *	Sweet Briar
	<i>Malus domestica</i> *	Apple Tree
	<i>Crataegus monogyna</i> *	Hawthorn
AMYGDALACEAE	<i>Prunus persica</i> *	Peach Tree
PROTEACEAE	<i>Persoonia levis</i>	Broad leaf Geebung
	<i>Persoonia linearis</i>	Narrow leaf Geebung
	<i>Petrophile pulchella</i>	Conestick
	<i>Lomatia myricoides</i>	River Lomatia
	<i>Hakea sericea</i>	Needle Bush
	<i>Hakea dactyloides</i>	Broad Leaf Hakea
	<i>Banksia marginata</i>	Silver Banksia
MYRTACEAE	<i>Eucalyptus bridgesiana</i>	Apple Box
	<i>Eucalyptus mannifera</i>	Brittle Gum
	<i>Eucalyptus viminalis</i>	Ribbon Gum
	<i>Eucalyptus dalrympleana</i>	Mountain Gum
	<i>Eucalyptus rubida</i>	Candlebark
	<i>Eucalyptus macrorhyncha</i>	Red Stringybark
	<i>Eucalyptus radiata</i>	Narrow-leaved Peppermint
	<i>Eucalyptus dives</i>	Broad Leaved Peppermint
	<i>Eucalyptus fastigata</i>	Brown Barrel
	<i>Eucalyptus stellulata</i>	Black Sally
	<i>Eucalyptus pauciflora</i>	Snow Gum
	<i>Eucalyptus rossii</i>	Scribbly Gum
	<i>Leptospermum flavescens</i>	Tea Tree
	<i>Leptospermum obovatum</i>	Tea Tree
	<i>Leptospermum myrtifolium</i>	Myrtle Tea Tree
	<i>Leptospermum polygalifolium</i>	Yellow Tea Tree
	<i>Callistemon citrinus</i>	Crimson Bottlebrush
	<i>Baeckea linifolia</i>	Baeckea
HALORAGACEAE	<i>Gonocarpus tetragynus</i>	Raspwort
RUTACEAE	<i>Boronia pinnata</i>	Boronia
MIMOSOIDEAE	<i>Acacia melanoxylon</i>	Blackwood
	<i>Acacia implexa</i>	Hickory Wattle
	<i>Acacia paradoxa</i>	Kangaroo Thorn Wattle
	<i>Acacia gladiiformis</i>	Sword-leaf Wattle
	<i>Acacia falciformis</i>	Broad-leaved Hickory
	<i>Acacia buxifolia</i>	Box-leaf Wattle
	<i>Acacia dawsonii</i>	Poverty Wattle
	<i>Acacia decora</i>	Western Golden Wattle
	<i>Acacia decurrens</i>	Black Wattle

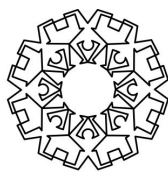


Table 4.6 - Observed Flora List

Family Name	Botanical Name	Common Name
FABOIDEAE	<i>Acacia terminalis</i>	Sunshine Wattle
	<i>Acacia dealbata</i>	Silver Wattle
	<i>Indigofera australis</i>	Indigo
	<i>Desmodium varians</i>	Slender Tick-trefoil
	<i>Glycine clandestina</i>	Twining Glycine
	<i>Hardenbergia violacea</i>	False Sarsparilla
	<i>Lotus australis</i>	Australian Trefoil
	<i>Medicago polymorpha</i>	Burr Medic
	<i>Trifolium sp *</i>	Clover
	<i>Trifolium repens *</i>	White Clover
	<i>Trifolium campestre *</i>	Hop Clover
	<i>Trifolium glomeratum</i>	Cluster Clover
	<i>Trifolium arvense *</i>	Haresfoot Clover
	<i>Oxylobium ilicifolium</i>	Native Holly
	<i>Daviesia latifolia</i>	Broad Leaf Bitter-pea
	<i>Dillwynia phylloides</i>	Pea Flower
	<i>Dillwynia retorta</i>	Egg & Bacon
	<i>Dillwynia sericea</i>	Showy Parrot-pea
	<i>Bossiaea buxifolia</i>	Pea Flower
	<i>Cytisus scoparius *</i>	English Broom
GERANIACEAE	<i>Geranium homeanum</i>	Cransbill
STACKHOUSIACEAE	<i>Stackhousia monogyna</i>	Creamy Candles
SANTALACEAE	<i>Exocarpos cupressiformis</i>	Native Cherry
PITTOSPORACEAE	<i>Bursaria spinosa</i>	Blackthorn
APIACEAE	<i>Hydrocotyle sp.</i>	Pennywort
	<i>Hydrocotyle laxiflora</i>	Stinking Pennywort
	<i>Daucus glochidiatus</i>	Australian Carrot
CAMPANULACEAE	<i>Wahlenbergia graciis</i>	Sprawling Bluebell
	<i>Wahlenbergia stricta</i>	Tall Bluebell
ASTERACEAE	<i>Conyza albida</i>	Tall Fleabane
	<i>Gnaphalium americana</i>	Cudweed
	<i>Cassinia uncata</i>	Sticky Cassinia
	<i>Cassinia arcuata</i>	Biddy Bush/ Sifton Bush
	<i>Chrysocephalum scorpioides</i>	Button Everlasting
	<i>Chrysocephalum apiculatum</i>	Yellow Buttons
	<i>Bracteantha bracteata</i>	Golden Everlasting
	<i>Bidens pilosa *</i>	Cobblers Pegs
	<i>Arctotheca calendula *</i>	Capeweed
	<i>Cymbonotus lawsonianus</i>	Bears-ear
	<i>Cirsium vulgare *</i>	Spear Thistle
	<i>Silybum marianum *</i>	Variegated Thistle



Table 4.6 - Observed Flora List

Family Name	Botanical Name	Common Name
	<i>Centaurea calcitrapa</i> *	Star Thistle
	<i>Hypochaeris glabra</i> *	Smooth Catsear
	<i>Tragopogon porrifolius</i> *	Salsify
	<i>Chondrilla juncea</i> *	Skeleton Weed
	<i>Taraxacum officinale</i> *	Dandelion
	<i>Sonchus asper</i> *	Prickly Sowthistle
	<i>Sonchus oleraceus</i> *	Common Sowthistle
SOLANACEAE	<i>Lycium ferocissimum</i> *	African Boxthorn
	<i>Solanum brownii</i>	Violet Nightshade
CONVOLVULACEAE	<i>Dichondra repens</i>	Kidney Weed
BORAGINACEAE	<i>Echium vulgare</i> *	Viper's Bugloss
EPACRIDACEAE	<i>Epacris paludosa</i>	Heath
	<i>Epacris microphylla</i>	Coral Heath
	<i>Melichrus urceolatus</i>	Urn Heath
	<i>Astroloma humifusum</i>	Native Cranberry
	<i>Monotoca scoparia</i>	Prickly Broom-Heath
	<i>Brachyloma daphnoides</i>	Daphne Heath
SCROPHULARIACEAE	<i>Veronica plebeia</i>	Trailing Speedwell
PLANTAGINACEAE	<i>Plantago lanceolata</i> *	Ribwort (lambs tongue)
VERBENACEAE	<i>Verbena bonariensis</i>	Purpletop
LAMIACEAE	<i>Ajuga australis</i>	Australian Bugle
POTAMOGETONACEAE	<i>Potamogeton tricarinatus</i>	Floating Pondweed
LOMANDRACEAE	<i>Lomandra glauca</i>	Pale Mat-rush
	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
	<i>Lomandra multiflora</i>	Many-flowered Mat-rush
	<i>Lomandra filiformis</i>	Wattle Mat-rush
PHORMIACEAE	<i>Dianella revoluta</i>	Spreading Flax Lily
ASPHODELACEAE	<i>Bulbine bulbosa</i>	Bulbine Lily
ANTHERICACEAE	<i>Arthropodium milleflorum</i>	Pale Vanilla Lily
TYPHACEAE	<i>Typha orientalis</i>	Broad-leaved Cumbungi
JUNCACEAE	<i>Juncus</i> sp.	Rush
	<i>Juncus continuus</i>	Rush
	<i>Juncus subsecundus</i>	Rush
	<i>Juncus australis</i>	Rush
	<i>Juncus usitatus</i>	Common Rush
	<i>Juncus flavidus</i>	Tussock Rush
CYPERACEAE	<i>Schoenus</i> sp.	Bog-rush Species
	<i>Schoenus apogon</i>	Common Bog-rush
	<i>Lepidosperma laterale</i>	Variable Saw Sedge
	<i>Eleocharis sphacelata</i>	Tall Spike Rush
	<i>Eleocharis acuta</i>	Common Spike-rush

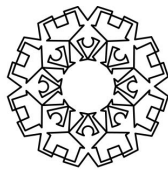


Table 4.6 - Observed Flora List

Family Name	Botanical Name	Common Name
POACEAE	<i>Carex appressa</i>	Tall Sedge
	<i>Carex inversa</i>	Knob Sedge
	<i>Bothriochloa decipiens</i>	Red Grass
	<i>Cymbopogon refractus</i>	Barbed-wire Grass
	<i>Themeda australis</i>	Kangaroo Grass
	<i>Paspalum dilatatum</i> *	Paspalum
	<i>Pennisetum clandestinum</i> *	Kikuyu
	<i>Aristida ramosa</i>	Purple Wiregrass
	<i>Aristida vagans</i>	3 Awned Wiregrass
	<i>Cynodon dactylon</i>	Couch Grass
	<i>Austrodanthonia</i> sp.	Wallaby Grass
	<i>Chionochloa pallida</i>	Silvertop Wallaby Grass
	<i>Agrostis aemula</i>	Blown Grass
	<i>Aira</i> sp.	Hairgrass
	<i>Echinopogon</i> sp.	Hedgehog Grass
	<i>Avena fatua</i> *	Wild Oats
	<i>Holcus lanatus</i> *	Yorkshire Fog
	<i>Hordeum leporinum</i> *	Barley Grass
	<i>Elymus scaber</i>	Common Wheatgrass
	<i>Vulpia bromoides</i> *	Squirrel Tail Fescue
	<i>Vulpia myuros</i> *	Rat's Tail Fescue
	<i>Dactylis glomerata</i> *	Cocksfoot
	<i>Lolium perenne</i> *	Perineal Ryegrass
	<i>Briza maxima</i> *	Quaking Grass
	<i>Poa labillardieri</i>	Tussock Grass
	<i>Poa annua</i> *	Winter Grass
	<i>Poa sieberiana</i>	Snowgrass
	<i>Bromus cartharticus</i> *	Prairie Grass
	<i>Phalaris aquatica</i> *	Phalaris
	<i>Austrostipa scabra</i>	Rough Speargrass
* denotes Introduced Species		

4.14.3 FAUNA

The field surveys aimed to provide a 'snap-shot' of a relatively large area to gain an overview of existing communities, their condition and the diversity of habitat that is present within the Study Area.

The aim of field reconnaissance surveys was to identify potential areas of future constraints for development based on habitat quality analysis.



Species identified opportunistically during field survey are listed in **Table 4.7**. Coding in this table also indicates in which habitat the observations and detections were made. Coding used is G = Grasslands, OP = Open woodlands or open woodland interface (including pockets of open woodland remnant and the Marrangaroo Creek corridor) and W = Woodland.

One threatened fauna species was identified during the field survey, being the Gang Gang Cockatoo. This species was recorded within woodland well buffered from open pastureland.

All observed fauna species are listed in **Table 4.7**.

Table 4.7 - Observed Fauna List

Amphibians					
Scientific Name	Common Name	G	OP	W	
<i>Crinia signifera</i>	Brown Froglet/ Common Eastern Toadlet	X	X	X	
<i>Limnodynastes dumerilii</i>	Banjo Frog		X	X	
<i>Limnodynastes fletcheri</i>	Barking Marsh Frog	X	X	X	
<i>Limnodynastes peronii</i>	Brown Striped Frog		X		
<i>Limnodynastes tasmaniensis</i>	Spotted Marsh Frog		X	X	
<i>Uperoleia laevigata</i>	Smooth Toadlet			X	
<i>Litoria caerulea</i>	Green Tree Frog			X	
<i>Litoria dentata</i>	Bleating Tree Frog		X	X	
<i>Litoria peronii</i>	Peron's Tree Frog			X	
Reptiles					
Scientific Name	Common Name	G	OP	W	
<i>Amphibolurus muricatus</i>	Jacky Lizard		X		
<i>Ctenotus robustus</i>	Fence Skink	X	X		
<i>Ctenotus taeniolatus</i>	Copper-Tailed Skink		X		
<i>Eulamprus quoyii</i>	Eastern Water Skink		X	X	
<i>Lampropholis delicata</i>	Grass Skink	X			
Mammals					
Scientific Name	Common Name	G	OP	W	
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna		X		
<i>Vombatus ursinus</i>	Common Wombat	X	X	X	
<i>Trichosurus vulpecula</i>	Common Brushtail Possum		X	X	
<i>Macropus giganteus</i>	Eastern Grey Kangaroo	X	X		
<i>Macropus rufogriseus</i>	Red-necked Wallaby			X	
<i>Wallabia bicolor</i>	Swamp Wallaby		X	X	
<i>Canis familiaris</i> *	Dog			X	
<i>Vulpes vulpes</i> *	Fox	X	X		
<i>Felis catus</i> *	Feral Cat	X	X		

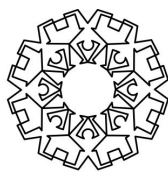


Table 4.7 - Observed Fauna List

<i>Oryctolagus cuniculus</i> *	Rabbit		X	
<i>Lepus capensis</i>	Brown Hare	X		
<i>Sus scrofa</i> *	Pig			X
<i>Capra hircus</i> *	Goat	X	X	X
Birds				
Scientific Name	Common Name	G	OP	W
<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant		X	
<i>Threskiornis spinicollis</i>	Straw-necked Ibis		X	
<i>Elanus notatus</i>	Black-shouldered Kite			X
<i>Falco longipennis</i>	Australian Hobby	X	X	
<i>Chenonetta jubata</i>	Wood Duck	X	X	
<i>Anas superciliosa</i>	Pacific Black Duck	X	X	
<i>Coturnix ypsilophora</i>	Brown Quail	X		
<i>Fulica atra</i>	Eurasian Coot		X	X
<i>Vanellus miles</i>	Masked Lapwing		X	
<i>Geophaps lophotes</i>	Crested Pigeon		X	
<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo		X	X
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo		X	X
<i>Cacatua roseicapilla</i>	Galah	X	X	
<i>Platycercus elegans</i>	Crimson Rosella	X	X	
<i>Platycercus eximius</i>	Eastern Rosella		X	X
<i>Psephotus haematonotus</i>	Red-rumped Parrot	X	X	
<i>Podargus strigoides</i>	Tawny Frogmouth			X
<i>Dacelo novaeguineae</i>	Laughing Kookaburra		X	X
<i>Alcedo azurea</i>	Azure Kingfisher		X	
<i>Alauda arvensis</i>	Skylark	X		
<i>Hirundo neoxena</i>	Welcome Swallow	X	X	
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		X	
<i>Turdus merula</i> *	Blackbird	X		
<i>Petroica goodenovii</i>	Red-capped Robin		X	
<i>Eopsaltria australis</i>	Eastern Yellow Robin		X	
<i>Rhipidura leucophrys</i>	Willy Wagtail	X	X	
<i>Psophodes olivaceus</i>	Eastern Whipbird		X	X
<i>Cinclorhynchus cruralis</i>	Brown Songlark	X		
<i>Malurus cyaneus</i>	Superb Blue Wren		X	
<i>Smicrornis brevirostris</i>	Weebill		X	
<i>Acanthiza pusilla</i>	Brown Thornbill		X	



Table 4.7 - Observed Fauna List

<i>Acanthiza nana</i>	Yellow Thornbill		X	X
<i>Anthochaera carunculata</i>	Red Wattlebird		X	X
<i>Philemon corniculatus</i>	Noisy Friarbird		X	X
<i>Lichenostomus leucotis</i>	White-eared Honeyeater		X	
<i>Pardalotus striatus</i>	Striated Pardalote		X	
<i>Passer domesticus</i> *	Sparrow	X		
<i>Sturnus vulgaris</i> *	Common Starling	X	X	
<i>Acridotheres tristis</i> *	Common Myna	X		
<i>Corcorax melanorhamphos</i>	White-winged Chough		X	
<i>Grallina cyanoleuca</i>	Magpie-lark		X	
<i>Artamus cyanopterus</i>	Dusky Woodswallow		X	
<i>Cracticus torquatus</i>	Grey Butcherbird	X	X	
<i>Strepera graculina</i>	Pied Currawong	X	X	
<i>Corvus coronoides</i>	Australian Raven	X	X	X
* Denotes Introduced Species				
G = Grassland				
OP = Open Woodland/Fringe				
W = Woodland				

4.14.4 SIGNIFICANT SPECIES, POPULATIONS AND COMMUNITIES

Endangered Ecological Communities and Populations

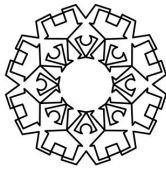
Two Endangered Populations are listed for the Wallerawang 1:100,000 Mapsheet. These include *Pultenaea villifera* in the Blue Mountains LGA and *Keraudrenia corrolata* var. *denticulata* in the Hawkesbury LGA. Neither of these populations occurs within the Study Area.

A total of 42 Endangered Ecological Communities (EECs) are listed for the Wallerawang 1:100,000 map sheet. The majority of these EECs have strong influences from the topography, elevation, vegetation units and climate of the upper Blue Mountains forests, woodlands, heaths, swamps and natural grasslands. None of these EECs occur within the Study Area.

No Endangered Populations or Critical Habitat as defined and described by the Scientific Committee Determinations are located within the Study Area.

Wetlands of International Importance

No Wetlands of either National or International Significance occur in the vicinity of the Study Area.



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Threatened Species

Flora

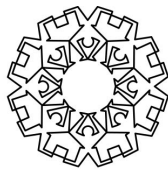
A total of 37 flora species are listed with special conservation significance from the Wallerawang 1:100,000 Mapsheet. Fifteen of these species were identified as having the potential to occur on or nearby the Study Area based on known occurrence or presence of favourable habitat. These threatened flora species have been assigned a low to moderate likelihood of occurrence or higher and include:

- *Boronia floribunda* - Pale Pink Boronia
- *Boronia microphylla* - Small-leaved Boronia
- *Boronia rigens* - Stiff Boronia
- *Boronia ruppia* - Rupp's Boronia
- *Caustis flexuosa* - Curly Sedge, Old Mans Whiskers
- *Derwentia blakelyi*
- *Dipodium punctatum* - Hyacinth Orchid
- *Dipodium roseum*
- *Lomatia silaifolia* - Wild Parsley, Crinkle Bush
- *Persoonia acerosa*
- *Persoonia hindii*
- *Persoonia marginata*
- *Philothea obovalis* - Wax Flower
- *Prostanthera stricta*
- *Todea Barbara* - King Fern

Fauna

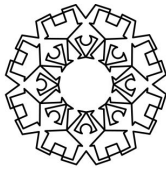
A total of 52 fauna species are listed with special conservation significance (threatened) from the Wallerawang 1:100,000 Mapsheet. A further two species of wetland migratory birds, six species of non-wetland migratory birds and ten marine bird species are listed from the area. Twenty-six of these species were identified as having the potential to occur on or nearby the Study Area based on known occurrence or presence of favourable habitat. These significant fauna species have been assigned a low to moderate likelihood of occurrence or higher and include:

- Bathurst Copper Butterfly (*Paralucia spinifera*)



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- Littlejohn's Tree Frog (*Litoria littlejohni*)
- Rosenberg's Goanna (*Varanus rosenbergi*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Greater Long-eared Bat (*Nyctophilus tmorensis*)
- Little Bent-wing Bat (*Miniopterus australis*)
- Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Great Pipistrelle (*Falsistrellus tasmaniensis*)
- Koala (*Phascolarctos cinereus*)
- Squirrel Glider (*Petaurus norfolcensis*)
- Eastern Quoll (*Dasyurus viverrinus*)
- Square-tailed Kite (*Lophoictinia isura*)
- Barking Owl (*Ninox connivens*)
- Powerful Owl (*Ninox strenua*)
- Gang Gang Cockatoo (*Callocephalon fimbriatum*)
- Superb Parrot (*Polytelis swainsonii*)
- Swift Parrot (*Lathamus discolor*)
- White-throated Needletail (*Hirundapus caudacutus*)
- Diamond Firetail (*Stagonopleura guttata*)
- Regent Honeyeater (*Xanthomyza phrygia*)
- Black-chinned Honeyeater (*Melithreptus gularis gularis*)
- Speckled Warbler (*Pyrrholaemus sagittatus*)
- Grey Crowned Babbler (*Pomatostomus temporalis temporalis*)
- Brown Treecreeper (*Climacteris picumnus*)
- Macquarie Perch (*Macquaria australasica*)



4.14.5 FUTURE PLANNING CONSIDERATIONS – FAUNA, FLORA AND BIODIVERSITY

It is expected that any future development would progress with ecological assessment carried out on a site by site basis while also considering the cumulative impact of development throughout the area over time.

The primary ecological aim of any development within the Marrangaroo Study Area would be to maintain or improve the terrestrial and aquatic biodiversity of the area by protecting remnant vegetation, providing adequate buffers between development and sensitive habitat and enhancing native habitat.

Development Constraints

Woodland edge buffer zones of a minimum 25 metres should be established between development areas and native bushland adjoining broader woodland and forest communities. This buffer zone may need to be increased following specific ecological site assessment to protect sensitive vegetation or habitat. Management of buffer areas would primarily serve to manage adjoining habitat. It is likely that these areas would require sympathetic management in order to return sites to a better ecological condition. Management may require control of weeds, feral animals, policing improper use (ie. dumping, trail bike riding) and fire hazard control.

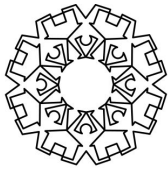
The Marrangaroo Creek course from an ecological perspective should be protected by a minimum buffer zone of 50 metres from either side of the channel with allowance for native vegetation associated with the riparian corridor. This would serve to protect the existing structure of the woodland corridor associated with the creek and lower impact upon movement, foraging, refuge and aquatic habitat.

Prominent drainage depressions, unnamed creeks and feeder streams should be protected by a minimum 20 metre buffer either side of the course. This buffer zone would serve to protect the Marrangaroo Creek catchment. Opportunities may exist to establish wetland retention basins on farm dam, soaks and spring sites within smaller drainage channels.

Future planning should incorporate small open woodland pockets, clumps of scattered trees and 'fingers' of native vegetation into the development design. Future planning for compensatory plantings and rehabilitation areas should aim to develop green belts throughout the development area and enhance existing movement corridor and buffer zones. Drainage courses and feeder streams across existing pasturelands provide a good basis for rehabilitation and green belt establishment.

Weeds

Weed control measures would need to be undertaken as part of any future development to ensure that environmental impacts are minimised. Different measures would be required across different sites, especially along watercourses. Regular monitoring is also required during and post development and should be included as part of routine care for buffer zones and important habitat. The processes involved in implementing weed control are also varied. A proven process is the local establishment and involvement of bushcare groups or the community fostering of specific catchment areas.



Feral Animals

The strong influence of residential areas, agricultural areas, the woodland/ pastureland fringe and publicly accessed infrastructure and roads has increased the populations of introduced species and feral predators throughout the Study Area. Several species were recorded across the site during field reconnaissance including fox, cat, dog, pig, goat and rabbit. Introduced predator species threaten native species populations and can cause localised native species extinctions especially on small woodland bird, reptile and mammal populations.

Other introduced species such as pig and rabbit can degrade habitat by removal of plant species, damage to vegetation, ground-surface damage, spread of weed species and spread of disease.

Programs should be instigated with an understanding of feral populations and the existing native communities that serve to control all pest animals across the Study Area.

Land Rehabilitation, Habitat Corridors and Green Belts

The protection of important habitat, riparian corridors and established buffer zones should not rest on the exclusion of development from these areas. Active development should also aim to promote the rehabilitation of disturbed and degraded land, and where possible increase the extent of native communities and habitat in the area.

Key areas to be considered for future rehabilitation include:

- Gaps and narrows in the vegetation of the Marrangaroo Creek channel, especially where it crosses open agricultural land;
- Areas which have been inappropriately cleared in the past such as prior wet or swampy land;
- Steep slopes prone to surface erosion; and
- Gaps within important bushland corridors or between important bushland 'islands'.

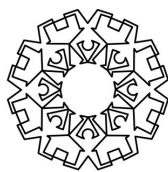
A figure/diagram showing rehabilitation, corridors and islands will be produced for the Structure Plan.

4.15 BUSHFIRE RISK

The Study Area is identified as Bush Fire Prone on the Lithgow Bush Fire Prone Land Map and incorporates both Residential and Special Fire Protection Purpose developments.

Woodland and forested areas within and surrounding the Study Area pose a bushfire risk to potential future development within the Study Area. The *Planning for Bushfire Protection* guidelines (RFS/Planning NSW 2001) provide the requirements for bushfire protection measures that would be required for any future development.

The bushfire risk is the chance of fire starting and affecting life or property. The incidence of fire usually occurs as a result of either arson activities, carelessness or from natural acts such as lightning strikes. The risk to the Study Area is from fire occurring in the native vegetation being open woodland, woodland and forested areas both within and surrounding the Study Area.



Asset Protection Zones (APZs) would be required to reduce the risk to any proposed development from direct attack however; airborne ember attack would prevail during significant fire events.

APZs stipulated in the Planning for Bushfire Protection guidelines (RFS/Planning NSW, 2001) are based on vegetation type measured over a distance of 140m and incorporate:

- Inner Protection Areas (IPAs) bounded by a perimeter road or reserve which circumscribes the hazard side of land intended for development, and has a building line consistent with the incorporation of an APZ within the property.
- Outer Protection Areas (OPAs) managed for hazard reduction, and located on the bushland side of the perimeter road.

The minimum specifications for APZs for residential purposes in bushfire-prone areas are presented in **Table 4.8**.

Table 4.8 - Minimum Specifications for Asset Protection Zones (APZs) for Residential Purposes in Bushfire-prone Areas

Vegetation	Slope	Inner Protection Area (metres)	Outer Protection Area (metres)	APZ (metres)	
Forests	Upslope	>5 °	20	0	20
		5-0 °	20	10	30
	Downslope	>0-5 °	30	10	40
		5-10 °	40	10	50
		10-15 °	50	10	60
		15-18 °	60	10	70
Woodlands, heaths, open scrub	Upslope	>5 °	20	0	20
		5-0 °	20	10	30
	Downslope	>0-5°	25	10	35
		5-10 °	30	10	40
		10-15 °	40	10	50
		15-18 °	50	10	60
Rainforests, grasslands, open woodlands, mallee	Minimum separation distance of 20 metres (managed understorey or grasses) required regardless of construction level for all slopes.				

Source: NSW RFS/Planning NSW, 2001



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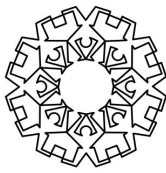
Special Protection Developments are those that by the nature of their use, present limited mobility issues (NSWRFS/Planning NSW, 2001). These developments include schools, child care centres, hospitals, hotel/motel or other tourist accommodation, homes used principally by mentally incapacitated persons, housing for older people with disabilities, group homes and retirement villages. The minimum specifications for APZs for Special Protection Developments in bushfire-prone areas are presented in **Table 4.9**.

Table 4.9 - Minimum Specifications for Asset Protection Zones (APZs) for Special Protection Zones in Bushfire-prone Areas

Vegetation	Slope	Inner Protection Area (metres)	Outer Protection Area (metres)	APZ
Forests	Upslope >5°	50	10	60
	5-0°	60	15	75
	Downslope >0-5°	65	15	80
	5-10°	75	15	90
	10-15°	85	15	100
	15-18°	85	15	100
Woodlands, heaths, open scrub	Upslope >5°	20	10	30
	5-0°	25	15	40
	Downslope >0-5°	35	15	50
	5-10°	45	15	60
	10-15°	65	15	80
	15-18°	85	15	100
Rainforests, grasslands, open woodlands, mallee	Minimum separation distance of 20 metres (managed understorey or grasses) required regardless of construction level for all slopes.			

Source: NSWRFs/Planning NSW, 2001

Appropriate asset protection zone/s will need to be established with each DA. The Structure Plan will provide a road hierarchy with alternative egress, and contain provisions for adequate water supply for fire fighting. The choice of land uses will seek to minimise the perimeter for the area of land interfacing the hazard which may be developed.



4.16 INDIGENOUS HERITAGE

4.16.1 HERITAGE SITES AND VALUES

A search was conducted of the DEC Aboriginal Heritage Information Management System to identify any items or places of indigenous heritage significance recorded for the Study Area. This search produced twelve sites of significance within the Study Area. Eight of these sites, all being 'Open Camp Sites', have been recorded on land currently used by Department of Corrective Services as part of the Lithgow Correctional Centre (**Figure 19**). Other sites previously recorded within the Study Area include an 'Isolated Find', another 'Open Camp Site' and two 'Unknown Site Types'.

The Study Area lies within an area of interest to the Greater Lithgow Aboriginal and Torres Strait Islander Corporation (GLATSIC). A field survey of the Study Area was undertaken on the 24th and 25th January 2006 by Mr Bob Sutor of the GLATSIC and an Ecologist from Geolyse. Parts of the Study Area appearing to have potential to contain artefacts were investigated. These included rocky outcrops and overhangs, elevated ridge-lines and hill crests, dirt tracks, springs and soaks within drainage depressions, tributaries within sheltered valleys and main creek courses. The large amount of existing European disturbance across the majority of the Study Area made it difficult to determine the level of past indigenous disturbance. Ground vegetation across the majority of the Study Area was tall and dense making ground visibility very low.

An isolated artefact occurrence was discovered during the field survey and is shown on **Figure 19**.

During the survey, Mr Sutor shared his knowledge of the locality. An overview of this information includes the following:

- The Study Area (Marrangaroo) was primarily used as a movement route for indigenous people moving between their lands and different resources, rather than as a known home ground where people or groups would commonly live or come to meet. The area would connect tribal areas of the Gundungurra people and the Wiradjuri.
- The area would have been used by people for obtaining food. The broad flats of the basin-valley providing water, hunting and other food resources.
- The upper plateaus and escarpment-tops would have been preferable travelling routes between areas.
- It is likely that parts of the Study Area would have once presented a relatively cold and shaded area not favoured for setting up camps. Areas toward the base of slopes were likely to have been swampy or boggy. Frost hollows would have been present in lower-lying basins and gullies. The escarpments to the east and south shade broad parts of the area on winter mornings. These factors, combined with the cool to cold climate, make the Study Area an unfavourable site for longer term camp-sites.
- The elevated plateaus and escarpment tops of the surrounding slopes would have provided people with a more favourable environment for both living and obtaining food. Numerous



- HERITAGE ITEMS**
- INDIGENOUS HERITAGE ITEMS**
- OPEN CAMP SITE
 - UNKNOWN SITE TYPE
 - ISOLATED FIND
 - ISOLATED FIND THROUGH FIELD SURVEY
- NON-INDIGENOUS HERITAGE ITEMS**
- NATIONAL SIGNIFICANCE
 - STATE SIGNIFICANCE
 - LOCAL SIGNIFICANCE
 - EUROPEAN RELICS IDENTIFIED THROUGH FIELD SURVEY
 - SITE BOUNDARY

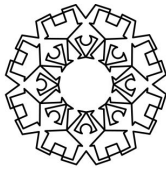
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0 250 500 750 1000m
SCALE CONTOUR INTERVAL: 10m

SOURCE:
AERIAL PHOTOGRAPH, CONTOURS & DRAINAGE - © LAND AND PROPERTY INFORMATION (2005)
INDIGENOUS HERITAGE ITEMS - NPWS ABORIGINAL HERITAGE INFORMATION MANAGEMENT SYSTEM (2005); NATIONAL HERITAGE ITEMS - AUSTRALIAN HERITAGE COUNCIL (2006)
STATE HERITAGE ITEMS - NSW STATE HERITAGE OFFICE (2006); LOCAL HERITAGE ITEMS - CITY OF LITHGOW HERITAGE STUDY (2000)

FIGURE 19:
MARRANGAROO
RECORDED HERITAGE ITEMS



springs and soaks are present on the upper plateaus and shallow drainage depressions. The sandstone escarpments provide protected overhangs and caves considered preferable for sheltering. The elevated escarpments and plateaus also provide dry ground, morning sun, good vantage points for looking for food and watching out for other people in the area. Caves and overhangs with Aboriginal art-work are present in the broader locality.

- It is difficult to determine the original pre-European vegetation of the Study Area from the existing strata. It is likely that the area consisted of broad areas of woodland with natural openings.
- No known scar trees or burial sites are known from the Study Area, however the area has undergone a history of high level impacts associated with European occupation which has modified much of the natural surface of the site. Very few old-mature trees remain. Large areas of the Study Area have previously been cultivated or grazed.
- The Marrangaroo Creek would have been a source of water and food. Broad areas of the banks are now covered with bracken and blackberry making it impossible to identify potential early tool working sites. It is likely that the flow rates and bed characteristics of the creek have changed.
- Stone material found within the locality, such as quartzite and ochre, is suitable for tool and paint making. Other tool making material would also have been imported into the area.
- Permanent springs in the shallower drainage depressions may have provided a source of water for people moving through the Study Area. Many of the springs have been opened up to form farm dams. Earthworks have disturbed the ground surrounding these sites.

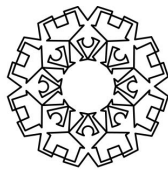
4.16.2 CONSTRAINTS AND MANAGEMENT ISSUES - HERITAGE

The Study Area encompasses important places of indigenous heritage significance. The indigenous heritage sites and values of the area are important not only to the indigenous community of Lithgow and surrounds but to the broader community in general.

It is recognised that development activities on relatively undisturbed land have a much greater potential to disturb and destroy sites of indigenous significance than do the same activities on land already subject to mechanical disturbance.

Whilst development within the Study Area would affect a number of landforms, development-related impacts are more likely to centre on previously disturbed sites, than on the disturbance of those areas with greater heritage sensitivity.

Development of currently uncleared areas has the potential to result in the destruction of sites that have not otherwise been substantially disturbed. Within the context of a Structure Plan, landforms requiring protection from development-related impact to preserve an adequate representative sample of the archaeological record should include all woodland areas of the Study Area including the riparian woodland corridor of the Marrangaroo Creek. It is considered that most, if not all, of the archaeological conservation areas will be concurrent with areas requiring conservation as a result of the environmental and/or scenic qualities.



4.17 NON-INDIGENOUS HERITAGE

4.17.1 HERITAGE SITES AND VALUES

Searches were conducted of the Australian Heritage Council's Register of the National Estate, the NSW Heritage Office's State Heritage Register, the Lithgow City Local Environmental Plan (1994) and the City of Lithgow Heritage Study (2000) to identify items of heritage significance that fall within the bounds of the Study Area.

National and State Heritage Significance

One item of both National and State Heritage Significance was found to occur within the Study Area (**Figure 19**). This item is the Middle River (Marrangaroo Creek) Rail Bridge. This bridge is considered a significant technical accomplishment. It has 9.1 metre spans totalling 73.2 metres and when built was the seventh longest stone bridge in Australia. Together with the viaducts at Farmer's Creek and Coxs River, this bridge formed part of the stage of the Great Western Railway which followed the great zig zag on the western face of the Blue Mountains. The bridge is thus an integral part of a section of the New South Wales rail system of immense historical significance (Australian Heritage Council, n.d.).

The following information was provided by the NSW Heritage Office:

- A late Victorian Cottage on Oakey Forest Road is listed on the Department of Housing's heritage and conservation register under Section 170 of the Heritage Act.
- The NSW State Heritage Office has under consideration a number of potential items relating to the Marrangaroo Shale Mine such as the Industrial Archaeological sites, gatehouse, chimney, and Anglican Church on the Great Western Highway.

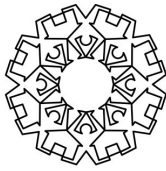
Local Heritage Significance

Lithgow LEP 1994 lists two items of local significance for Marrangaroo these are:

- The Anglican Church, Great Western Highway
- Railway items Newnes Junction – Sodwalls, Main Western Line

City of Lithgow Heritage Study (2000) provides a thematic analysis of the heritage of Lithgow which is extremely rich. The Study identifies approximately 400 heritage items. The Study Area accommodates seven items of local heritage significance including Fernbrook (Farmhouse), River Cottage, Marrangaroo Prayer Chapel, Glenroy (Farmhouse), Lithgow Golf Clubhouse, an Old Mine Site and the Marrangaroo Creek (highway) Bridge (**Figure 19**).

A site walkover was undertaken to identify any obvious European ruins or relics. Four such items were identified and include a house ruin, shed ruin, quarry and a track likely associated with historic mining activity in the area.



4.17.2 CONSTRAINTS AND MANAGEMENT ISSUES - HERITAGE

Conservation measures for items of National, State and Local significance should be implemented as part of any potential future development of the Study Area. Any proposed development would need to consider heritage impacts. Sites or structures worthy of retention marking European occupation of specific sites would need to be individually assessed for their heritage value as part of any future development. Potential heritage items identified through the City of Lithgow Heritage Study (2000) need to be included in an amending LEP.

4.18 LANDSCAPE AND SCENIC QUALITY

Scenic quality measures the degree to which the visual aesthetics of a landscape are valued by people (Parson Brinckerhoff 2004). For the Study Area rural character, views, heritage, open space and bushland were identified by the community as valuable assets (see **Section 6 - Consultation**).

In the past, the land has been predominantly used for rural purposes such as small scale grazing with some cultivation. This has influenced the landscape character of the area.

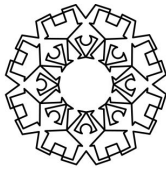
Typical highway uses (service station, motel, industrial lots) have established over time with frontage to the Great Western Highway. These are located sporadically along its length maintaining a semi-rural environment. Other long term uses such as the Quarry and Defence land are 'tucked away' on the periphery of the Study Area minimising their influence on landscape values.

Visual change has been introduced with more urbanised development in Marrangaroo Fields Estate. This urban character will be further consolidated if the proposed residential subdivision of 217 lots north of the Golf Course proceeds.

Significant views are provided from the Highway to open land, vegetated hills, the intermittent rocky scarp and heritage buildings/structures to the east and west. The Correctional Centre is a strong visual element within the landscape at an important entry point to Lithgow from the Central West. Given the high volume of traffic on this road and visitors to the region it is recommended that views to the Correctional Centre be ameliorated and consideration be given to erecting a mural along the Highway or similar barrier as found in a number of Highway locations throughout Metropolitan Sydney.

Within the Study Area there are natural landscape features sensitive to change which also have cultural significance (Marrangaroo Creek and riparian vegetation and heritage items) or are landmark features such as the rocky scarp, steeply vegetated hills and bushland.

The visually prominent features of the Study Area have been identified and mapped for this LES and the opportunity exists to protect them through a draft Local Environmental Plan to maintain high scenic quality. For example, an escarpment protection zone or similar could be included as part of the blocks containing the escarpment.



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The Study Area is enclosed and defined by a ring of steeply sided vegetated hills. These are in different ownership however, the Commonwealth Department of Defence own land along the full length of the eastern boundary while the western boundary is Crown Land currently being considered for inclusion into the estate of the Department of Environment and Conservation. It is anticipated that this ownership would assist the retention of vegetation for habitat, biodiversity, water quality and landscape values. It is recommended that Council consider a protection zone to retain this backdrop for its entire sweep around the valley for existing and future populations in Marrangaroo.

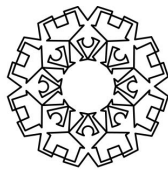
In the western portion of the Study Area, residents of Marrangaroo Fields, the Golf Course and residential (undeveloped) land to the north obtain views across rural land to the east. Views from the western portion can be distant (to Wallerawang) or short range within the valley.

These important landscape features will be considered within the Structure Plan and recommendations made for buffers, protection areas, revegetation and biodiversity corridors. In planning for the area it will be important to integrate these where suitable into an open space system, bike and walking trails and community meeting points. Guidelines to manage development along the edges with the built environment will ensure Marrangaroo Creek, woodland and riparian corridors are not isolated nor overdeveloped.

4.18.1 CONCLUSION

Marrangaroo is a scenically attractive area highly valued by its community. The low level of existing urbanisation reinforces its rural character. It is an area uniquely encompassed within steeply wooded hills with Marrangaroo Creek running through the Study Area from the north east, crossing under the Highway and Railway to edge the western boundary.

Prominent features such as the rocky scarp require protection as does the environmental and heritage values of Marrangaroo Creek.



Transport and Infrastructure Analysis

5.1 ACCESS AND TRANSPORT NETWORKS

5.1.1 INTRODUCTION

Two major transport systems traverse the Marrangaroo Study Area, being the Great Western Highway and the Main Western Railway Line. Both transport systems provide major transport links from central western New South Wales through to the eastern seaboard of the State. The Great Western Highway has a frontage of approximately 3.5km to the Study Area and provides access to both the eastern and western sections of the land.

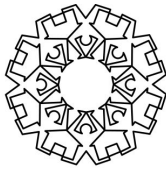
This section of the Local Environmental Study will assess the available access to the Study Area and evaluate the current usage of the transport networks in terms of vehicle numbers and train movements. Assessment of the need to limit proposed access points onto the Great Western Highway will also be made.

5.1.2 ROAD NETWORK

The road network through and within the Study Area comprises a number of roads in addition to the Great Western Highway. The major roads within the Study Area include:

- Great Western Highway (State Highway No. 5).
- Access road to the Lithgow Correctional Centre.
- Reserve Road providing access to the Department of Defence land.
- Oakey Forest Road providing access to the Lithgow City Raceway Kart Circuit and the Quarry.
- Girraween Drive and Golf Links Drive providing access to Marrangaroo Fields and Windera Estate residential areas and the golf course.
- An unformed public road.

Information has been sought in relation to the daily vehicle numbers using the roads within the Study Area. The Roads and Traffic Authority (RTA) has been able to provide information in relation to the Annual Average Daily Traffic (AADT) using the Great Western Highway. AADT is defined as the total volume of traffic passing a roadside observation point over a period of a year, divided by the number of days in a year.



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The RTA has provided estimates of AADT at 2 locations along the Great Western Highway within the Study Area at the following recording stations:

- Recording Station 99.239 (Lithgow, north of MR516 Main Street) Year 2004 AADT 16558. The percentage of cars and light vehicles at this recording station is approximately 89.6% with heavy vehicles (rigids, semis and B-doubles) comprising 10.4% of the traffic volume.
- Recording Station 99.024 (Marrangaroo 0.3km east of SH18) Year 2004 AADT 16454. The percentage of cars and light vehicles at this recording station is approximately 86.4% with heavy vehicles (rigids, semis and B-doubles) comprising 13.6% of the traffic volume.

Lithgow Council's road database has been searched for information relating to the roads within the Study Area, however, no information of relevance was available from that source and additionally, Council has not been able to provide traffic data on any of the other roads within the Study Area.

The Great Western Highway comprises a dual lane carriageway in each direction separated by a concrete median. The intersection of the Great Western Highway and Main Street (MR516) in Lithgow is controlled by traffic signals with right turn phases for traffic travelling on the Highway and Main Street.

Northwards from the intersection with Main Street, the Great Western Highway is speed limited to 70km/hr for approximately 750m until the speed limit changes to 100km/hr. From the 100km/hr speed sign, the distance to Marrangaroo is approximately 2.5km, the turnoff to the Correctional Centre 5.2km and the Mudgee Road interchange (Castlereagh Highway SH18) is 5.8km.

The Mudgee Road intersection with the Great Western Highway is a grade separated interchange.

The Correctional Centre access road and Highway intersection has dedicated left and right turn lanes for traffic accessing the road off the Great Western Highway.

The Reserve Road and Highway intersection has dedicated left and right turn lanes for traffic accessing the road off the Great Western Highway.

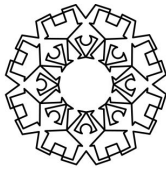
The Oakey Forest Road and Highway intersection has dedicated left and right turn lanes for traffic accessing the road off the Great Western Highway. The Oakey Forest Road rail crossing is controlled by flashing lights and boom gates.

The Girraween Drive and Highway intersection has dedicated left and right turn lanes for traffic accessing the road off the Great Western Highway. Girraween Road crosses the Main Western Railway via a single lane bridge.

The Correctional Centre access road, Reserve Road, Oakey Forest Road and Girraween Drive are all two way, two lane bitumen sealed roads of varying widths.

The RTA has advised that the section of the Great Western Highway through the Marrangaroo Study Area has a high recorded accident rate comprising:

- Fatalities (pedestrian in 2000)



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- Single vehicle accidents where vehicles have left the road carriageway either on curves or straight alignment
- Dual vehicle accidents travelling in the same direction (side swipes or rear end collisions)
- Dual vehicle accidents with a head on collision

5.1.3 HIGHWAY ACCESS

The Great Western Highway (State Highway No. 5) is defined as a motorway and was gazetted as a Controlled Access Road on 18 December 1981. All access points onto a Controlled Access Road must be licensed by the RTA and such licensed accesses are to include public road access and private driveway access to individual properties.

Information provided by the RTA indicates that licensed accesses within the Study Area frontage of the Great Western Highway include:

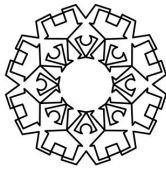
- Reserve Road to the east of the Highway;
- Oakey Forest Road to the west of the Highway;
- Girraween Drive to the west of the Highway;
- An unformed public road to the east of the Highway; and
- Individual accesses to private property with frontage to the Great Western Highway.

In general, the RTA will grant no further licensed access points across the motorway boundary and therefore the future development of the Study Area should rely on the consolidation of the existing licensed access points relating to the public roads on the eastern and western side of the Highway. This position has not been formalised by the RTA and a meeting with its representatives is planned in the near future.

5.1.4 RAIL NETWORK

The Main Western Railway Line traverses the Study Area generally parallel to the Great Western Highway and located to the west of the Highway. The Main Western Railway links a number of rail systems from central west NSW and provides access to the Sydney Rail network. The Main Western Railway Line is under the management of Australian Rail Track Corporation Ltd (ARTC) as far east as Bowenfels with RailCorp having responsibility for the rail system from that point eastwards and in the metropolitan area.

ARTC has advised by correspondence dated 10 March 2006 (including advice on several other matters) that sections of the Main Western Railway are classified as Heritage Structures. The ARTC letter states in part:



5. Heritage Structures

The disused viaduct and the operational viaduct at Marrangaroo are both on ARTC's s170 Heritage Register and the State Heritage Register.

The curtilage includes the structures and extends for a distance of 20 metres in all directions.

The s170 also includes the former railway formation between Newnes Junction and Sodwalls, ie. around Marrangaroo this includes the approaches to the aforementioned disused viaduct and the formation and disused tunnel beneath the Mudgee Road (just outside the Study Area).

The ARTC letter also makes comment in relation to railway level crossings, stating in part:

1. Level Crossings – Government and ARTC Policy

Level crossings represent a significant safety risk to passengers, train crews and motor vehicle occupants – with regard to safety alone; grade separation is preferable to a level crossing.

It is NSW Government policy to minimise the number of level crossings on the State's rail network. Level crossings are closed and removed at every opportunity.

Within the Study Area, ARTC notes that clause #13 and 14 of Development Approval for DA 426/03 (217 lot residential subdivision) specifies that a new road overbridge be provided at the developers expense. Once this alternative access is provided, the Oakey Forest Road level crossing is expected to be closed.

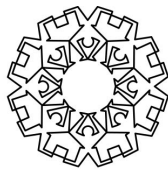
On the 29 May ARTC made the additional comment:

When a development is likely to increase traffic across an existing Level Crossing, ARTC highly recommends that Council consult with it in working towards a new under or overbridge and that some form of developer contributions to be made towards such an improvement.

This will be an important consideration in the development or redevelopment of land on the western side of the Railway.

The Main Western Rail system through the Study Area comprises dual tracks. Information provided by the ARTC indicates that up to 22 train movements per day use the Main Western Railway Line. The train movements include an eastbound and westbound XPT passenger service each day together with up to 10 eastbound and 10 westbound freight train movements per day.

In addition to the Main Western Railway, a branch rail siding at the northern end of the Study Area once provided a rail link to the Department of Defence land in the eastern section of the Study Area. However, this site no longer exists having been removed in the 1980's.



5.2 SERVICES & INFRASTRUCTURE

5.2.1 INTRODUCTION

Discussions with Council staff, research through Council's files and field observation has enabled the following list of Council's water supply and sewerage reticulation infrastructure to be compiled. The listing has been confined to infrastructure components that are relevant to the Marrangaroo Study Area.

Relevant details including capacity of the various infrastructure components follow in this section of the report.

A schematic diagram of the existing water supply infrastructure is indicated on **Figure 20**. A schematic diagram of the existing sewerage infrastructure is indicated on **Figure 21**.

5.2.2 WATER SUPPLY INFRASTRUCTURE

Water Treatment Plants

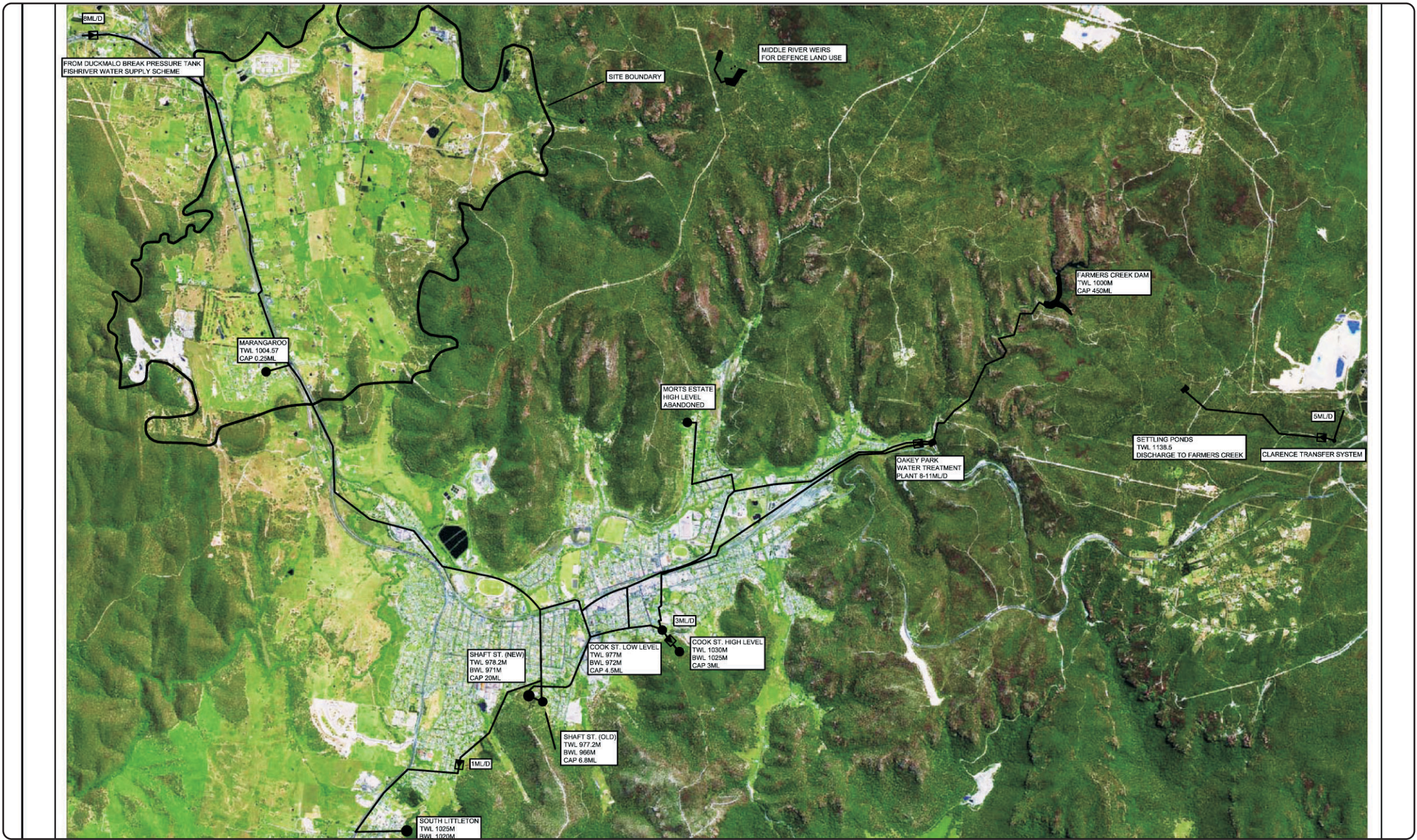
The source of the existing potable water supply to Lithgow is from the Oakey Park Water Treatment Plant with additional flows from the Fish River Water Supply scheme. The Marrangaroo Study Area's primary source of potable water is from the Fish River Water Supply Scheme with a backup of supply from the Oakey Plant Water Treatment Plant via Lithgow town reservoirs in time of supply interruptions.

The Oakey Park Water Treatment Plant is gravity fed raw water from Farmers Creek Dam and has a current capacity of 8 ML/d. Discussions with Council have indicated the current capacity of the plant could be increased to 11 ML/d with minor improvements to the plant. The treatment of the water includes chemical additive of soda ash, alum and polyelectrolyte, flocculation, clarification (horizontal flow), filtration (mono media) and post dosing of chlorine and soda ash. Farmers Creek Dam has its natural stream inflows supplemented by the Clarence Colliery groundwater transfer system which pumps up to 5 ML/d as required. Once treated, the water is pumped to the Cook St (low level) and Shaft St (old and new) reservoirs.

The Fish River Water Supply scheme is fed from Oberon Dam and the Duckmaloi Weir with water from the Duckmaloi Weir treated and blended with the water from Oberon Dam at the Duckmaloi Clarification Plant. Water is then gravity fed to the towns of Wallerawang, Portland, Lidsdale, Rydal, Cullen Bullen, Glen Davis, Marrangaroo and Lithgow with numerous minor users along its route. The system has a current capacity of 11 ML/d and Council has an Annual Allocation of 2019 ML/yr.

Storage Reservoirs

Water from the Oakey Park Water Treatment Plant is pumped via 450mm and 300mm diameter rising mains to the Cook St (low level) and Shaft St (old and new) reservoirs. Water is then gravity fed to the majority of the Lithgow Township along with the Marrangaroo Fields Estate in times of interrupted supply from the Fish River Water Supply.





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FIGURE 21:
MARRANGAROO
SEWAGE SCHEME OVERVIEW

REF: 205177



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Water is pumped from the Cook St (low level) reservoir to the Cook St high level reservoir which gravity feeds higher areas of Lithgow Township together with the South Littleton reservoir which is fed from a pump station in Vickers St off the Shaft St reservoir.

Water from the Fish River Supply scheme is pumped via a 300mm diameter rising main into the Shaft St reservoir with the pipeline running along the Great Western Highway through the Marrangaroo Study Area. There is a small reservoir at Marrangaroo Fields Estate that acts as an emergency storage and is fed via a booster pump off the Fish River Water Supply pipeline.

A summary of Lithgow's water reservoirs operational details are listed below in **Table 5.1**.

Table 5.1 - Lithgow Water Reservoirs Operational Details

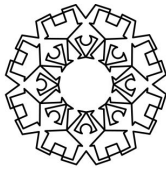
Reservoir	Storage Capacity (ML)	Top Water Level (m)	Bottom Water Level (m)	Reservoir Height (m)
Cook St (low level) Reservoir	4.5	977.0	972.0	5.0
Cook St (high level) Reservoir	3.0	1030.0	1025.0	5.0
Shaft St (new) Reservoir	20.0	978.2	971.0	7.2
Shaft St (old) Reservoir	6.8	977.2	968.0	9.2
South Littleton Reservoir	1.0	1025.0	1020.0	5.0
Marrangaroo Reservoir	0.25	1004.6	-	-

5.2.3 SEWERAGE INFRASTRUCTURE

Sewage Treatment Plant

The Lithgow Sewage Treatment Plant consists of a Bathurst Box followed by conventional trickling filters and final tertiary treatment ponds, servicing the Lithgow Township, Marrangaroo Fields Estate and the Lithgow Correctional Centre. The treatment plant has recently been upgraded to its current capacity of 23,000 EP and future works are planned to improve the quality of the treated effluent which is discharged to Farmer's Creek. Council's current discharge license is for up to 30,000 kL/d to be discharged from its final tertiary ponds into Farmer's Creek. Council has indicated that the current loading on the plant is 17,000 EP leaving a residual capacity of 6,000 EP for future development in the Marrangaroo Area or other areas within the Lithgow township. There maybe scope to improve this with better use of water.

It is not proposed to establish an alternative or satellite STP in the Study Area.



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Sewage Pump Stations

Council currently operates four (4) sewage pump stations that service the Marrangaroo Study Area. The four pump stations are known as the Correctional Centre Pump Station, the Marrangaroo Pump Station, the Methven Pump Station and the No.1 Pump Station.

The Correctional Centre Pump station is located at and services the Lithgow Correctional Centre only. The pump station pumps via an independent rising main direct to the Lithgow Sewage Treatment Plant.

The Marrangaroo Pump Station services the Marrangaroo Fields Estate via gravity mains to the pump station's location at the southern end of the Study Area. The pump station pumps via a rising main into a gravity main feeding to the Methven Pump Station.

The Methven Pump Station services a small area on the north-western outskirts of Lithgow along with the pumped flows from the Marrangaroo Pump Station. The pump station pumps via a rising main into the No.1 Pump Station.

The No.1 Pump Station is Lithgow's main pump station pumping direct to the Sewerage Treatment Plant.

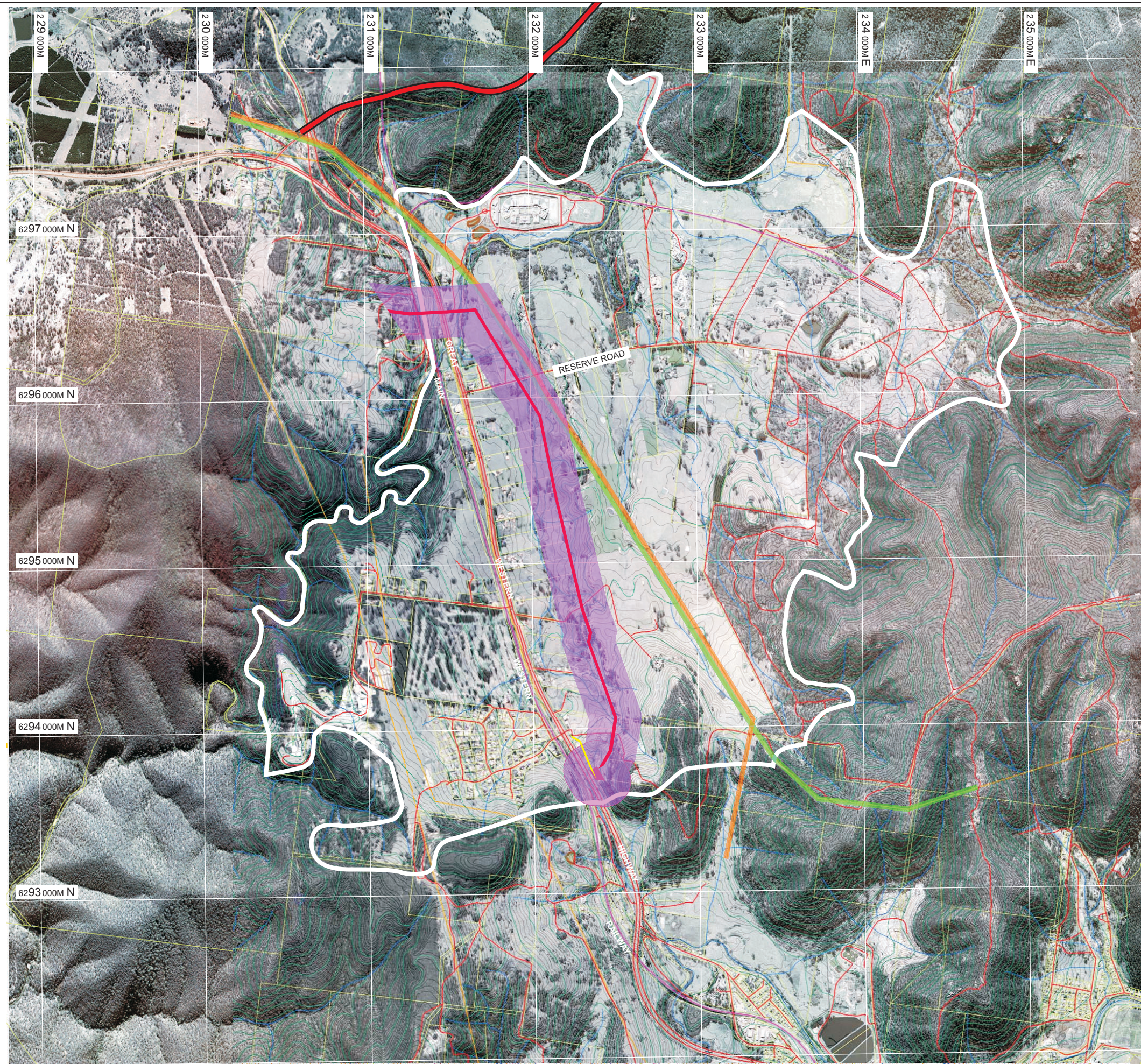
5.2.4 ELECTRICITY, GAS AND TELECOMMUNICATIONS SERVICES

A schematic diagram of the existing Electricity, gas and telecommunication services is indicated on **Figure 22**.

There is an 11kV electrical supply that runs along the Great Western Highway together with a 66kV line running roughly northwest/southeast diagonally through the Marrangaroo Study Area. The 11kV line has minimal residual capacity leaving the main 66kV line as the main future source of supply.

A 150mm gas trunk main is located in a 20m wide easement running through private properties roughly parallel to and approximately 150 meters east of the Great Western Highway. The 150mm gas trunk main runs into a feeder substation at the southern end of the Study Area located on Lot 22 DP777868. The substation is the principle feeder to Lithgow Township, Marrangaroo area and the Correction Centre. Lithgow Council and Agility have agreed to undertake a risk assessment of the pipeline and feeder substation for any proposed new land uses. Section 8 has more detail on this matter.

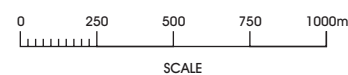
Telstra has major optical fibre cables along with copper cables running underground along the Great Western Highway through the Study Area. Various underground dedicated services currently service the Study Area feeding into this main line along the highway.

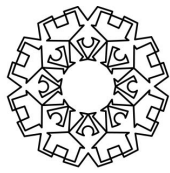


INFRASTRUCTURE

- BELLS LINE OF ROAD (APPROXIMATE LOCATION)
- SEALED & UNSEALED ROADS
- EASEMENT FOR TRANSMISSION LINE 27.5 WIDE
- EASEMENT FOR TRANSMISSION LINE 30.48 WIDE
- NAT. GAS TRANSFER STATION
- PIPELINE EASEMENT 20 WIDE
- 157m BUFFER (SUBJECT TO RISK ASSESSMENT)
- EASEMENT FOR WATER 10.06 WIDE
- SITE BOUNDARY

205177





Consultation

6.1 OVERVIEW

The aim of the community engagement program was twofold:

- To make the community aware of the process involved in developing a Land Use/Structure Plan for the area; and
- To engage the community to identify the issues and concerns relating to the future development of the locality.

The project brief required the program to be as accessible and far reaching as possible using best practice techniques to engage the public. An engagement plan was developed and a consultation schedule drawn up.

The Marrangaroo Community Group representing landowners and a Council Working Group (senior officers and Councillors) were established and run by Council. The Marrangaroo Community Group met monthly with representatives from the Working Group attending.

6.2 MARRANGAROO COMMUNITY GROUP

The Marrangaroo Community Group (MCG) was established to:

- Provide advice concerning the range and complexity of issues related to the potential development of the Marrangaroo site;
- Assist stakeholders to appreciate planning/land use constraints and opportunities;
- Assist Council to think through the possible options for the site; and
- Provide advice concerning ways broad consultation could be more effectively undertaken.

The first meeting was held 22 December 2005 and Terms of Reference developed to guide roles and expectations. The Group is advisory in nature, chaired and run by Council with decisions about the site remaining solely the responsibility of Council.

Representatives from the following were invited onto the MCG:

- Lithgow Correctional Centre
- Arch Vale Trout Farm
- Lithgow Golf Club
- Barclay Family Holdings



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- Metromix Pty Ltd
- 5 Land owners

6.3 COMMUNITY

Consultation with the community in the preparation of the Local Environmental Study has included:

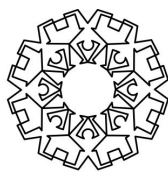
- Council in December 2005, notifying all landholders by letter of the LES and Structure Plan.
- A newsletter to inform the community of the study, process and opportunities for input and distributed in January. An update of that newsletter was made available at the Open House on 16 February 2006. Further newsletters have been issued on Council's initiative.
- A direct link with the latest advice on the front page of Lithgow City Council's website.
- Articles in Council Connections a quarterly newsletter distributed to all ratepayers in the Lithgow local government area.
- An 'Open House' was held on 16 February 2006 to provide information about the project; display the results of the environmental analysis of the Study Area, to obtain feedback from the community and provide one-on-one advice. This was held at the Golf Club House, from 9.00am to 8.00pm. Sixty four (64) people registered, with approximately 100 visiting over the course of the day.

During the day attendees were asked: - what they valued about the area, what opportunities they saw for its development and what concerns or issues they had in developing it. A survey was also made available and 20 were filled in on the day. The majority of attendees who completed the survey identified themselves as local residents and landowners of Marrangaroo. Most heard about the open house through the Newsletter.

Table 6.1 below summarises the values, issues and opportunities identified on the day.

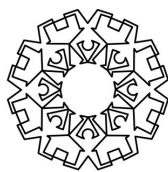
Table 6.1 - Summary of community values, issues and opportunities from 'Open House' 16 February 2006

VALUES
Rural character, amenity and outlook.
Open space, views and beauty.
Proximity to Lithgow but with peace and quiet.
Wildlife, bushland, natural vegetation.
Mix of land uses and larger block sizes.
Heritage both built (convict bridge and church) and natural surrounding wooded hills, platypus colony etc.
Lifestyle, affordability and friendly people.



**Table 6.1 - Summary of community values, issues and opportunities from 'Open House'
16 February 2006**

ISSUES
Existing and potential future land use conflicts eg. residential with small hobby farms, the quarry, noise from Defence land, agricultural activities, minimum security Correctional Centre.
Traffic and Access onto 100km highway particularly at Oakey Forest Road and Marrangaroo Fields Estate.
Road networks need to be bus friendly so a network can be established to service retirement villages, seniors living, school children and the general community.
Need to understand demand for growth in the area.
No industrial development in Marrangaroo catchment.
Proper planning needed instead of ad hoc responses to individual development.
Protect Marrangaroo Creek and maintain its water quality.
Protect the Platypus colony: the last known colony above Lake Lyell.
Silica dust from quarry and the need to ensure dust suppression as required under DA consent.
Desk top survey of the area is not enough. Undertake full flora and fauna survey.
Woodland spur off Marrangaroo Creek needs protecting – the Copper butterfly, Gang Gang and 43 bird species and wombats have been sighted in this area.
Poor past planning practices and inadequate controls in the LEP to protect the environment from development.
Existing rural residential lifestyle being 'boxed' in by a more urban environment.
Protecting: • the visual quality of the area including the entry to Lithgow; • heritage views of old convict bridge, church, outcrops; • riparian corridor of Marrangaroo Creek; and • the habitat of the Derwenta Blackelyi (little blue flower) after which the creek is named.
The negative impact coal production has had on the population.
Need for comprehensive artificial wetland/settling/ponds for new development.
OPPORTUNITIES
Provide for economic growth and increase opportunities to live and grow in Lithgow.
Incorporate employment generating uses, 'clean' light industry and business houses
Provide for industrial lots including bulky goods.
Provide land for business with good access and visibility.
Control and make future development 'best practice' while opportunities exist to do it.
Ensure strict compliance with legislation for potential industrial development.
Maintain the natural beauty of the area and guard the water quality and wildlife in Marrangaroo Creek.



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**Table 6.1 - Summary of community values, issues and opportunities from 'Open House'
16 February 2006**

Provide a range of recreational opportunities, provide housing on large lots, and provide a good mix of residential land sizes.

Separate noisy activities from residential; provide safe bike paths to link with Lithgow.

Plan the area for the future expansion and growth of Lithgow. Provide a balance between industry, residential and recreation

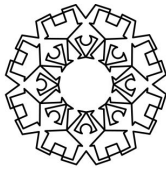
Proper consideration of infrastructure requirements for development e.g. Water, sewer, drainage and power.

Source: Geolyse Pty Ltd

On 2 March a workshop was held with the Marrangaroo Community Group and Marrangaroo Working Group. This meeting considered feedback from State Government departments and infrastructure/service providers, examined areas of the site with similar characteristics and constraints and considered possible land uses for these areas.

The following issues were identified:

- Defence are rationalising their Holsworthy site. Had they given any indication of the future use of the site for housing personnel?
- Did RTA indicate they would fund any of the road works in the area?
- Need to use water smartly & free up potable water use on playing fields etc. Consider dual water system for future development.
- The existing STP should be upgraded to manage the requirements of any development at Marrangaroo. The servicing and infrastructure analysis within the Structure Plan should look at not only the capital costs but on-going costs.
- RTA may have data on flood levels near the bridge on Marrangaroo Creek. The flood map by Tierney (1988) does not indicate what happens during a maximum flood event at the Highway. However, their *"calculations do not indicate that the 100 year flood event would reach roadway level at the Highway Bridge"*. SES however, has advised that in extreme events water does cross the Highway (depth unknown).
- Land around Marrangaroo Creek near the Highway has been reshaped to increase the height of certain land so it is out of the flood way. The 1:100 year levels mapped for the Correctional Centre study (by Tierney) will now be different.
- Cabins exist in the hills behind Endless Belt. An easement may exist giving them access to this land as the road into Endless Belts is private. This road runs through Defence land.



6.4 STATE GOVERNMENT AND INFRASTRUCTURE PROVIDERS

On 6 February 2006, Lithgow City Council hosted a meeting of NSW State Government Departments and infrastructure providers to find out in detail what issues needed to be addressed in the Local Environmental Plan to ensure compliance with State policy and provide cost efficient infrastructure to the area.

Sixteen (16) written submissions were received from the following:

- Agility
- Australian Rail Track Corporation
- Commonwealth Department of Defence
- Department of Education
- Department of Environment and Conservation
- Department of Planning
- Department of Primary Industries
- Department of Natural Resources
- NSW Heritage Office
- NSW Police
- NSW State Emergency Service
- Rural Fire Service
- State and Regional Development
- Sydney Catchment Authority
- Sydney West Area Health Services
- Telstra

Table 6.2 summarises the issues raised by State Government agencies and Infrastructure Providers in their submissions. A full copy of their written submission is included in **Appendix C** along with a list of all agencies and infrastructure providers invited to comment. Additional comments were received to the draft LES and are included in **Appendix D**.

Table 6.2 - State Government Agency and Stakeholder written submissions.

Authority/Stakeholder	Summary of Issues
Agility	20m easement exists over the gas pipeline. Any change in current land use or population density of the area adjacent to the pipeline or Lithgow Truck Receiving Station (TRS) within 300* metre radius would increase the risk to society. [*later amended to 157m] - Risk is associated with the potential for a release and ignition of high pressure natural gas from the pipeline or the TRS. - A risk assessment was recommended. When Lithgow Council are considering and planning proposed developments adjoining to the gas pipeline, the following guidelines on pipeline safety, operational and maintenance issues need to be considered: - The pipeline integrity and safety must be ensured from damage arising from potential third-party activities both during and in the post project construction period. As the pipeline is a single feed to the Central West region, the reliability of supply is paramount. - There are multiple agencies crossing the pipeline and the easement. Potential pipeline failure of either pipeline will have the knock-on effect on the other pipeline. The consequent effects may include human injury, property damage, environmental harm and loss of supply. - Pipeline operations require that the pipeline and easement must be kept clear for surveillance, pipeline inspection and testing, and emergency responses. - Structures that are to be planned on the easement including buildings, fences, sheds, trees etc are to be submitted in writing to Agility for approval. - Other civil services such as roads, drainage, utilities, subgrade infrastructure and design considerations that are proposed within the pipeline and easement corridor must be approved by Agility in writing. Agility would prefer that any infrastructure crossing of the easement is made perpendicular to the pipeline alignment. In response to the draft LES further information was provided by Agility engineers who provided a precise radius of 157m for the pipeline and station.
Australian Rail Track Corporation (ARTC)	- Level crossings are closed and removed at every opportunity. - DA 426/03 for 217 residential lots specifies that a new road over bridge be provided at developer's cost. Once this alternative access is provided, the Oakey Forest Road level crossing is expected to be closed. - Development must consider rail related noise and vibration impacts. - Run-off or stormwater discharge onto the rail corridor is unacceptable. - Requirement to adequately fence off the rail corridor to prevent unauthorized access. - Both the disused viaduct and operation viaduct at Marrangaroo are on ARTC's s170 Heritage register and the State Heritage Register. Curtilage includes structures and 20 m radius. It also includes the former railway formation between Newnes Junction and Sodwalls. - A RailCorp 66kV transmission line, outside the corridor managed by ARTC, is in parts of the Study Area.
Commonwealth Department of Defence	- Defence land is essentially used as a tri-service explosive ordinance training area and is used through out the year. - Training results in the generation of noise and vibration and concern was raised with possible urban encroachment.

Table 6.2 - State Government Agency and Stakeholder written submissions.

Authority/Stakeholder	Summary of Issues
	- Request for appropriate land uses and buffers adjoining Defence land to reduce land use conflict. - Recommended that s149 certificates identify that the land is subject to noise and vibration from Defence activities. In response to the draft LES, Defence raised the need to manage and mitigate potential future land use conflicts. They were concerned with the location of residential dwellings within 400 metres of its land particularly in the north eastern sector. Until further information is provided about what type of employment generating activities are likely to occur they also remain concerned about this activity bordering their land. They advised a more formal submission would be made to the exhibited documents.
Department of Conservation and Environment	- LES needs to demonstrate how existing and proposed land use at Marrangaroo integrates with the whole of the Lithgow LGA. - Establish a clear case for any extension of settlement. - Engage the community, including the Aboriginal community to define the values they hold for the locality. - Provide a map based approach for development and identify areas and items of natural and cultural heritage and a priority statement for how these will be protected. - Biodiversity is to be recognized, protected and enhanced. - Identify threatened species, aboriginal cultural heritage and environmentally sensitive land. - Land adjoins DEC estate at Mount Walker – guidelines attached. - Check for scheduled activities. - List of other specific environmental protection issues to be considered in the LES. In response to the draft LES, DEC provided a number of comments. These have been incorporated into this final document for exhibition wherever possible.
Department of Education	- Once dwelling capacity is established the Department will be able to provide an indication on the need for a future school site. - A site selection criterion for school sites was attached. - Currently there is spare primary and secondary school accommodation available in Lithgow.
Department of Planning	- Councils are best placed to identify the local issues necessary to prepare a schedule of proposed studies. - Council can send its schedule of proposed studies and DoP will provide comments and advice on the need to prepare a formal LES. - Extract attached from Metropolitan Strategy to provide guidance on sustainability issues for land releases.
Department of Primary Industries	- LES should be consistent with wider Strategic planning process underway. <u>Minerals</u> - The only coal resources lie along the eastern edge of the Marrangaroo Valley. Coal mining leases associated with the Fernbrook Colliery were cancelled in 2002. This land has been acquired by the Commonwealth for the Defence Forces.

Table 6.2 - State Government Agency and Stakeholder written submissions.

Authority/Stakeholder	Summary of Issues
	- Quartzite quarry is located on the western edge and is operated by Metromix. Main product is coarse aggregate, the quartzite mines is of sufficient purity and uniformity that is suitable for use in steel manufacture. Mining leases extend to 2023 with sufficient reserves for up to 50 years. - The deposit is one of only two known sources of such silica in NSW and DPI-Mineral Resources would object to any development proposals or rezoning which restricted the current and future operations of the quarry. - Current buffer between quarry and residential must not be reduced. - No additional residential in areas such as the Go Kart track and Golf Course parcels as the most likely medium term extension of the quarry is to the north east. - Development west along Oakey Forest Road must not increase traffic along this road. Intersection with Hwy would benefit from an upgrade or a reduction in Hwy speed. - Potential exists to load quarry product onto rail at the Marrangaroo railway siding if required. <u>Forests</u> - No specific issues within the Marrangaroo locality. <u>Agriculture</u> - Locality is highly fragmented which has impacted upon its agricultural viability. - LES should assess the potential of agriculture to remain as a land use. - LES should address animal pests and weeds and consider how these might be managed if land uses change. - Consider the saline groundwater present. Recommend salinity management plans to address the potential impacts upon all lands within the locality. <u>Fisheries</u> - Potential impacts on Threatened Species and aquatic habitats. - Locality is within the potential distribution range of the Macquarie Perch and Adams Emerald Dragonfly. - Fish passage is to be maintained along the waterways. - Lots and roads should be designed to minimize waterway crossings. Waterway crossing will need to be reviewed by DPI Fisheries. - Department does not support the piping or channelisation of waters courses and strongly recommends that flood prone land be appropriately zoned and flood buffers put in place. - No net increase in runoff and a nil reduction in water quality of receiving waters. - All future development and water infrastructure planning includes measure consistent with <i>Water Sensitive Urban Design</i>. - Intact riparian zone with vegetated buffers for all waterways. - Key Threatening Processes are: degradation of native riparian vegetation and removal of large woody debris within any watercourse. <u>Aquaculture</u> - Water quality and water flow need to be carefully considered to avoid impacting on existing aquaculture facility within the catchment or any future proposals. - Refer to ANZECC Water Quality Guidelines. - NSW Food Authority strictly monitors food quality parameters. It is imperative to ensure water quality in the Marrangaroo land use study is maintained or

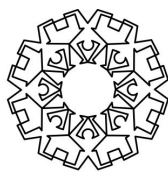


Table 6.2 - State Government Agency and Stakeholder written submissions.

Authority/Stakeholder	Summary of Issues
	enhanced. • Failure to account for water cumulative impacts may greatly impact on the ability for an aquaculturalist to sell their product. • Protect and where possible enhance the quality and quantity of water in the catchment.
Department of Natural Resources	• Protection of watercourses and riparian corridors. • Rivers and streams must be categories by DNR and minimum corridor widths adopted. • Objectives and principles provided for waterways which must be considered in the LES.
NSW Heritage Office	• Assess the heritage significance of the valley and any impacts the development may have upon its significance. • Check the State Heritage Inventory for heritage items & consult lists maintained by the National Trust of Australia, Australian Heritage Council and <i>Environment Protection and Biodiversity Conservation Act 1999</i>. • A late Victorian cottage on Oakey Forest Road is listed on the Department of Housing's heritage and conservation register (is this listed as potential HI in heritage study). • Number of potential heritage items identified. • Undertake a field survey by a qualified practitioner of non-aboriginal heritage items within the Study Area. • A permit is required prior to commencement of works if disturbance to a site with known or potential archaeological relics is proposed.
NSW Police	• Police be involved in the initial structural development stage i.e. roads etc • Police to be involved in continual consultation with the development based on the principles of the Crime Prevention Through Environmental Design (CPTED). • Council must make representation to State Government for additional funding for Police if the development is intended to double the size of the town. • Police would consider the development of a new police station at the new site depending upon negotiations conducted with key stakeholders at the appropriate/relevant time. • If public housing is to be situated within the development then it is to be dispersed throughout the entire development. • A formal CPTED assessment can be completed on the initial infrastructure which would address a multitude of more complex issues.
NSW State Emergency Service	• Flooding occurs in Marrangaroo Creek mainly as a result of heavy rain during thunderstorms and with little or no warning. • Water has been ankle deep in Reserve Road & in extreme events water has covered the Great Western Highway where the current bridge crosses the creek. • Lithgow Local Flood Plan will be reviewed and rewritten in 2006/2007 financial year.
Rural Fire Service	• Area is bush fire prone. • Detailed bush fire assessment of the Study Area be done to determine the suitability of the site for further residential and Special Fire Protection Purpose developments.

Table 6.2 - State Government Agency and Stakeholder written submissions.

Authority/Stakeholder	Summary of Issues
	6 items identified which need to be considered in the bush fire assessment.
State and Regional Development	- Availability of employment lands in Lithgow. - Provision of ongoing employment and wealth creation opportunities to support Lithgow's growth into the future.
Sydney Catchment Authority	- Locality is within the drinking water catchment for Sydney. - Development should be able to achieve a neutral and beneficial effect on water quality. - Water quality modeling should be done if any of the area is identified for urban development. - A riparian area needs to be defined through the LES and applied to Marrangaroo Creek.
Sydney West Area Health Services	- Maintain sustainable environments that support health and well being. - Strengthen the positive health and well being impacts of land use planning. In response to the draft LES a wide range of matters were highlighted. These have been dealt with as far as possible within this document. A number of their comments relate to the future development of the site and management of development application matters.
Telstra	- Both Customer Access Networks and Inter Exchange Optical Fibre cables are available. - Can outline typical scenarios inline with development expectations.

On 2 March a workshop was held to refine State Government and infrastructure provider parameters and closely examine constraints to development.

A range of interconnected issues have been identified by the community, government and infrastructure providers. Despite this there is common ground for determining a best and highest use for the land which considers and incorporates these matters at a strategic level.

The Local Environmental Study therefore provides the base for the Structure Plan and subsequent detailed studies across the Study Area.



Summary of Issues

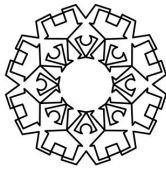
Consultation (**Section 6**) and the environmental analysis (**Section 4**) identified issues for the future planning of Marrangaroo.

On a broad level factors constraining development of urban land in Lithgow are:

- Restricted supply of suitable land. Land in and around Lithgow is characterised by steep vegetated slopes with limited flat broad or rolling areas suitable or desirable for sustaining urban development.
- Need to protect and preserve environmentally sensitive areas and landscapes that reflect the valued character of the LGA.
- The cost of providing new or upgraded urban infrastructure.
- Ensuring new development maintains a neutral or beneficial effect on water resources in the Sydney Drinking Water Catchments.
- Separation between incompatible land uses such as extractive industry, housing, energy production, agriculture, forests and national parks.
- Past industrial growth and planning decisions now influencing growth in Lithgow, Wallerawang and Portland.

Specific to the Study Area, the primary areas that present issues for resolution are:

- The presence and range of potential activities on Defence land bordering the entire eastern side of the Study Area.
- Commercial operation of the Quarry in the western corner.
- Access onto the Great Western Highway (100km zone through the Study Area).
- Major road and rail corridor splitting the area into two distinct parts.
- Protection, rehabilitation and management of Marrangaroo Creek and its riparian corridor to maintain water quality (Sydney Catchment Authority) and habitat (DPI).
- Flood liable land.

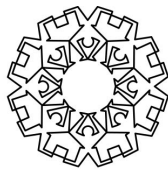


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There are also a secondary range of issues identified:

- Susceptibility of the ground water to contamination.
- Management of the ground water table and salinity with development of the area.
- Proposed low security Correctional Centre along side the existing maximum security Correctional Centre.
- Improving existing access onto the Highway.
- Ensuring compatible land uses and well planned development that does not undermine the environmental values, scenic outlook, heritage and rural character of the area.
- Demand for urban land (comprising residential, commercial, industrial, business etc).
- Maintaining a sense of community, access (non-highway) and connectedness to the town and services of Lithgow.
- Fragmented land ownership and existing dwellings fronting the Great Western Highway, Reserve Road and Oakey Forest Road.

These factors have been drawn into the analysis to guide landuse decisions.



Consideration of Constraints and Opportunities

8.1 OVERVIEW

The principle opportunities and constraints to the development of the area are:

- Marrangaroo Creek, water quality and riparian vegetation;
- Flooding;
- Defence activities to the east and the Quarry to the west; and
- Topography, area and location of the Study Area on the Great Western Highway and Main Western Rail line, proximity to town, and available services and infrastructure.

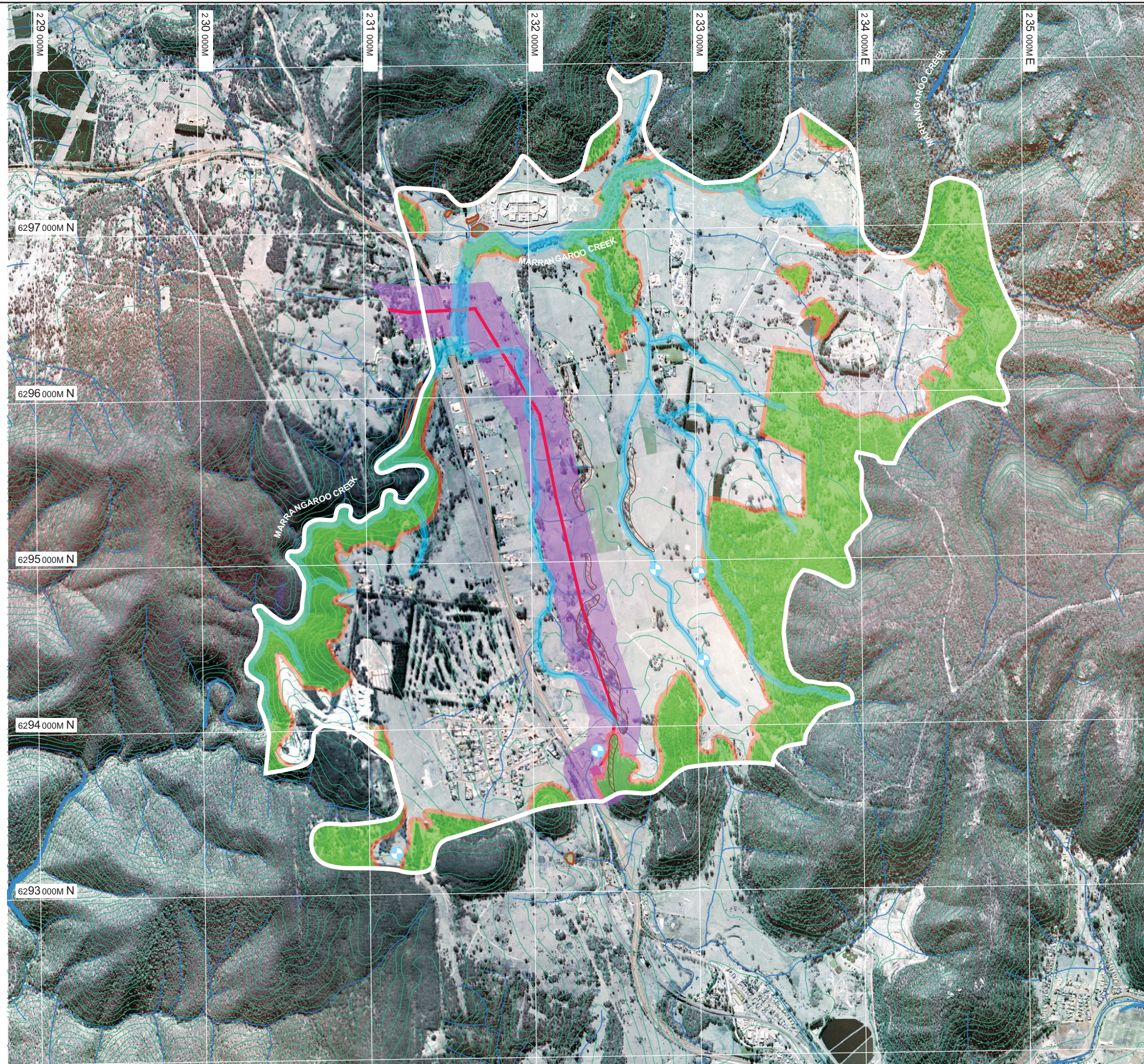
Major physical and applied constraints have been mapped and are shown in **Figure 23**. The ephemeral streams and rocky scarp are features needing careful management. Areas of the site are also steep, adjoin woodland and have watercourses running through them. Development in these areas will need to minimise environmental impact and retain the character of the area.

The undulating nature of large portions of the site make it ideal for urban development while the flatter lands to the north are suited to employment, business or technology parks.

A rocky scarp with shallow soils is indicated in **Figure 23**. This scarp is not continuously evident and the rocky outcrops vary along its length. These have been pinpointed to ensure their management as environmentally scenic elements of the landscape. A much smaller but interesting outcrop is found along the central ephemeral creek and could be integrated into a park or public space so it too is conserved and contributes to the character of a new built environment.

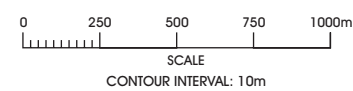
With a change in land use in the area, Agility has advised that the natural gas transfer station and pipeline will require a 157 metre buffer to minimise risk in the event of a rupture. A risk assessment is underway to determine what development is going to be the most suitable adjoining land use.

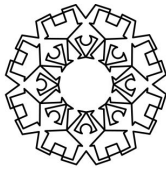
The groundwater is recorded as being vulnerable to contamination, as a domestic source, from industry. It is also mapped as 'brackish'. Once potential future land uses and their location across the Study Area are agreed Geolyse Pty Ltd will assess the potential impact of these on water quality. SEPP 58 will be the primary vehicle to achieve this and will be included in the Structure Plan.



- MAJOR PHYSICAL & APPLIED CONSTRAINTS**
- NAT. GAS TRANSFER STATION
 - PIPELINE EASEMENT 20 WIDE
 - 157m BUFFER (SUBJECT TO RISK ASSESSMENT)
 - WOODLAND
 - 25m BUFFER
 - ROCKY SCARP
 - EPHEMERAL FEEDER STREAMS (UNCLASSIFIED) 20m BUFFER EACH SIDE
 - MARRANGAROO CREEK 50m BUFFER EACH SIDE
 - IDENTIFIED SPRINGS
 - DRAINAGE LINE
 - 10m CONTOUR LINE
 - SITE BOUNDARY

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8.1.1 WATERCOURSES

The Department of Natural Resources has developed a classification to identify minimum riparian corridor widths required along water courses. The three categories reflect the environmental significance of the watercourse and are:

- Category 1 – an environmental corridor with a minimum riparian core of 40 metres both sides of the watercourse plus a 10 metre wide vegetated buffer (total 50 metres either side).
- Category 2 – terrestrial and aquatic habitat with a minimum 20 metre core both sides of the watercourse plus a 10 metre wide vegetated buffer (total 30 metres either side).
- Category 3 – bed and bank stability/water quality with a minimum 10 metre along both sides of the watercourse with an additional buffer generally not required.

8.1.2 MARRANGAROO CREEK

The Department of Natural Resources (DNR) has categorised Marrangaroo Creek as a Category 1 watercourse. Until further studies are done based on geomorphology, flooding and species composition the Department has advised a preliminary planning buffer of 100 metres either side (comprising the minimum core and vegetation buffer). **Figure 24** applies a 100 metre buffer to Marrangaroo Creek to show its maximum possible extent.

The environmental analysis also recommended that development should be excluded from riparian zones adjacent to the seasonal streams and drainage depression areas (yellow solodic soils). The yellow solodic soils are found in areas along drainage lines with poor drainage characteristics. These areas follow the flat lands immediately adjacent to Marrangaroo Creek and the ephemeral creek line closest to the Highway (See **Figure 10**).

Figure 23 maps a minimum buffer to Marrangaroo creek of 50 metres in line with the recommendations of the Wentworth Group of Scientists (2003) which suggest the following standards:

“Conserving and restoring riparian vegetation 50m to 100m either side of major rivers and wetlands, 20m to 50 m either side of creeks and 10m to 20m either side of streams.”

and provides another scientific benchmark for decision making.

Marrangaroo Creek is not a major river however the implications of flooding, soil type and drainage, the environmental significance of the creek and its value as riparian corridor for fauna and flora and its importance to the community warrant a preliminary buffer between 50 metres to 100 metres either side of the creek until detail studies can validate a precise distance. This establishes a minimum of 50 metres and a maximum of 100 metres, consistent with DNR advice.

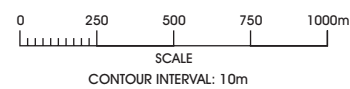
It is suggested that discussions be held with the Catchment Management Authority and the Sydney Catchment Authority to seek funding to accurately map the core riparian zone and to determine the



ECOLOGICAL CONSTRAINTS

- WOODLAND
- 25m BUFFER
- 1 DNR CLASSIFICATION CATEGORY 1
- 2 DNR CLASSIFICATION CATEGORY 2
- EPHEMERAL FEEDER STREAMS (UNCLASSIFIED) 20m BUFFER EACH SIDE
- EPHEMERAL FEEDER STREAMS 50m BUFFER EACH SIDE
- MARRANGAROO CREEK 100m BUFFER EACH SIDE
- DRAINAGE LINE
- 10m CONTOUR LINE
- SITE BOUNDARY

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additional corridor buffer for Marrangaroo Creek. This could also identify and fund actions to restore and rehabilitate the Creek.

The following environmental objectives for Category 1 watercourses were provided by DNR:

- Provide a continuous corridor for the movement of flora and fauna species through the catchment and beyond the catchment.
- Provide extensive habitat (and connectivity between habitat nodes) for terrestrial and aquatic fauna.
- Maintain the viability of native riparian vegetation.
- Manage edge effects at the riparian/urban interface.
- Manage the impacts from saline affectation.
- Provide bed and bank stability.
- Protect water quality.
- Protect instream aquatic vegetation.

Techniques to achieve these objectives are provided (see submission from DNR – Appendix C) and will be considered in the Structure Plan.

8.1.3 EPHEMERAL STREAMS

The Department of Natural Resources has been able to access some but not all watercourses in the Study Area to categorise them. Further consultation with DNR is required during the preparation of the Structure Plan to finalise stream categories.

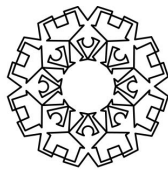
Two ephemeral streams have been classified as Category 2. These are marked on **Figure 24** and are indicated with the maximum 50 metre buffer either side.

The stream closest to the Highway and running through properties fronting the Highway crosses Reserve Road and feeds into Marrangaroo Creek. The soils underlying this creek are yellow solodics and not suited to development. The minimum corridor and buffer width suggested by the Department of Natural Resources is 30 metres with a maximum of 50 either side of the watercourse. Flood and ecological surveys will be required to determine a final corridor width.

The stream running parallel to this, but east of the rocky scarp and under the transmission line, is also a Category 2 watercourse with a recommended minimum of 30 metres and a maximum of 50 metres each side. However, this watercourse maybe upgraded to a Category 1 where it is joined by other streams and crosses Reserve Road to flow into Marrangaroo Creek.

The objectives to be attained for a Category 2 watercourse set by DNR are to:

- Maintain the viability of native riparian vegetation.



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- Provide suitable habitat for terrestrial and aquatic fauna.
- Manage the impacts from saline affectation.
- Provide bed and bank stability.
- Protect water quality.
- Protect instream aquatic vegetation.

Techniques for achieving these objectives were provided by the Department of Natural Resources and will be considered in the preparation of the Structure Plan.

Importantly, the Department in providing this preliminary advice was clear that final outcomes need to be better understood and the provision of a concept plan and more detailed studies (ecology and flooding) would guide a final decision.

8.1.4 REMNANT BUSHLAND AND GEOLOGICAL FEATURES

To protect the remnant plant communities once characteristic of the area and provide habitat for native flora and fauna species, it is recommended that the woodland mapped in **Figure 24** be protected and managed through a new LEP and DCP. A 25 metre buffer is recommended around its edges.

The bushland has value as an education and recreational resource as well as providing wildlife corridors to link with surrounding vegetation. Marrangaroo Creek is a significant asset in the Study Area and its riparian vegetation aids in protecting water quality and habitat.

The rocky scarp running north-south through the Study Area is an important visual feature which along with the bushland contributes to the unique character of the area. This too requires protection and management through a scenic protection layer or similar control in a new LEP and DCP.

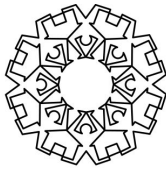
8.1.5 FLOODING

Information on flooding has been sought from Lithgow City Council, the SES, RTA and the community. The only flood study available to us was undertaken by Tierney & Partners for the Lithgow Correctional Centre. It has established a minimum and maximum probable flood zone for the purposes of building the Correctional Centre.

Council has mapped flood liable land for Lithgow. This does not cover Marrangaroo. The SES advises that while Farmer's Creek is the primary focus for flooding, Marrangaroo Creek also floods. The extent of land subject to flooding is not clear.

Ministerial Direction No 15 on Flood Prone Land states what a Council must do.

- 1 A draft LEP shall include provisions that give effect to and are consistent with the NSW Flood Prone Land Policy and the principles of the Floodplain Development Manual, 2005.



2. A draft LEP shall not rezone land within the flood planning areas from Special Area, Recreation, Rural or Environmental Protection Zones to a Residential, Business, Industrial or Special Area zone.
3. For flood planning areas a draft LEP cannot permit development in floodway areas, permit a significant increase in the development of that land, permit development that will result in significant flood impacts to other properties, increase requirements for Government expenditure on flood mitigation, infrastructure or services and permit general development without consent.

To comply with this direction it will be necessary to firstly identify whether there are any flood planning areas in Marrangaroo. Alternatively the rezoning will need to accord with a floodplain risk management plan or be in the opinion of the Director-General, of minor significance.

8.1.6 DEFENCE AND QUARRY LAND

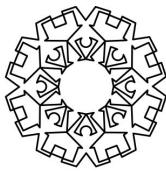
Both these existing uses generate noise and vibration and have been identified as long term resources. Future adjoining uses will need to be compatible with these uses. Adequate separation is needed between these existing uses and residential housing.

The Department of Primary Industries Mineral Resources and Metromix have sought assurances that only compatible uses will be permitted in the vicinity of the quarry so its future operations are not compromised. This may require zone changes and imposing a 400 metre buffer to exclude residential housing during the life of the quarry to allow for continued economic growth and employment opportunities.

The Department of Defence has also requested assistance in ensuring the ongoing viability of Defence activities at Marrangaroo in the National interest. The location of compatible uses adjoining their land particularly to the north east is needed to deal with noise and vibration. As a Federal entity the Department of Defence is not bound by NSW Policy however it could have regard to the Industrial Noise Policy. The application of a buffer for residential development can be imposed, similar to the Quarry, to the primary noise source being the demolition range. The exact location of the range is unknown other than being to the north west of their site.

While Defence have indicated a preference for open space adjoining their land, under the Industrial Noise Policy, the Amenity Noise Criteria is more restrictive for passive recreation (50dBA) and active recreation such as school playgrounds and golf courses (55 dBA) than industrial land which is 70 dBA. The best use of the land is unlikely to be open space in excess of future population needs when employment generating land and wider housing choice is required to boost activities within the Local Government Area.

Significantly, the Marrangaroo Community Group reported that debris from the site has fallen on properties along Reserve Road outside Defence land in past years. It is incumbent on Defence to contain its activities on its own land and for Council to manage future, sustainable and environmentally safe landuses. In this case, suitable activities can be identified to co-exist with noise and vibration, for example, warehousing, transport depots, light industry. Further consultation is required with the



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Department of Defence to determine the best outcome. In the Land Use Options, an indicative 400 metre investigation area has been applied to land bordering Defence land to the north east.

8.1.7 GAS

Agility (wholly owned entity of the Australian Gas Light Company) has advised:

- AGL Gas Networks (GN) own and operate natural gas reticulation infrastructure under the NSW Gas Supply Act 1996 with operation pressures as required to supply the community of the Lithgow LGA.
- The Young to Lithgow high-pressure pipeline is located in a 20 metre easement running through the Study Area. The 150 mm ID pipeline operates at 9930 kPA maximum allowable operating pressure and is the major gas transmission supply to the Central West of NSW.
- The ATP natural gas metering station and AGLGN pressure regulation station are known as the Lithgow Trunk Receiving Station (TSR) and are located adjacent to the Great Western Highway within the Study Area.
- The Young to Lithgow pipeline and the Lithgow TRS were designed to incorporate safety measure commensurate with the existing land use.
- Any proposal to change the current land use or increase population density of the area adjacent to the pipeline or within 157 m radius of the TRS would increase the safety risk to society (with the release and ignition of high pressure natural gas).

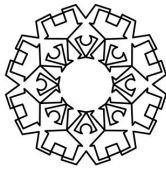
A pipeline risk assessment is needed in accordance with Australian Standard 2885 for any change in land use or subdivision. Lithgow Council has asked Agility to undertake such a risk assessment of the pipeline and Lithgow Trunk Receiving Station to assist in identifying the full range of factors requiring consideration now for future development. Such an assessment will arrive at outcomes that manage any risk to society and any necessary mitigation measures. It is understood from preliminary advice from Agility that high density community uses or sensitive uses such as schools, hospitals, aged care, prisons etc. cannot be located within a radiation contour distance of 157m from these gas facilities.

Figure 22 maps the location of the Lithgow Trunk Receiving Station and pipeline (existing easement of 20 metres) with a 157m buffer. Within this buffer measures can be taken to reduce risks to the lowest possible level. Possible low density land uses adjoining these facilities have been indicated in the Land Use Options.

8.1.8 HEALTH SERVICES

The Sydney West Area Health Service has advised that:

- Lithgow Hospital and Lithgow Community Health Centre will be the main public sector health facilities for Marrangaroo locality.



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- There is capacity within the new Lithgow Hospital to accommodate some increase in the Lithgow LGA population.
- There are no plans to significantly expand current public sector facilities under the current population projections for the LGA (decreasing slightly and aging) endorsed by the Department of Planning.
- Should development proceed and be incorporated into Department of Planning estimates, further investigations will be done to assess the growth capacity of the Hospital and Community Health facilities.
- Public transport options to access the Hospital and Community Health Centre should be incorporated into the development.

8.1.9 EDUCATION

The Department of Education and Training has advised that currently there is spare primary and secondary school accommodation available in Lithgow. Until more information is known on dwelling density, DET is unable to comment further on the need for a future school site. However, the Site Selection Criteria provides broad guidance and states:

One primary school site per 2000+ new homes and one high school for 5000+ new homes (urban fringe release areas).

Consideration must be made in respect of the following:

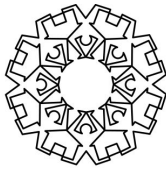
- a) possible existing facilities in nearby location*
- b) non government share of the primary age population*
- c) type of housing*
- d) nature of the new population*
- e) rate of proposed residential development.*

8.1.10 LOCAL BUSINESS

There are a number of private businesses in the Study Area which contribute to the local economy.

One of these, Metromix Pty Ltd owns and operates the Marrangaroo Quartzite Quarry located in the south western corner of the Study Area. The Quarry has been in operation since 1912 in various forms and with various operators over the years. It currently employs 10 people with an additional plant employment of approximately 20 people. It spends approximately \$2 million per year operating the plant which includes contractors and service suppliers thus contributing to the Lithgow economy.

The Go-Kart operation is an important regional activity with weekend meetings of the Eastern Creek and Lithgow Go-Kart clubs.



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Other employment activities in the area include the Motel, Kitchen Manufacturer, and Furniture maker, Endless Belts, Correctional Centre, Service Station and the Golf Course.

The area is currently cut into two parts by a 100km Highway. No other services or facilities exist in the locality.

8.1.11 LAND SUPPLY AND DEMAND

An analysis of available land in and around the township of Lithgow and Marrangaroo reveals over 1,234 potential dwelling sites. Approximately 900 of these are in South Bowenfels. The demand for land is generally reflected by the number of dwellings constructed in a specified period. The average take up rate of 33 lots per year is based on Councils register for 2001- 2004 and is a useful indicator of demand where population growth is consistent. Lithgow however, is subject to fluctuations and influenced by market forces from both Sydney and the Blue Mountains and the changing nature of its primary employment sectors.

Lithgow's population has grown by 0.5% (ABS 2006) between 2001 and 2005 with a preference for single dwellings. The number of dwellings in the LGA has also increased over each census period (1996 and 2001). The aging population and smaller household numbers will also affect demand for land and housing.

Despite the existing supply of land, it must be adequate to meet the demand for different types of dwellings and provide choice to meet demand across a wider spectrum. Sufficiently different areas need to be considered and released onto the market in Lithgow to provide a range in lot size, aspect, access and location of housing options which support the existing CBD, business, industry and infrastructure.

Balancing supply and demand is an important issue. A sufficient supply of land is needed to ensure prices are not forced upwards excluding potential homeowners from the market. Similarly, an oversupply of land can lead to downward pressures on the market and result in infrastructure investment by both Council and developers being underused. Much of the land held for development is privately owned. The timing of its release onto the market is therefore unknown. There is currently no land release strategy for Lithgow which could help to address this issue.

An analysis of industrial and warehousing land reveals a need for well planned, large 'cluster' areas to attract business to the LGA. Lithgow is well placed to attract employment generating opportunities. There are inadequate areas zoned for these purposes with good access to road and rail.

While not assessed in detail under this LES, there is sufficient commercial land within Lithgow for retail purposes. No new land should be considered outside these existing centres, the focus being to build and strengthen Main Street.



8.2 PLANNING FOR THE FUTURE

Sustainable development underpins planning for Marrangaroo. This is development that benefits the community, economy and environment. It involves three objectives – ecological integrity, community well being and economic prosperity (PlanningNSW 2000).

These objectives are supported by sustainable development principles as set out in Schedule 2 of the Environmental Planning and Assessment Regulation 2000:

- The precautionary principle, namely if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measure to prevent environmental degradation,
- Inter-generational equity,
- Conservation of biological diversity and ecological integrity, and
- Improved valuation, pricing and incentive mechanisms.

From these principles and objectives more precise guiding criteria can be developed to assist decisions on land use and conservation for Marrangaroo. These are set out in **Section 9**.

8.2.1 PLANNING PRECINCTS

An analysis of the strengths, weaknesses, opportunities and threats to development of Marrangaroo has guided the development of planning precincts as a first base for considering land uses.

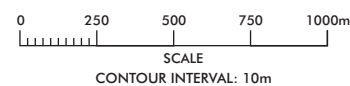
Table 8.1 is a summary of these attributes and reflects the outcomes of the workshops held on the 2 March 2006 with both the Marrangaroo Community Group and Government agencies and infrastructure providers. **Figure 25** illustrates the location of these precincts across the Study Area.



PLANNING PRECINCTS

- PRECINCT BOUNDARY
- WOODLAND
- 25m BUFFER
- DEFENCE LAND
- ROCKY SCARP
- EPHEMERAL FEEDER STREAMS
20m BUFFER EACH SIDE
- MARRANGAROO CREEK
50m BUFFER EACH SIDE
- + IDENTIFIED SPRINGS
- DRAINAGE LINE
- 10m CONTOUR LINE
- SITE BOUNDARY

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SOURCE:
AERIAL PHOTOGRAPH, CONTOURS & DRAINAGE - © LAND AND PROPERTY INFORMATION (2005)
MAXIMUM 1 IN 100 YEARS FLOOD LEVELS - TIERNEY & PARTNERS PTY LTD CONSULTING ENGINEERS (1988)

FIGURE 25:
MARRANGAROO
PRECINCTS WITH IDENTIFIED
CHARACTERISTICS FOR PLANNING

Table 8.1 - Marrangaroo Planning Precincts

PRECINCT A	
CHARACTERISTICS	• Located in the most north eastern corner of the project area. • Access off Reserve Road is via a private road. • Formerly part of Fernbrook Colliery, it is now occupied by Endless Belts manufacturing company. • Bridge access provided across Marrangaroo Creek to current development. • Predominantly open agricultural land.  
OPPORTUNITIES	• Well defined, isolated area surrounded on three sides by vegetated slopes. • Fernbrook Farmhouse is located in the area and is listed as a potential heritage item. • Proposed riparian woodland corridor as recreation/open space link.
CONSTRAINTS	• Adjoins Defence land and its activities. • Land is subject to flooding from Marrangaroo Creek. • Ecological features and buffers. • One potential source of contamination identified. • Potential traffic impacts from an intensification of development in this corner. 
LAND USE OPTIONS	• Low intensity use preferable. Option for single use industry or commercial operation. • Light industry • Commercial tourism and recreation • Some large lot rural activities e.g. horse farm/training, nursery, organic farming e.g. berries.



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PRECINCT B

CHARACTERISTICS

- Rural residential lots with frontage to Reserve Road, some grazing.
- A construction/machinery storage is the only industrial type use existing.
- Area is bounded by Marrangaroo Creek to the north and open woodland to the west.
- An ephemeral feeder stream runs through the area.
- Adjoining land uses are the Lithgow Correctional Centre to the north and Defence land to the east.



OPPORTUNITIES

- Flat, well defined rural landscaped.
- Good road access.
- Complimentary supporting uses or with adjoining area 'A'.
- Provide landscape avenue/buffer along northern side of Reserve Road.
- Prepare design guidelines so the built environment is compatible with, interfaces and respects the adjoining high conservation area of Marrangaroo Creek and riparian corridor.

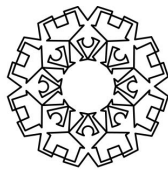
CONSTRAINTS

- Uses need to be compatible with activities generated from the adjoining Defence land to the east and conservation and protection of Marrangaroo Creek to the north.
- Marrangaroo Creek is a Category One watercourse (Department of Natural Resources).
- Maintenance of water quality.
- Depth to brackish ground water table.
- Four potentially contaminating sources identified in the area.



LAND USE OPTIONS

- Employment generating precinct for non-polluting industries and services.
- Open space and recreational uses with links to woodland and Marrangaroo Creek.



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PRECINCT C

CHARACTERISTICS

- Marrangaroo Creek forms the north and western boundaries of the area.
- Open woodland defines the eastern boundary.
- The Correctional Centre is the primary adjoining land use.
- Views across the site from the Great Western Highway however Reserve Road is the primary access point.
- Large lots rural residential/living on approximately 25 acre lots.



OPPORTUNITIES

- Well defined rural landscape edged by Marrangaroo Creek and woodland.
- Ready access from Reserve Road.
- Two potential heritage items – Marrangaroo Prayer Chapel and Marrangaroo Creek Bridge.
- One indigenous heritage item (isolated find) is in the area.
- Relatively flat undeveloped grazing land suitable for a wide range of uses.

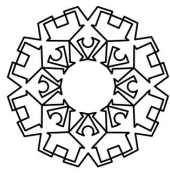


CONSTRAINTS

- Flooding from Marrangaroo Creek.
- Nearness to Correctional Centre.
- Maintenance of adjoining riparian corridor and water quality.

LAND USE OPTIONS

- Suitable for urban or employment generating activities that do not compromise Marrangaroo Creek and adjoining woodland.
- Tourism services.



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PRECINCT D

CHARACTERISTICS

- Predominately agricultural grazing land with large lot rural residential fronting Reserve Road.
- Edged by Defence Land to the east with steep vegetated hills.
- Undulating land with views across the valley.



OPPORTUNITIES

- Contains the largest single holding in the area for development.
- Undulating land with views to the north, west and east.





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PRECINCT D

CONSTRAINTS

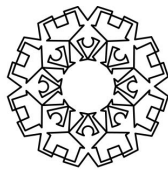
- A number of ephemeral streams run through the area as well as scenic rocky outcrop/ ridge along western boundary.
- Maintaining water quality.
- An alternative route to the Highway (100km) is needed for any increase in population or employment in the area.
- Six (6) potentially contaminating sources identified near to Reserve Road.
- Depth to brackish groundwater.



LAND USE OPTIONS

- Urban - residential, open space, community facilities (in the centre) linked backed into Lithgow.
- Some large lot rural lifestyle blocks in areas constrained by topographic features or adjoining land uses.





PRECINCT E

CHARACTERISTICS

- Predominantly 10 acre lots with good visibility from the Great Western Highway.
- Mixed land uses.
- Visual entry point to Lithgow.
- Development beyond these areas is restricted by the rocky outcrop behind.

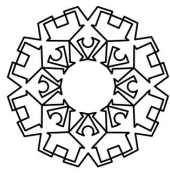


OPPORTUNITIES

- Visibility and proximity to Highway.
- Rationalise access points to Highway.
- Provide a landscape buffer and service road while retaining Highway exposure.

CONSTRAINTS

- Four (4) potentially contaminated sites identified.
- High number of licensed access points onto the 100 km Highway.
- RTA not supportive of any further public roads onto the highway (2 approved).
- Maintaining water quality of an ephemeral creek (Category 2 DNR) and minimising crossings.
- Number of lots in different ownership.
- Assessment of the Lithgow gas trunk receiving station and pipeline is required. A 157 metre buffer may be required with a change in land use.
- Easement to gas pipeline.
- Noise impacts from Highway.



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PRECINCT E

LAND USE OPTIONS

- Uses compatible with Highway frontage.
- Business enterprise corridor or highway services.
- Well serviced land within an attractive business estate.

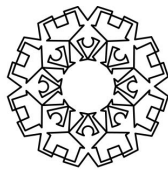




GEOLYSE

PRECINCT F

CHARACTERISTICS	- Narrow band of land between the Great Western Highway and the Western Rail Line. - Mixed uses. - Marrangaroo Creek traverses the area to the north.	
OPPORTUNITIES	Can be embellished to form an attractive visual corridor/ entry to Lithgow.	
CONSTRAINTS	- Noise from both the highway and railway. - Narrow parcels of land. - Current land uses. - Access from the Highway. - Four (4) potentially contaminated sites identified.	
LAND USE OPTIONS	- Relocate existing uses and embellish area with tree planting. - Highway service area for north bound traffic to the Central West (Mudgee, Dubbo, Orange, Bathurst).	



PRECINCT G

CHARACTERISTICS

- Large parcel of land on the western side of the Highway zoned 2(a) residential.
- Consent granted in 2004 for 217 lot residential subdivision (approximately 600sq m). Access is proposed from the Highway via a bridge over the rail line.
- Marrangaroo Creek and woodland form the western boundary of the site.
- Main western rail line runs along its eastern boundary.
- As residential land it will from a strong urban edge to the Study Area unless there is a requirement to install noise barriers and mounds which the housing sits behind and predominantly out of view.



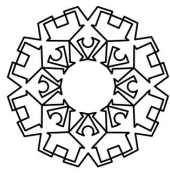
OPPORTUNITIES

- Views across the valley to the east.
- Highway exposure and potential access to rail line.
- Located close to the Golf course.



CONSTRAINTS

- Rail and road noise requiring buffers for residential use of the land.
- Grade of Oakey Forest Road and conflict with Quarry trucks.
- Expected long life of the Quarry and its continued operation.
- Approved, isolated, relatively dense (600 sq m) urban development (compared with Marrangaroo fields with a minimum of 2000 sq m).
- Ecological parameters to maintain water quality to Marrangaroo Creek.



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PRECINCT G

LAND USE OPTIONS

- While consent has been granted for housing the site is also suitable for:
 - Business park, light industrial development
 - Accommodation linked to the Golf Course



PRECINCT H

CHARACTERISTICS

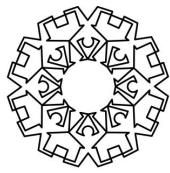
- Open, flat grazed parcel of land.
- Zoned 2(a) residential but is currently undeveloped.
- A large Integral transmission line cuts across its western corner.



OPPORTUNITIES

- Undeveloped, adjoins the Golf Course.
- Opportunity to prevent land use conflict.





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PRECINCT H

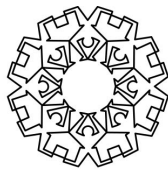
CONSTRAINTS

- Adjoins Go-Kart tracks and is within 400metres of the Quarry and acceptable noise limits for residential development.
- Potential conflict with Quarry trucks if access provided onto Oakey Forest Road.
- Proximity to transmission lines.



LAND USE OPTIONS

- Uses need to be compatible with the adjoining Quarry, Go-Kart track, and transmission line.
- Leisure and service industry linked to golf course.
- Private open space, commercial recreation, motel/hotel, convention etc.



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PRECINCT I

CHARACTERISTICS

- Large open grassland traversed by the Integral transmission line.
- Zoned 2(a) residential but marked as a buffer zone in the Marrangaroo Fields Estate Development Control Plan.

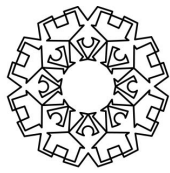


OPPORTUNITIES

- Provides a buffer between the existing quarry and adjoining residential dwellings.
- Opportunity to manage land use conflict.

CONSTRAINTS

- Transmission line runs through it; and adjoins the Quarry.
- DPI – Mineral Resources have advised that the Quarry has resources for the next 50 years and is one of two important sources of silica for NSW.



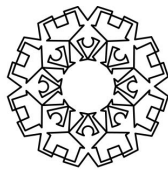
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PRECINCT I

LAND USE OPTIONS

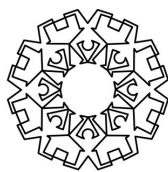
- Retain as a buffer to the Quarry.
- Possible options: private open space, commercial recreation, tree planting, stormwater management and wildlife corridor.
- Some activities (e.g. plant nursery or not-for-profit) that do not generate noise, dust, odour or traffic and are compatible as an 'intermediary' use between the quarry and residential housing.





PRECINCT J

CHARACTERISTICS	- Large area of open grassland bordering Marrangaroo Fields Estate to the north and steep vegetated slopes to the south. - Zoned 2(a) residential with a potential lot layout provided in Marrangaroo Fields Estate DCP.
OPPORTUNITIES	- Opportunity to provide a green edge to urban development and finalise the development of this area. - Possible s94 contributions for upgrade of the single lane bridge crossing over the railway line. - Possible link to 2(a) zoned land south of the area & further investment contributions to upgrade single lane bridge.  <i>Looking west back towards Marrangaroo Fields Estate from across the Highway.</i>
CONSTRAINTS	- Increased traffic onto the Highway over the single lane railway bridge. - Provision and cost of servicing. - Assessment of gas substation and extent of possible 157m buffer, across the Highway.
LAND USE OPTIONS	Residential on the flatter land with an open space recreation or scenic protection zone on the steeper wooded slopes to maintain a rural and scenic backdrop to the area. 



Land Use Options

9.1 OVERVIEW

Through the analysis of characteristics, opportunities and constraints three landuse options were developed based on the suitability and capability of the land for development. A set of guiding principles/criteria were also collated to assist decisions for conserving, managing and developing the area.

9.2 GUIDING PRINCIPLES

Principles to guide decisions on potential landuse were developed and distributed to the Marrangaroo Community Group, Government Agencies and Infrastructure Providers. The response from all groups was to combine this information into one set while incorporating the outcomes from the workshops.

Table 9.1 reveals how similar these principles are and that both can guide planning for Marrangaroo.

Table 9.1 - Guiding Principles for Marrangaroo

Principles adapted from Sustainable Urban Settlement Guidelines for regional NSW and Integrating Land Use and Transport.	Principles adapted from community input (Open House 16 February 2006)
1. Separate incompatible uses from one another.	1. Minimise land use conflict and protect existing resources from incompatible land uses to allow for continued economic growth.
2. Locate development near services and infrastructure reducing costs.	2. Design and implement cost effective infrastructure for the whole area to support its development.
3. Design areas to provide access to natural environment, services, employment and recreational opportunities.	3. Well planned development with adequate safeguards for the environment. Improve access from Marrangaroo Fields and Oakey Forest Road onto the 100km Highway.
4. Protect environmental attributes and areas of visual amenity such as ridgelines and viewpoints.	4. Protect heritage views and rural character/setting of the area. Maintain the natural beauty of hills (forested, rock formations and vegetation) for wildlife, attractiveness and the lifestyle option it provides.
5. Incorporate wildlife corridors along gullies and waterways and avoid creating barriers for wildlife movement.	5. Protect Marrangaroo Creek, its water quality and wildlife in particular the platypus colony.
6. Nominate buffer areas between urban development and natural areas and waterways.	6. Provide adequate separation between land uses and links to open space.



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Table 9.1 - Guiding Principles for Marrangaroo

Principles adapted from Sustainable Urban Settlement Guidelines for regional NSW and Integrating Land Use and Transport.	Principles adapted from community input (Open House 16 February 2006)
7. Avoid urban development in flood prone areas, bushfire danger, soil erosion areas etc.	7. Provide a range of recreational opportunities including access to bushland walks.
8. Provide basic services within residential neighbourhoods or villages – such as a shop or community centre. Do not plan or develop services greater than the needs of the target population.	8. Need employment generating land uses e.g. clean light industrial, business and land with good access and visibility.
9. Cluster community, service, educational, retail and commercial uses near the centre of neighbourhoods. Such uses should <u>not</u> be located on regional transport routes.	9. Maintain the visual quality of the entrance to Lithgow and ensure community and lifestyle are protected.
10. Locate compatible land uses together to reduce trip lengths, provide viable transport choice and encourage walking and cycling.	10. Road network needs to be bus friendly (wide, adequate turning circles, good & safe access). Provide walking, cycle and public transport with links back into Lithgow.
11. Encourage the type of development that will benefit the greatest number and range of people in the community with the least adverse impact.	11. Separate minimum security Correctional Centre and residential housing. 12. Protect all reasonable access to valuable resources, such as the Quarry, that supply essential material for construction. 13. Increase economic opportunities to live and grow in Lithgow.

Source: Geolyse Pty Ltd

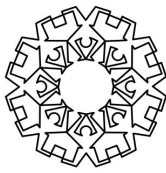
These principles have been used in developing Land Use Options 1, 2 and 3 below and will be used in preparing the Structure Plan.

9.3 LAND USE OPTIONS

The three land use options derived below incorporate a wide range of possible uses for the land to match community expectations and values, best fit with existing land uses while seeking the highest and best use of the land.

These proposed land uses are:

- Conservation of Marrangaroo Creek, its riparian vegetation and remnant woodland, with buffers to ephemeral streams;
- Highway Business Services within proximity to the Great Western Highway;
- Employment Generating Industry (not heavy industry) at the interface to the Correctional Centre;



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- Low impact tourism on land adjoining defence activities, yet contiguous with Marrangaroo Creek and surrounded by steeply vegetated land;
- Rural lifestyle (large lot residential) on the higher slopes and adjoining Defence land;
- Urban (comprising open space, neighbourhood centres and housing of different densities); and
- Private open space, commercial recreation and tourist accommodation in areas subject to impact from existing uses and infrastructure.

These listed land uses appear in all options but in varying locations.

To assist in explaining these options the project area is divided into two parts:

- Land east of the Highway and zoned for agricultural purposes. This part comprises the Correctional Centre, Defence land, businesses and housing fronting the highway and farming land.
- Land to the west of the Highway zoned for residential purposes and comprising the Golf course, Marrangaroo Fields Estate, Quarry, Go kart operation, dwellings along Oakey Forest Road, grazing land and the sliver of land between the highway and the railway line.

Importantly in all three options buffers are indicated to drainage lines which have been classified as a 'river' under the *Rivers and Foreshores Improvement Act 1948* by the Department of Natural Resources. Maximum planning buffer widths (50m and 100 m) have also been nominated by DNR for two thirds of the area. Geolyse Pty Ltd has nominated a 20 metre planning width to those not yet finalised.

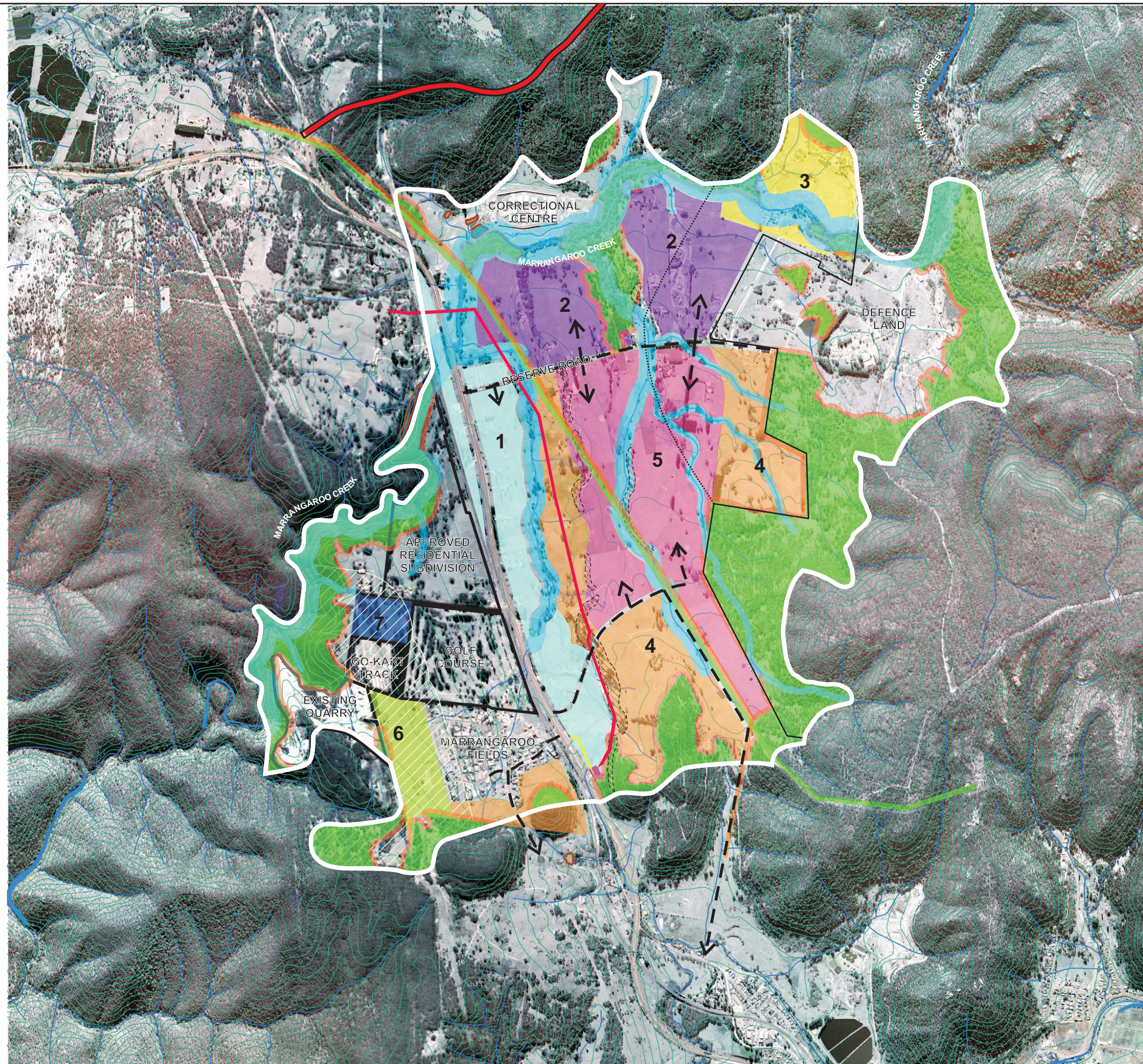
We understand these are not fixed widths but require flood and ecological studies along with a concept plan of development to make a final decision. They are included now to highlight the potential opportunities and constraints for the future development of the land. Importantly, they are not the final set for ongoing planning of the area and may change.

Further discussions between Council and the Department of Natural Resources are proposed to give more clarity to this issue.

9.4 LAND USE OPTION 1

Land to the east of the Highway

Within this option (**Figure 26**) employment land is located entirely north of Reserve Road to take advantage of the flat land, capacity to upgrade Reserve Road, proximity to the highway and Correctional Centre as well as being compatible with activities on Defence land. Design guidelines would need to ensure that development positively interfaced with the woodland reserve and Marrangaroo Creek to prevent barriers, such as fences, and cold hard frontages impacting on the use, safety and amenity of the area.



- PROPOSED LAND-USES**
- 1 HIGHWAY / BUSINESS SERVICES
 - 2 EMPLOYMENT GENERATION
 - 3 LOW IMPACT TOURISM
 - 4 RURAL LIFESTYLE
 - 5 URBAN
 - 6 PRIVATE OPEN SPACE & COMMERCIAL RECREATION
 - 7 TOURIST ACCOMMODATION & CONVENTION & COMMERCIAL RECREATION

- KEY:**
- DEFENCE LAND
 - AREA FOR FURTHER INVESTIGATION WITH DEFENCE
 - ← POSSIBLE ACCESS ROUTE
 - PROPOSED OPTION FOR BELLS LINE OF ROAD (APPROXIMATE LOCATION)
 - ▨ QUARRY 400m BUFFER FOR RESIDENTIAL
 - ▨ EASEMENT FOR TRANSMISSION LINE 27.5 WIDE
 - ▨ EASEMENT FOR TRANSMISSION LINE 30.48 WIDE
 - ▨ EASEMENT FOR WATER 10.06 WIDE
 - ▨ NAT. GAS TRANSFER STATION (SUBJECT TO RISK ASSESSMENT)
 - ▨ PIPELINE EASEMENT 20 WIDE (SUBJECT TO RISK ASSESSMENT)
 - ▨ WOODLAND
 - ▨ 25m BUFFER
 - ▨ ROCKY SCARP ENVIRONMENTAL PROTECTION
 - ▨ EPHEMERAL FEEDER STREAMS (UNCLASSIFIED) 20m BUFFER EACH SIDE
 - ▨ EPHEMERAL FEEDER STREAMS 50m BUFFER EACH SIDE
 - ▨ MARRANGAROO CREEK 100m BUFFER EACH SIDE ENVIRONMENTAL PROTECTION
 - DRAINAGE LINE
 - 10m CONTOUR LINE
 - ▭ SITE BOUNDARY

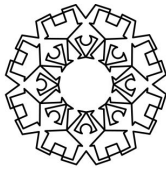
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0 250 500 750 1000m
SCALE
CONTOUR INTERVAL: 10m

SOURCE:
AERIAL PHOTOGRAPH, CONTOURS & DRAINAGE - © LAND AND PROPERTY INFORMATION (2005)

FIGURE 26:
MARRANGAROO
PROPOSED LANDUSE PLAN
OPTION 1



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Low impact tourism or a single use industry is proposed to the far north eastern corner to minimise impacts associated with Marrangaroo Creek and flooding. Marrangaroo Creek, with rehabilitation, will form an important biodiversity corridor in the area. Importantly development in this area needs to be compatible with activities on the adjoining Defence land.

South of Reserve Road on undulating land urban living is proposed. In areas where the topography is steeper and less suited to being cut and filled large lot residential blocks of varying density are shown. This less compact form of development also contributes to maintaining some of the rural character of the area in more visually prominent areas.

For more dense urban development to proceed within the heart of Marrangaroo, alternative access to the Highway back into the fabric of Lithgow Township needs to be identified and fostered. This is important for the functionality of the Highway as a 100km Freeway but also for safety, amenity, cycling and walking and the well-being of the community. An alternative local road network into Lithgow would readily link this area with services and facilities of the centre.

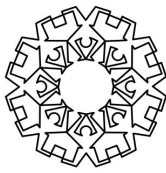
Large lot residential being rural lifestyle blocks are also proposed between the ephemeral stream closest to the Highway and the rocky scarp. The rationale for this is to assist in preserving unique features of the landscape, minimise dense urban development in close proximity to the gas pipeline and again retain a level of development commensurate with the values of the area.

Along the highway where exposure is high, highway and business services are proposed being uses compatible with noise generated by the Great Western Highway and the Main Western Rail line. This option would require the implementation of an internal service road for some of its length. While a second unmade public road exists on this side, its location is not ideal and an alternative location is proposed and was developed in consultation with the RTA.

Approximately 12 dwelling houses (of varying improvement value) exist at intervals along this eastern Highway frontage requiring careful consideration of how they will integrate with any new future development. Many of the dwellings do not support agricultural activities but the lots are of a size and nature more akin to rural residential.

On going residential use of this area is not supported because of the proximity to the Highway, the gas pipeline and transfer station and the potential future need for relatively large, flat parcels of land for business with good access to services and infrastructure (Baker 2006). While the Enterprise Corridor (set by Department of Planning's Standard Instrument (Local Environmental Plans) Order 2006) may be suitable for this area it does have some short comings in that the objectives of the zone do provide for retail and office space which may compete with Lithgow CBD and multi dwelling houses must be permitted in the area. The current objectives listed for an Enterprise Corridor are:

- To promote businesses along main roads and to encourage a mix of compatible uses.
- To enable a mix of employment (including business, office, retail and light industrial uses) and residential uses.
- To maintain the economic strength of centres by limiting the retailing of food and clothing.



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Land to the west of the Highway

Residential land adjoining the highway will be constrained by noise generated by the Highway, Railway and to the south by the gas transfer station (**Figure 26**) located on the other side of the Highway. While a residential subdivision has been approved north of the Golf Course this land is also suitable for industrial and technology park development.

Given the expected 50 year life of the Quarry and its role in supplying construction material for the building industry, a 400 metre buffer is required for residential dwellings to comply with Industry Standards. This will limit development in this arc to those compatible with the operation of the Quarry. This will not release the Quarry from its license obligations set by the EPA.

Plates A below shows the buffer drawn as an arc calculated from the extent of the mine leases. While it is uncertain whether development will achieve this full potential an alternative buffer shown in Plate B is indicated for discussion. This buffer is drawn from the extent of the existing quarry boundary not the mining leases and removes some land from its effect. Both buffers are the prerequisite 400 metres. The application of the buffer will need to be negotiated with the relevant parties and considered when preparing a local environmental plan or development control plan for the area. In the interim it is a guide for Council and developers on the inherent limitations in the area.

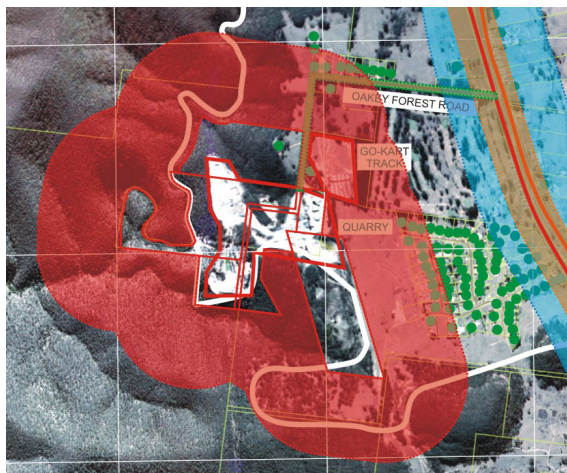


Plate A. Buffer from extent of leases

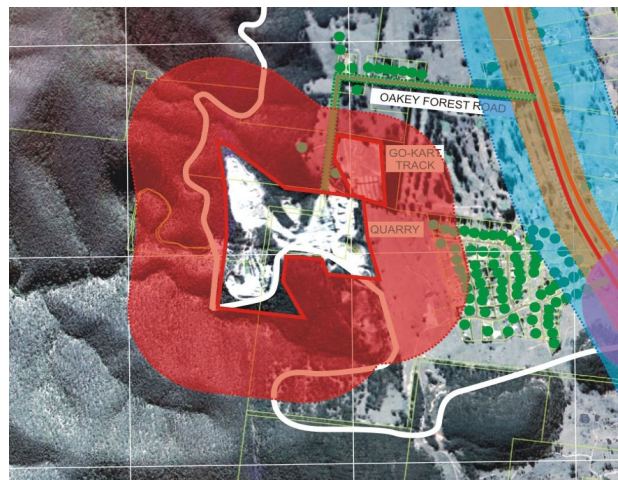
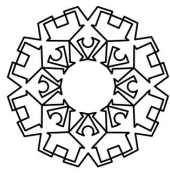


Plate B. Buffer from extent of approved existing operation

The proposed land uses within this area are private open space and commercial recreation to support existing recreational activities (Go-Kart and Golf Course) as well as tourism/convention activities. While Oakley Forest Road is used by Quarry haulage trucks, additional traffic should be minimised.

Capacity exists south of the existing Marrangaroo Fields Estate for further subdivision outside the buffer areas nominated for the Quarry and gas transfer station. The RTA are firmly of the view that any new development that increases traffic across the single bridge crossing onto the Highway will need to contribute to its upgrade to a two way crossing or find an alternative route back into the Lithgow township. This view is supported by the community who through the consultation process have expressed concern with the dangers of the current crossing and the need to fix it.



Development in and around this area will need to retain the steeply vegetated slopes which are important scenic and landscape features valued by the community. Their retention also supports biodiversity corridors and assists in maintaining water quality objectives within the Sydney Water Catchment.

9.5 LAND USE OPTION 2

This option, depicted in **Figure 27** has moved some of the proposed land uses to alternative locations. In this option former rural living (large lot residential) land adjoining Defence land has been replaced by employment generating uses. This brings potential employment opportunities closer into the heart of an urban area and provides a buffer to activities on Defence land. The only concern with this option is the number of drainage lines running through this area and its topography which in parts would need to be levelled to provide flat platforms for business development which may impact negatively on the environment.

Urban development has been extended across Reserve Road to integrate with opportunities provided by Marrangaroo Creek and the woodland reserve. In this option open space activities would front onto the creek corridor with residential development set back closer to Reserve Road. The open space, whether playing fields, netball courts, tennis etc would also provide some distance between the Correctional Centre and housing as well as deal with any potential flooding.

Importantly, design principles will be produced to ensure there is not a hard edge between activities north and south of Reserve Road and this spine serves as an activity centre.

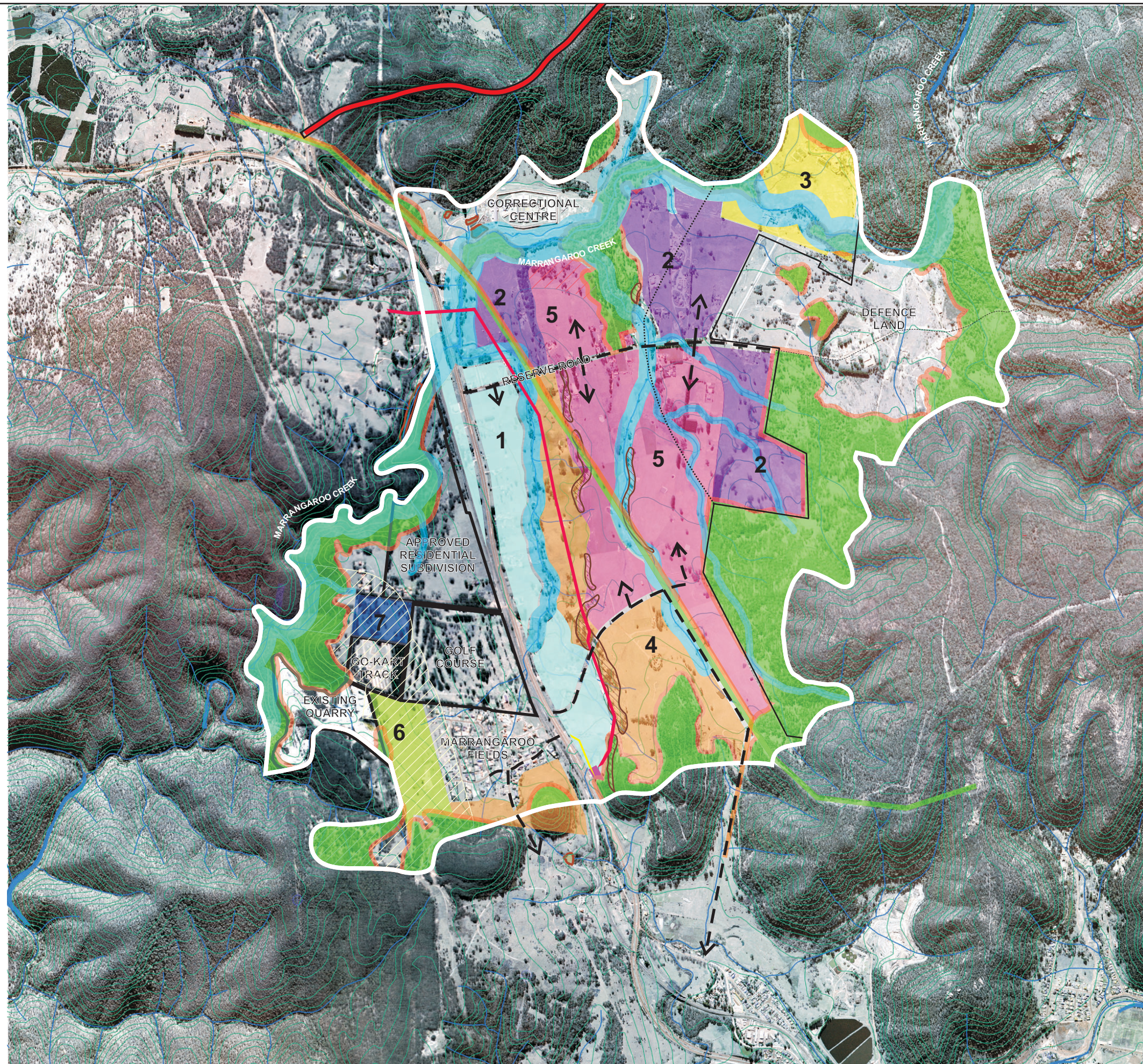
In both options the watercourses provide opportunities for embellishment as biodiversity corridors as well as integrating recreational opportunities through the centre of the eastern part.

No changes have been made to land uses on the western side of Marrangaroo.

9.6 LAND USE OPTION 3

This option shown in **Figure 28**, to the east, removes the low impact tourism use in the north east corner to make all land north of Reserve Road, employment generating uses. Because of the environmental qualities of this area these are not heavy industry uses but light industry uses, such as, warehouse or distribution centres, freight transport facilities, depots, neighbourhood shops etc. Development adjoining the defence land will need to be compatible with noise and vibration generated from this site.

Light industry means an industry, not being hazardous or offensive industry or involving use of a hazardous or offensive storage establishment, in which the processes carried on, the transportation involved or the machinery or materials used do not interfere with the amenity of the neighbourhood by reason of noise, vibration, smell, fumes, smoke, vapour, soot, ash, dust, waste water, waste products, grit or oil, or otherwise.



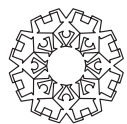
PROPOSED LAND-USES

- 1 HIGHWAY / BUSINESS SERVICES
- 2 EMPLOYMENT GENERATION
- 3 LOW IMPACT TOURISM
- 4 RURAL LIFESTYLE
- 5 URBAN
- 6 PRIVATE OPEN SPACE & COMMERCIAL RECREATION
- 7 TOURIST ACCOMMODATION & CONVENTION & COMMERCIAL RECREATION

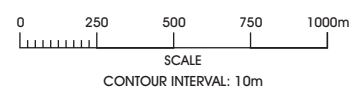
KEY:

- DEFENCE LAND
- AREA FOR FURTHER INVESTIGATION WITH DEFENCE
- ← POSSIBLE ACCESS ROUTE
- PROPOSED OPTION FOR BELLS LINE OF ROAD (APPROXIMATE LOCATION)
- ▨ QUARRY 400m BUFFER FOR RESIDENTIAL
- ▨ EASEMENT FOR TRANSMISSION LINE 27.5 WIDE
- ▨ EASEMENT FOR TRANSMISSION LINE 30.48 WIDE
- ▨ EASEMENT FOR WATER 10.06 WIDE
- ▨ NAT. GAS TRANSFER STATION (SUBJECT TO RISK ASSESSMENT)
- ▨ PIPELINE EASEMENT 20 WIDE (SUBJECT TO RISK ASSESSMENT)
- ▨ WOODLAND
- ▨ 25m BUFFER
- ▨ ROCKY SCARP ENVIRONMENTAL PROTECTION
- ▨ EPHEMERAL FEEDER STREAMS (UNCLASSIFIED) 20m BUFFER EACH SIDE
- ▨ EPHEMERAL FEEDER STREAMS 50m BUFFER EACH SIDE
- ▨ MARRANGAROO CREEK 100m BUFFER EACH SIDE ENVIRONMENTAL PROTECTION
- DRAINAGE LINE
- 10m CONTOUR LINE
- SITE BOUNDARY

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SOURCE:
AERIAL PHOTOGRAPH, CONTOURS & DRAINAGE - © LAND AND PROPERTY INFORMATION (2005)

FIGURE 27:
MARRANGAROO
PROPOSED LANDUSE PLAN
OPTION 2



PROPOSED LAND-USES

- 1 HIGHWAY / BUSINESS SERVICES
- 2 EMPLOYMENT GENERATION
- 3 LOW IMPACT TOURISM
- 4 LARGE LOT RESIDENTIAL
 - 4a - 20,000m² LOTS
 - 4b - 4,000m² LOTS
 - 4c - 2,000m² LOTS
- 5 URBAN
- 6 PRIVATE OPEN SPACE & COMMERCIAL RECREATION & TOURIST ACCOMMODATION

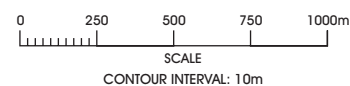
SPECIAL ACTIVITIES

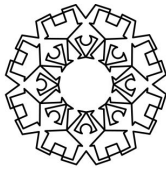
- DEFENCE LAND
- CORRECTIONAL CENTRE
- QUARRY

KEY:

- DEFENCE LAND
- AREA FOR FURTHER INVESTIGATION WITH DEFENCE
- ← POSSIBLE ACCESS ROUTE
- PROPOSED OPTION FOR BELLS LINE OF ROAD (APPROXIMATE LOCATION)
- ▨ QUARRY 400m BUFFER FOR RESIDENTIAL
- ▨ EASEMENT FOR TRANSMISSION LINE 27.5 WIDE
- ▨ EASEMENT FOR TRANSMISSION LINE 30.48 WIDE
- ▨ EASEMENT FOR WATER 10.06 WIDE
- ▨ NAT. GAS TRANSFER STATION (SUBJECT TO RISK ASSESSMENT)
- ▨ PIPELINE EASEMENT 20 WIDE (SUBJECT TO RISK ASSESSMENT)
- ▨ WOODLAND
- ▨ 25m BUFFER
- ▨ ROCKY SCARP ENVIRONMENTAL PROTECTION
- ▨ EPHEMERAL FEEDER STREAMS (UNCLASSIFIED) 20m BUFFER EACH SIDE
- ▨ EPHEMERAL FEEDER STREAMS 50m BUFFER EACH SIDE
- ▨ MARRANGAROO CREEK 100m BUFFER EACH SIDE ENVIRONMENTAL PROTECTION
- DRAINAGE LINE
- 10m CONTOUR LINE
- SITE BOUNDARY

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Rural living (large lot residential) has been re-instated to the eastern border with Defence land. If a 400 metre buffer is imposed to Defence land for residential development, a number of options will need to be considered for land in this vicinity. These may be:

- Restrictions on dwellings. For example, nominating building envelopes for dwellings outside the restricted area but permitting garden sheds, garages, pools, stables, back yards etc within it.
- Changing the urban or rural living/large lot residential areas to a mix of open space and employment.
- Making the whole area within the 400m arc employment generating.
- Seeking support from Defence to either purchase the most sensitive areas or relocate the demolition range.

Presently Defence have indicated a preference for open space adjoining their land. However Council will enter further negotiations with Defence to find a higher and better use for the community while balancing land compatibility issues.

Access to the Great Western Highway has also changed in this option to reflect the preferred area by the RTA and Council, negotiated late in the project. The location of the existing unformed public road remains on Options 1 & 2 for reference and to assist in tracking decisions.

The most significant changes however found in Option 3 are to the western side of Marrangaroo.

In this option it is proposed to introduce an open space/recreation/tourism land use compatible with the quarry, go-kart operations, the transmission line and constraints to further development imposed by the topography.

Land north of Oakey Forest Road has previously been earmarked for industrial purposes and with careful site layout could be an attractive industrial estate linked to the Highway and Railway with minimal impact on existing dwellings. Employment uses in this location are more compatible with noise impacts generated from the highway and railway.

Consideration could be given however, to some residential use of the land particularly to the west adjoining Marrangaroo Creek and other existing dwellings.

Marrangaroo Fields is shown as large lot residential housing to differentiate it from a more suburban pattern of development. Here the environmental qualities, rural setting and scenic qualities of the area would be protected.

9.7 PREFERRED OPTION

The preferred option is Land Use Option 3. It more closely aligns with the principles set out in **Table 9.1** and provides for the highest and best use of the land within known parameters.

Notwithstanding this there is still room for further refinement to improve the long term sustainable management of the land. These will be better understood through exhibition of the LES and draft Structure Plan for Marrangaroo and consideration of community and government agency submissions.



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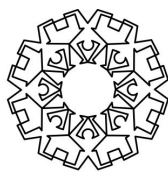
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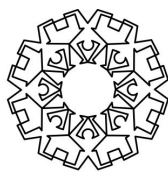
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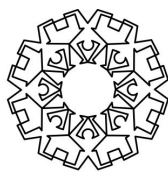
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Appendix A

SEPP 11 – TRAFFIC GENERATING DEVELOPMENT

State Environmental Planning Policy No 11—Traffic Generating Developments

[1985-011]

Status Information

Currency of version

This is the latest version of this legislation.

Legislation on this site is usually updated within 3 working days after a change to the legislation.

This version was last updated on 10 March 1995.

This version relates to the period commencing on 9 August 1985 to date.

Act under which legislation made

This legislation was made under the [Environmental Planning and Assessment Act 1979](#)

Date made

9 August 1985

Provisions in force

The provisions displayed in this version of the legislation have all commenced. See [Historical notes](#)

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New South Wales

1 Name of Policy

This State environmental planning policy may be cited as *State Environmental Planning Policy No 11—Traffic Generating Developments*.

2 Aims, objectives etc

The aims, objectives, policies and strategies of this Policy are to ensure that the Traffic Authority:

- (a) is made aware of, and
- (b) is given an opportunity to make representations in respect of, development referred to in Schedule 1 or 2.

3 Interpretation

- (1) In this Policy, except in so far as the context or subject-matter otherwise indicates or requires:

arterial road means:

- (a) a road shown on a map referred to in an environmental planning instrument by:
 - (i) a continuous or intermittent red line on white between firm black lines, or
 - (ii) a broken red band on white between intermittent black lines,
- (b) a road proclaimed to be a main road under the *Main Roads Act 1924*, and
- (c) a road declared to be a secondary road under the *Main Roads Act 1924*.

roadside stall means a building or place where only primary products produced on the property on which the building or place is situated are exposed or offered for sale.

Traffic Authority means the Traffic Authority of New South Wales.

- (2) A reference in Schedule 1 or 2 to the erection of a building does not include a reference to the making of structural alterations to the building, except where the structural alterations have the effect of increasing the gross floor area beyond the figure specified in Schedule 1 or 2 in relation to the building.

4 Application of Policy

This policy applies to the State.

5 Certain provisions in environmental planning instruments to be of no force or effect

A provision contained in any other environmental planning instrument requiring a consent authority, before determining a development application, to consult with and to take into consideration in determining that application any representations of the Department of Main Roads, the Police Department (Traffic Branch) or the Traffic Authority shall, to the extent only of the requirement, be of no force or effect.

6 Model Provisions

The definitions in clause 4 (1) of the *Environmental Planning and Assessment Model Provisions 1980* (except for the definitions of **arterial road**, **general store**, **main road** and **roadside stall**) are adopted for the purposes of this Policy.

7 Development applications to be referred to the Traffic Authority

- (1) Subject to subclause (2), this clause applies to applications for development consent to carry out development specified in Schedule 1 or 2.
- (2) Where the Traffic Authority has notified a consent authority that this clause does not apply to a development application (whether by reference to the type, purpose or location of the development the subject of the application or otherwise) this clause shall not apply to that development application.
- (3) Where a consent authority receives a development application to carry out development specified in Schedule 1, the consent authority shall, within 7 days of its receipt of the application, forward a copy of the application to the Traffic Authority.
- (4) Where a consent authority receives a development application (other than a development application to which subclause (3) relates) to carry out development specified in Schedule 2, being development on or of land that has direct vehicular or pedestrian access to:
 - (a) an arterial road, or
 - (b) a road connecting with an arterial road, if the access is within 90 metres (measured along the road alignment of the connecting road) of the alignment of the arterial road,the consent authority shall, within 7 days of its receipt of the application, forward a copy of the application to the Traffic Authority.
- (5) Where a copy of a development application has been forwarded to the Traffic Authority pursuant to subclause (3) or (4), the consent authority shall not determine the application until:
 - (a) it has received a representation with respect to the application from the Traffic Authority, or
 - (b) the Traffic Authority has informed the consent authority that it does not wish to make any representation with respect to the application, or
 - (c) 21 days have elapsed after the date on which the copy of the application was forwarded to the Traffic Authority,whichever first occurs.
- (6) The consent authority shall forward to the Traffic Authority a copy of any determination of a development application referred to in subclause (3) or (4) when giving notice of that determination to the applicant pursuant to section 92 of the Act.

Schedule 1

(Clause 7 (3))

Development for the purpose of or being:

- (a) the erection of, or conversion of a building into, a residential flat building comprising 300 or more dwellings or the enlargement or extension of a residential flat building by the addition of 300 or more dwellings,
- (b) the erection of a building for the purposes of shops where the gross floor area of the building is or exceeds 2 000 square metres or the enlargement or extension of a building used for the purposes of shops where the gross floor area of that enlargement or extension is or exceeds 2 000 square metres,
- (c) the erection of a building for the purposes of shops and commercial premises where the gross floor area of the building is or exceeds 4 000 square metres or the enlargement or extension of a building used for the purposes of shops and commercial premises where the gross floor area of that enlargement or extension is or exceeds 4 000 square metres,
- (d) the erection of a building for the purposes of commercial premises where the gross floor area of the building is or exceeds 10 000 square metres or the enlargement or extension of a building used for the purposes of commercial premises where the gross floor area of that enlargement or extension is or exceeds 10 000 square metres,
- (e) the erection of a building for the purposes of commercial premises and industry where the gross floor area of the building is or exceeds 15 000 square metres or the enlargement or extension of a building used for the purposes of commercial premises and industry where the gross floor area of that enlargement or extension is or exceeds 15 000 square metres,
- (f) the erection of a building for the purposes of industry where the gross floor area of the building is or exceeds 20 000 square metres or the enlargement or extension of a building used for the purposes of industry where the gross floor area of that enlargement or extension is or exceeds 20 000 square metres,
- (g) subdivision of land into 200 or more allotments where the subdivision includes the opening of a public road,
- (h) drive-in theatres or the enlargement or extension of existing drive-in theatres so as to enable the accommodation of more than 200 motor vehicles,
- (i) educational establishments accommodating 50 or more students or the enlargement or extension of existing educational establishments to accommodate an additional 50 or more students,
- (j) transport terminals, bulk stores, container depots or liquid fuel depots or the enlargement or extension of any existing transport terminal, bulk store, container depot or liquid fuel depot by increasing by more than 8 000 square metres the area of land or the gross floor area of buildings used for that purpose,
- (k) junk yards or depots or regional depots, within the meaning of the *Waste Disposal Act 1970*,

- (l) heliports, airports or aerodromes,
- (m) extractive industry or mining,
- (n) areas used exclusively for parking or any other development having ancillary accommodation for 200 or more motor vehicles, or the enlargement or extension of a parking area where the enlargement or extension accommodates 200 or more motor vehicles.

Schedule 2

(Clause 7 (4))

Development for the purposes of or being:

- (a) the erection of, or the conversion of a building into, a residential flat building comprising 75 or more dwellings or the enlargement or extension of a residential flat building by the addition of 75 or more dwellings,
- (b) the erection of a building for the purposes of shops where the gross floor area of the building is or exceeds 500 square metres or the enlargement or extension of a building used for the purposes of shops where the gross floor area of that enlargement or extension is or exceeds 500 square metres,
- (c) the erection of a building for the purposes of shops and commercial premises where the gross floor area of the building is or exceeds 1 000 square metres or the enlargement or extension of a building used for the purposes of shops and commercial premises where the gross floor area of that enlargement or extension is or exceeds 1 000 square metres,
- (d) the erection of a building for the purposes of commercial premises where the gross floor area of the building is or exceeds 2 500 square metres or the enlargement or extension of a building used for the purposes of commercial premises where the gross floor area of that enlargement or extension is or exceeds 2 500 square metres,
- (e) the erection of a building for the purposes of commercial premises and industry where the gross floor area of the building is or exceeds 4 000 square metres or the enlargement or extension of a building used for the purposes of commercial premises and industry where the gross floor area of that enlargement or extension is or exceeds 4 000 square metres,
- (f) the erection of a building for the purposes of industry where the gross floor area of the building is or exceeds 5 000 square metres, or the enlargement or extension of a building used for the purposes of industry where the gross floor area of that enlargement or extension is or exceeds 5 000 square metres,
- (g) subdivision of land into 50 or more allotments,
- (h) tourist facilities, recreation facilities, showgrounds or sportsgrounds, in each case having accommodation for 50 or more motor vehicles or the enlargement or extension of any existing tourist facilities, recreation facilities, showgrounds or sportsgrounds where that enlargement or extension includes accommodation for 50 or more motor vehicles,
- (i) premises licensed under the *Liquor Act 1982*, or the *Registered Clubs Act 1976*, in each

case having accommodation for 50 or more motor vehicles or the enlargement or extension of any such premises where the enlargement or extension includes accommodation for 50 or more vehicles,

- (j) places of assembly or places of public worship, in each case having accommodation for 50 or more motor vehicles, or the enlargement or extension of any existing places of assembly or places of public worship where that enlargement or extension includes accommodation for 50 or more motor vehicles,
- (k) the erection of a building for the purposes of refreshment rooms where the gross floor area of that building is or exceeds 300 square metres or the enlargement or extension of a building used for the purposes of refreshment rooms where the gross floor area of that enlargement or extension is or exceeds 300 square metres,
- (l) drive-in take-away food outlets,
- (m) service stations (including service stations which have retail outlets),
- (n) motor showrooms having accommodation for 50 or more motor vehicles, the enlargement or extension of any existing motor showrooms where that enlargement or extension includes accommodation for 50 or more motor vehicles,
- (o) the erection of a building for the purposes of a hospital with accommodation for 100 or more beds or the enlargement or extension of a building for the purposes of a hospital where that enlargement or extension provides accommodation for 100 or more beds,
- (p) roadside stalls,
- (q) areas used exclusively for parking or any other development, in each case having ancillary accommodation for 50 or more motor vehicles, or the enlargement or extension of a parking area where the enlargement or extension accommodates 50 or more motor vehicles.

Historical notes

The following abbreviations are used in the Historical notes:

Am	amended	No	number	Schs	Schedules
Cl	clause	p	page	Sec	section
Cll	clauses	pp	pages	Secs	sections
Div	Division	Reg	Regulation	Subdiv	Subdivision
Divs	Divisions	Regs	Regulations	Subdivs	Subdivisions
GG	Government Gazette	Rep	repealed	Subst	substituted
Ins	inserted	Sch	Schedule		

Table of amending instruments

State Environmental Planning Policy No 11—Traffic Generating Developments published in Gazette No 114 of 9.8.1985, p 4125.

Appendix B

FLORA AND FAUNA ASSESSMENT

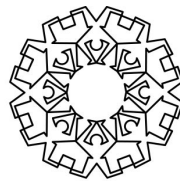
ECOLOGICAL OVERVIEW

MARRANGAROO, LITHGOW

PREPARED FOR:

LITHGOW CITY COUNCIL

MARCH 2006



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Project:	Marrangaroo, Lithgow
Client:	<i>Lithgow City Council</i>
Report No.:	<i>205177_F&F_002.doc</i>
Draft/Final:	FINAL

Geolyse Pty Ltd and the authors responsible for the preparation and compilation of this report declare that we do not have, nor expect to have a beneficial interest in the study area of this project and will not benefit from any of the recommendations outlined in this report.

The preparation of this report has been in accordance with the project brief provided by the client and has relied upon the information, data and results provided or collected from the sources and under the conditions outlined in the report.

All maps, plans and cadastral information contained within this report are prepared for the exclusive use of City of Lithgow Council to accompany this report for the land described herein and are not to be used for any other purpose or by any other person or entity. No reliance should be placed on the information contained in this report for any purposes apart from those stated therein.

Geolyse Pty Ltd accepts no responsibility for any loss, damage suffered or inconveniences arising from, any person or entity using the plans or information in this study for purposes other than those stated above.

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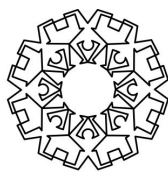
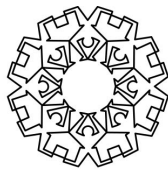


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Introduction

1.1 PURPOSE OF REPORT

Geolyse Pty Ltd has been commissioned to prepare a flora and fauna overview to support the City of Lithgow Council's Local Environmental Study and land-use Master Plan for the locality of Marrangaroo. The study area covers approximately 1,100 hectares and is positioned predominantly on the eastern side of the Marrangaroo Creek channel, 3.5 kilometres north-west of the city of Lithgow. The study area is situated in a largely cleared valley basin used mainly for grazing and residential purposes.

The flora and fauna overview provides a description of the plant species and vegetation communities occurring at the site and describes distribution and significance of these communities throughout the locality. Recorded and potentially occurring flora species of significance are identified and existing habitat of the study area assessed for these species.

The overview also assesses the significance of resident and migratory fauna and their habitats present across the study area. Existing, recorded and predicted species of significance are identified. The potential of the study area in providing important habitat for these species is assessed.

Based on this assessment, the overview aims to provide future planning considerations and identify areas of ecological constraint for any future change in land use.

Methodology

2.1 DESKTOP

Information from the NPWS *Atlas of NSW Wildlife* was sourced to identify any flora and fauna listed as threatened in the *Threatened Species Conservation Act 1995* that have been recorded in the vicinity of the subject land. The area for the database search covered the 1:100,000 map sheet for Lithgow.

Threatened species of national significance that could occur on the subject land were also identified following a search of the *Environment Protection and Biodiversity Conservation (EPBC)* online database (EPBC, 2006).

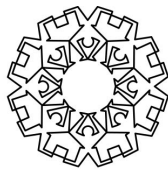
Threatened species with the potential of occurring in the subject land were further reviewed from listings in the *Threatened Species of Western NSW* (Ayers, Nash and Baggett eds., 1999), *Birds Australia* (2003) and the NSW Governments' *Bionet* online search tool. An additional search for rare and threatened plants with potential to occur on the subject land was derived from *Rare or Threatened Australian Plants* (Briggs and Leigh 1995).

2.2 FIELD SURVEY

Site surveys and field investigations were conducted over a four day period distributed between the 9th and 27th of January 2006. An initial site visit and reconnaissance of the area was carried out and then followed by subsequent site visits covering broad areas of relatively low diversity and focusing on smaller units of more diverse habitat such as creek channels, timbered islands, corridors and galleries and edges of remnant native vegetation.

At the time of the field survey diurnal field temperatures remained above 18 degrees Celsius. Localised storms and broader rainfall fell within the second week of January, resulting in over 40 millimetres of rain. Storms resulted in increased flows within the main creek channel with secondary creeks and drainage depressions having short-lived flows.

The open nature across much of the site and the clearly defined boundaries of the woodland communities allowed for good reconnaissance by foot over all communities present on the study area. Landform and vegetation units were located and correlated with topographic map and aerial photo details. Any specific locations, appearing to be more diverse or unusual (such as creek-lines, water-holding springs or soaks, rocky outcrops and isolated areas of native vegetation) were investigated in order to obtain an area overview of community diversity. The fauna assessment was based on identification of habitat type, distribution, quality and potential. This entailed opportunistic observations and identification of scats, markings, tracks and diggings. Habitat assessment included consideration of fauna of conservation significance and potential habitat of threatened fauna species that could occur in the locality.



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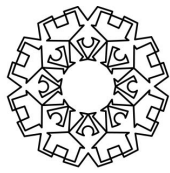
The study area is located on a mostly undulating site with steep slopes present along the incised Marrangaroo Creek channel to the west of the site and slopes increasing from moderate to steep on the footslopes of timbered hills and ridges located to the north, south and east of the study area. A large area of the study area has predominantly northerly to westerly aspects. The elevation of the study area ranges from 1060 metres above sea level (ASL) with the lowest open slopes of the study area reaching approximately 880 metres (ASL) along the lower reaches of the Marrangaroo Creek.

The Marrangaroo Creek ranges from being deeply incised (approximately 18 metres) with steeply sloping banks of up to 30 per cent slope to a relatively shallow channel-section with broad flat banks and adjacent alluvial flats. The Marrangaroo Creek is a perennial watercourse and is partially regulated by a weir structure located on toward the north-western boundary of the study area. This concrete weir structure has formed a substantial backwater extending north-east along the creek channel.

No other named creeks are present on the study area. Unnamed tributaries, feeder streams and drainage channels flow northward from surrounding elevated catchments toward the Marrangaroo Creek. Numerous farm dams are located within these secondary drainage channels.

The study area is only partially wooded with a defined edge of bushland delineating the steeper surrounding slopes and parts of the Marrangaroo Creek channel. Much of the previously 'farmed' land is open cleared country with isolated coppices of trees or poorly defined corridors or clumps present along drainage lines, roads or old paddock boundaries. The agricultural areas of the study area have been previously used for relatively intensive farming and grazing purposes. Deeply incised cattle and sheep pads, numerous fence-lines, clearing and lowered ground vegetation diversity indicate the past agricultural history of the site.

Pre-farming impacts to the site include localised areas of alluvial gold-mining which resulted in broad areas of many landscape types of the locality being methodically cleared. The remains of tailing heaps, cuttings, old shaft entrances and exotic vegetation are present along regions of the Marrangaroo Creek to the west of the study area and also in bushland to the north and south of the study area.



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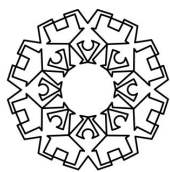


Plate 1 - Overlooking study area facing north-west. Main landscape components of the study area. Residential areas, agricultural land and woodlands on the elevated hills surrounding the site. Much of the study area boundary is defined by the woodland edge where bushland meets open agricultural land.

2.3 STUDY LIMITATIONS

Climatic conditions were considered adequate for the survey protocol carried out. Adequate vegetation and accessible water within and adjacent to the study areas provided suitable conditions for most existing fauna. Habitat is expected to be in a condition representative of an above average summer season. Further, climatic conditions were not considered to be significant as the study has primarily assessed habitat quality and quantity as opposed to direct sightings of specific flora and fauna species.

Existing knowledge and references of the land-systems and vegetation communities are also considered to provide adequate interpretation of the ecological values of the study area. Further, the survey focused on habitat potential of the study area rather than the observed occurrence/non-occurrence of species.



The information provided in this report interprets recorded on-site conditions. The report should be read with an understanding that it is a professional interpretation of study area conditions based on a specific dated survey and data sets. This interpretation is representative of the organisation of flora and fauna of the site, however, cannot fully define variations due to seasonal, climatic or diurnal change.

2.4 SURVEY STRATEGY

2.4.1 FLORA SURVEY

The main floristic components of the study area are a strongly defined edge between woodland and agriculturally modified grassland, the Marrangaroo Creek corridor, small and patchy remnant timber clumps and islands indicative of original tree strata and a broad valley basin dominated by agriculturally modified grassland. The edges of these communities tend to be inherent of past land use and clearing regimes rather than biophysical attributes such as soil type, slope and drainage. Much of the timbered regions within the study area are comprised of openly structured young-mature aged woodlands.

Reconnaissance throughout key communities of the site was made on foot using topographical maps and aerial photos. The initial reconnaissance focused on locating and defining various communities and levels of impact across the area. These included cleared areas, creek channels, uncommon landscape types and any areas which provided indications of community structure prior to clearing and farming events.

Special consideration was given to locating threatened and rare plant species habitat which may exist or have the potential to exist in the study area.

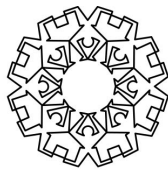
A description of the vegetation communities both within the subject site and immediate surrounds, as well as a list of the flora species recorded during the survey are given in the results and discussion section of this report (refer **Section 3**).

Due to prior disturbances across much of the site original community units were difficult to clearly define within the study area. The low proportion of large mature trees across much of the site allowed for any remnant woodland to be easily identified. Reference photos were taken across the entire site including vegetation structure, understorey compositions, impacted areas and landscape.

2.4.2 FAUNA SURVEY

The native habitat of the study area is reflective of floristic communities across the study area being well defined and remaining relatively consistent across the study area with the exception of the better structured woodland foot slopes and broader areas of the Marrangaroo Creek corridor.

The field survey for the fauna component was comprised primarily of habitat evaluation of the site, supported by desk-top data and broad reconnaissance of the site. More focused habitat survey was carried out within native vegetation communities and habitat appearing more diverse.



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The fauna habitat assessment evaluated primarily the vegetative communities' capacity to support fauna groups, including threatened species. The assessment considered factors such as potential nesting or roosting sites, movement corridors and galleries, refuge islands, foraging potential and diversity.

While conducting the flora survey opportunities were taken to observe and hear fauna. This included direct sightings, animal tracks, nesting sites, scats and other traces. All fauna recorded during the survey are listed in the results and discussion section (**Section 3**).

Results

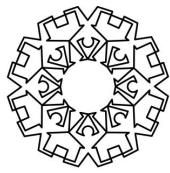
3.1 RESULTS AND DISCUSSION

3.1.1 LANDSCAPE

The landform features in the vicinity of the subject land are predominately undulating hills with slopes bounded by steeply rising slopes and scarps to the east of the study area. The hilly country of the study area measures between 3 and 15%. Slope gradient is up to 30% on some footslopes and also on slopes leading to the Marrangaroo Creek course towards the western part of the study area. Secondary drainage channels on the site have small localised catchments. Some drainage catchments originate from the elevated plateau located to the east of the study area. All Smaller drainage depressions are tributaries of the perennial Marrangaroo Creek. This creek joins the Cox's River located less than two kilometres downstream to the south-west of the study area.

The land around the subject area has had a long history of mining, grazing and farming impacts. Across the valley floors and lower basins of the broader locality, the land has been largely cleared of the original eucalypt woodlands.

The past clearing events and ongoing grazing practices across the study area has also eliminated a high proportion of the native understorey shrubs and sub-shrubs from the vegetation communities. Grazing across the study area has substantially reduced ground species diversity.



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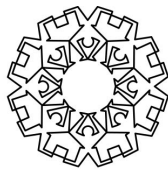


Plate 2 - Overlooking study area from 'Marroo' homestead (located central to the study area), facing north. Much of the study area is located in low-lying, undulating basin valley. Past land use practices have removed most of the native vegetation from more arable sites. Isolated trees and smaller 'islands' of timber remain. Many drainage depressions have been modified by dams and tree removal.

3.1.2 FLORA OF THE STUDY AREA

Due to the long history of agricultural use on the flatter more arable lands of the study area the dominating vegetation community is agriculturally modified grassland. The balance of the area is dominated predominantly by modified eucalypt woodland associations closely bounded by cleared pastureland with distinct ecotone between the two main communities. These woodland areas often provide a buffer region between previously cleared agricultural and residential land and more intact native woodland and forest present on the surrounding slopes, ridges and escarpments.

All community types across the study area have been impacted in some way by prior grazing or human associated land-use regimes and these impacts have substantially modified both the structure and composition of the understorey stratum. Only very small pockets of steep inaccessible terrain have escaped more intense impacts resulting from grazing, however these areas are typically located deep within the Marrangaroo creek gully and have been subject to past mining disturbances and weed infestation.



Modified Grasslands (Pastureland)

The dominant community over a large portion of the study area is a modified grassland comprised of open improved and unimproved pasture, prior and existing cropping lands. Other open areas such as road, rail and public infrastructure easements also contain a similar community composition as those found across the broader farmlands of the locality. Community structure and composition responds and reflects prior land-use impact, grazing intensities, geophysical characteristics, drainage and seasonal conditions. Grazing intensities and history vary across the agricultural lands of study area. Several smaller land-holdings have a relatively high intensity of grazing resulting in a low ground cover diversity. Larger rural holdings often have a broader managed grazing regime, incorporating fodder and cereal cropping into grazing rotation. Evidence such as old roads, stock troughs, worn cattle pads, yards and early fences provide an indication of prior landuse.

The prior clearing, grazing and potential improvement of pastureland for stock production has resulted in broad open areas of modified grassland. The community has islands and galleries of native and exotic trees. Scattered and isolated mature trees and small distinct pockets of shrubland are also present, however these tend to be associated with lesser productive agricultural land such as slopes with shallow-soils, wet or 'marshy' sites and lower lying drainage channels. Tree cover across the community type is typically sparse and comprised of older mature tree species. Natural recruitment is poor on grazed areas. Isolated trees across the study site are in average to poor health showing signs of wind damage, insect attack and stress.

The modified grassland community of the study area is variable in structure and diversity. The establishment of grasses and low forbs reflects prior disturbances, active grazing intensities, drainage and soil-type and upper stratum coverage. The broad open grazing flats with sparse or no timber has a ground cover typically dominated by pasture-related and robust exotic grass and weed species.

In areas where trees provide a sparse, scattered canopy, ground vegetation of the pasture community is substantially reduced and is comprised of a greater proportion of robust common grass species and less exotic forbs. This variance in ground composition also extends into the fringe areas of the open native woodland communities.

On open pasture areas where a long history of prior grazing or cropping activities have occurred a relatively low diversity of ground species is present with a very low composition of native species. Paddock which have been 'rested' or have had stock excluded for a period of time have more distinct species compositions, often with small, patchy areas of monospecific growth.

Low growing pasture related species and grass species dominate the ground cover in previously grazed or cropped areas with species including *Microlaena* species, Red Grass (*Bothriochloa decipiens*), Tussock Grasses (*Poa* sp.), Blown Grass (*Agrostis avenacea*), Yorkshire Fog (*Holcus lanatus*), Phalaris (*Phalaris aquatica*), Capeweed (*Arctotheca calendula*), Viper Bugloss (*Echium vulgare*), Smooth Catsear (*Hypochaeris glabra*), Clover and thistle species common across the study area. Isolated *Juncus* species and Tussock Rush (*J. flavidus*) also occur on moist sites and poorly drained areas throughout the pasturelands.



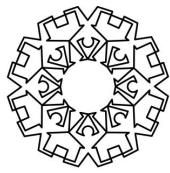
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On regularly grazed and more open areas of the pastureland community, native grasses and forbs become very sparse and scattered. Native grass species tend to be more restricted to areas where there is a native woodland/ pastureland interface and on areas which prove difficult or have restricted access by stock.

Recruitment by native shrub and tree species on open pastureland is low. Isolated shrubs occur on the community type, tending to be more common toward the woodland fringes. Shrub species recorded include Cassinia (*Cassinia* sp.), Blackthorn (*Bursria spinosa*), Yellow Tea Tree (*Leptospermum polygalifolium*) and Narrow-leaf Geebung (*Persoonia linearis*). Where grazing occurs, isolated shrubs and young saplings are likely to be damaged by stock.

In comparison, open ungrazed grassland communities present on the study area (eg. vacant land, rail easements and fenced road easements) typically have dense groundcover and very high litter loading. Grasses are commonly dominated by Paspalum (*Paspalum dilatatum*) and exotic weed species, however the stratum is often comprised of a native association including Silvertop Wallaby grass (*Chionochloa pallida*), Kangaroo Grass (*Themeda australis*), Speargrass (*Austrostipa scabra*) and Tussock Grass species.

No sites were detected across the study area which contained intact native grassland representative of original communities.



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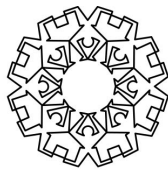


Plate 3 - Landscape typical of agriculturally dominated landuse on Marroo property facing north-west. No intact native understorey remains across these areas. Evidence of prior surface erosion on areas of shallow soils is common. Drainage depressions area accessed by grazing stock with robust grasses, sedge and weed species dominating the ground vegetation stratum.

Woodland Associations

A relatively intense history of disturbance across the study site has removed a large proportion of the original woodland alliance structures. Most areas with arable land, suitable for cropping, pasture improvement and grazing has been cleared of native woodland. This also includes drainage depressions and prior swampy land. It is likely that early clearing of woodland also extended into the surrounding hills and elevated gullies for mining or grazing requirements. Occasional old-mature trees remain in patches along the immediate Marrangaroo creek course, in some of the side gullies extending from the creek and also along less accessible areas of the site. Large trees are generally uncommon.

The mid and lower vegetation storeys of the woodland and open forest associations have a history of high ground impact resulting in the selective and active removal of many species. Many of the species prominent within community types of the study area include species which are less palatable, robust or prolific species. A high proportion of the understorey communities across the site would have damage due to a history of successional browsing by goats, sheep and cattle. Successional woody growth and a restricted growth habit of many larger shrub species indicate that this process has been



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continuing for a relatively long period of time. The diversity and lower stratum health varies with the ability for stock to easily access areas and the exclusion of species by competition by robust species such as Black Berry, Bracken, English Broom and Yellow Tea Tree. Very steep areas which have been difficult for stock to access have a slightly higher diversity and density of species; however these areas are often comprised of relatively infertile shallow soils.

The transitional zone between woodland and grassland community is typically dominated by an understorey more characteristic of pasture associated communities. Native ground species in areas of lesser disturbed areas of the internode between pastureland and woodland communities often include heath, robust grass, hardy ground forbs and shrubs and seasonally emergent flora components. Ground species identified within the edges of the woodland and open forest community include mainly robust forbs and low ground shrubs interspersed with occasional robust exotics and grass species. Species include Tussock (*Poa sp.*), Rough Speargrass (*Austrostipa scabra*), Snow Grass (*Poa sieberiana*), Blown Grass (*Agrostis avenacea*), Rock Fern (*Cheilanthes sp.*), Twining Glycine (*Glycine clandestina*) and Australian Carrot (*Daucus glochidiatus*). A higher proportion of herbaceous species are present along deeper soils within drainage depressions especially areas with an open canopy cover.

The main parent tree species on and adjacent to the study area include Red Stringybark (*Eucalyptus macrorhyncha*), Scribbly Gum (*E. rossii*), Snow Gum (*E. pauciflora*), Candlebark (*E. rubida*), Ribbon Gum (*E. viminalis*) and Broad Leaf Peppermint (*E. dives*). The composition of alliances across the study area is weak, often with deeply merged configurations and poorly defined boundaries. Due to prior impacts across the study area the woodland communities present are not clearly defined, with little or no indication by older trees to define original remnant configurations. Targeted species removal for fencing and building requirements may have also modified remaining woodland compositions.

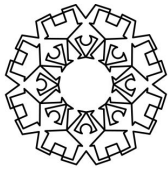


Plate 4 - Open woodland/ modified grassland fringe. Vegetation structure typical of the internode between open woodland and the open pasturelands. Trees have been allowed to naturally revegetate less arable land. Tree stratum is comprised of younger trees with a low diversity of understorey shrubs.

Large hollow-bearing trees are very scarce and occur mainly on less-accessible slopes, on the immediate lower banks of creeks and drainage depressions or as small clumps and coppices across the open pastureland areas. Many older trees have a slender, tall standing growth habit. The average diameter of trees within the study area is less than 400 mm DBH with average canopy height measuring between 10 to 14 metres on steeper, shallower soils and trees up to 20 metres tall on deeper co-alluvials and sheltered sites. Many areas along the edge between woodland and pastureland have trees with multi-stemmed, coppic growth form indicative of past thinning or clearing practices.

The fire history of the site is difficult to determine through field evidence alone. Few burnt stumps or large logs remain within the woodland communities present on the study area. Open forest upslope of the Marrangaroo Creek on the northern edge of the study area has patches of recent fire history less than 10 years old. Hot fires of the mid 1990's have modified the woodland structure on upper-slopes of the ridges beyond the east of the study area however these fires did not impact on timbered land within the subject site. Fragmented fire evidence indicates that portions of the lower Marrangaroo Creek channel may have been periodically burnt to remove blackberry infestations.



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Despite the modified nature of the vegetation community and the altered environment, tree health throughout the woodland and open forest communities is generally good. No die-back was observed, insect attack was infrequent and mistletoe infestations were uncommon and generally restricted.

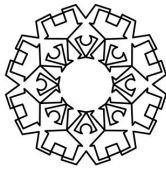


Plate 5 - A distinct habitat edge between woodland and pastureland on eastern boundary of study area. Past clearing is often defined by steeper slopes. Stock have access to woodland areas and also prevent natural recruitment of tree species. In areas where stock have been excluded for a number of years, tree and shrub species have regenerated quickly.

Benson and Keith (1990) identify four natural vegetation units occurring on or immediately adjacent to the study area. Due to the large areas of previously disturbed and cleared native communities, most of these mapped vegetation units exist around the perimeter of the study area. These include:

The woodland communities flanking the study area have been heavily disturbed and are often not representative of the original 'natural' structure. The native vegetation units described by Benson and Keith (1990) are often broadly merged or altered by past clearing, grazing and modified fire regimes. Subsequently, these units do not always have clearly defined boundaries or characteristic compositions typical of their natural structure.

'Mount Walker Complex'. This native woodland occurs on rugged topography between 1000 and 1100 metres and extensions of the community meet the Marrangaroo Creek channel located along the western boundary of the study area. Hillsides are generally steep with shallow, well drained sandy



loams. The woodland is dominated by associations of Broad-leaved Peppermint (*Eucalyptus dives*), Brittle Gum (*Eucalyptus mannifera*), Apple Box (*Eucalyptus bridgesiana*) and Inland Scribbly Gum (*Eucalyptus rossii*). The woodland structure is generally low but can reach up to 25 meters in more sheltered locations. On the lower and sheltered slopes fronting the Marrangaroo Creek below Mount Walker, prominent tree species include Ribbon Gum, Brown Barrel and Mountain Gum. With scattered Inland Scribbly Gum and Silvertop Ash (*Eucalyptus sieberi*) occurring on shallow, rocky soils.

Disturbances to the fringe of this woodland have been moderate to high which has subsequently modified the lower strata. Upper banks and slopes with shallow-soils have an open shrubby community made up of hardy species such as Blackwood (*Acacia melanoxylon*), Silver Wattle (*Acacia dealbata*) and Yellow Tea-tree (*Leptospermum flavescens*).

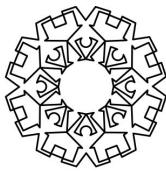
Lower within the creek channel, the understorey of this community has been infested with large areas of Blackberry (*Rubus discolor*) and Bracken (*Pteridium esculentum*).

Trees within the community are young to mature aged with mature trees being very scarce. Understorey is mainly bare with few large shrubs or ground shrubs. A thin layer of leaf litter covers much of the ground on the creek bank slopes, with higher elevated flat ground being mostly bare. Ground vegetation is predominantly comprised of pastureland related species and low grasses. Further down-slope this woodland association contains greater numbers of Broad Leaf Peppermint. Stringy Bark remains dominant in the association especially on elevated valley slopes. Older and isolated Stringybark trees on the open pastureland areas indicate that this community may have once covered the elevated flats of the study area possessing shallower soils.

Remnants of tall Ribbon Gum woodland are present along the moist, sheltered and deeper alluvial soils of the Marrangaroo creek course. Associated tree species include Scribbly Gum and protrusions of the Broad Leaf Peppermint association extending from adjacent mosaics of nearby vegetation units. The sheltered and colder south-facing lower valley slopes sometimes retain Snow Gum (*Eucalyptus pauciflora*) and occasional Brittle Gum (*Eucalyptus mannifera*). The ground cover of the community is often heavily infested by Blackberry and English Broom. These species have excluded a high proportion of the native understorey diversity in the lower channel. Willow and stone-fruit trees are also present. The presence of large mature trees occurring in the deeper regions of the creek channel indicates that trees may have been retained during early mining periods and subsequent clearing events.

Tree age diversity is poor across much of the study area. With the exception of the mature Ribbon Gums within the Marrangaroo Creek and isolated mature trees adjacent to open pastureland areas, most of the vegetation unit on and flanking the creek banks are relatively uniform in age. A high proportion of the trees are young-mature aged, non-hollow bearing with many pole-sapling aged trees (or younger occurring on the bank slopes). Recruitment is spasmodic on the upper bank shoulder and immediate flats however the age structure remains similar.

The woodland community of the mid and upper creek banks possesses an open understorey with a relatively low diversity of species. Many of the existing species are comprised of native low shrub, forb and grass species. The understorey of the woodland is variable. This is partially due to prior impacts and also soil, drainage and aspect features of the locality.



'Tablelands Grassy Woodland Complex'. The native woodland and open forest associations are present on the small isolated hills located on the eastern and western sides of the highway adjacent to the elevated area known as Tanksley Hill. This area is located south of the Marrangaroo Fields Estate. The vegetation unit includes a number of associations characteristic of poorer and shallower soils in the locality. Species associations are strongly related to topographic positioning.

On the dryer western and northern facing slopes and hill-sides, Inland Scribbly Gum and Red Stringybark are common with an understorey of common grass species and isolated shrubs such as Tussock Grasses (*Poa sieberiana* and *P. labillardieri*), Daphne Heath (*Brachyloma daphnoides*) and Box-leaf Wattle (*A. buxifolia*). This community has a distinct edge where it adjoins the cleared areas now supporting pasture-related grasslands on the lower foot-slopes.

On the lower slopes with more shelter or with co-alluvial soils, an open forest structure of Mountain Gum, Apple Box and Ribbon Gum is present, especially in sheltered saddles or adjacent to drainage depressions. Occasional Snow Gums occur in shaded frost hollows.

The vegetation unit present adjacent to the study area is largely made up of a relatively even aged tree stratum. Very few old-mature trees are present with a large proportion of the tree population comprised of non-hollow-bearing individuals.

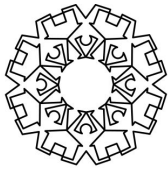
This vegetation unit was once relatively common, but has now been largely cleared from more arable foot-slopes and basins.

The community type is predominantly open, however some lower and more protected areas have a denser canopy with a closed shrubby understorey. Ground and mid-storey components closely reflect exposure to prior impacts, exposure and soil characteristics.

'Blue Mountains Sandstone Plateau Forest'. This open-forest unit delineates the infertile sandstone based upper slopes, sandstone ridges and plateaus between 800 and 1050 metres (ASL). The eastern and northern boundaries of the study area are delineated by the lower slopes of the sandstone plateaus and scarps and subsequently this community is mainly found in bushland adjacent to the study area. The vegetation unit is present east of the Defence owned land and north of the northern boundary of the study area.

Dominant trees on the sandstone based soils include Brittle Gum, Narrow Leaved Peppermint and Black Ash. The understorey is dominated by a shrub stratum growing to two metres in height with a sparse ground cover. Shrub species listed for this vegetation unit include Crinkle Bush (*Lomatia silaisolia*), Sunshine Wattle (*Acacia terminalis*), Broom Spurge (*Amperea xiphoclada*), Laurel Geebung (*Personia laurina*) and Broad-leaf Hakea (*Hakea dactyloides*).

'Montane Gully Forest'. This is an open-forest unit found above 850 metres (ASL) in narrow gullies and gorges extending off the edges of sandstone plateaus and typically located at the heads of drainage systems. Sites for the community are sheltered and exist on well drained, deep soils. Common tree species distinguishing the vegetation unit include Brown Barrel and Grey Gum. This community is mapped by Benson (1990) as occurring at the base of the slopes along the Marrangaroo Creek located east of the Lithgow Correctional Facility. It is likely that the creek channel was once dominated by this vegetation unit before clearing and grazing impacts. Smaller pockets are located



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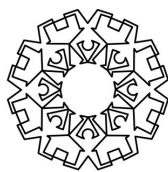
along drainage depressions close to the base of slopes on Defence owned land located to the east of the study area.

The soils of the study area in these locations are deep and co-alluvial based. Small pockets of mature trees remain on the immediate creek banks and large isolated eucalypts occur occasionally along the course. Much of the alluvial flats extending from the footslopes to the creek channel have been previously cleared close to the channel. Other tree species including Ribbon Gum and exotics including Willow species (*Salix sp.*) are also present in the creek channel and lower alluvial flats. Understorey has been substantially modified with large areas of Bracken, *Cassinia* species and *Rubus* species. Fenced areas of the banks and bed, where grazing has been lowered or restricted species include Woolly Tea-tree (*Leptospermum lanigerum*), Twining Glycine (*Glycine clandestina*), Bidgee Widgee (*Acaena novea-zelandiae*), Fishbone Fern (*Blechnum nudum*) and Yellow Tea Tree.

Areas of the footslopes immediate to the study area contain a tree stratum similar to that of the deeper co-alluvial soils of the Mount Walker vegetation unit with Mountain Gum, Ribbon Gum and *Acacia dealbata* present adjacent to the Marrangaroo Creek channel. The understorey stratum is patchy and open, being dominated by shrubs to 2 metres high and with a sparse ground cover on the elevated slopes, becoming denser on the deeper-soils of the foot-slopes.



Plate 6 - Example of taller woodland-forest vegetation located in damp sheltered valley to the north-east of the study area. Understorey is relatively diverse with high natural recruitment. This community is located below a small sandstone escarpment and is just outside the study area. Flora communities in these areas provide important habitat close to the study area.



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3.1.3 OBSERVED FLORA SPECIES

The potential of threatened flora species occurring on the site was evaluated by recorded data and the potential of existing habitat for threatened species. Species with the potential to occur based on bioclimatic distribution are also evaluated.

No threatened flora species were identified during the field survey.

All observed flora species are listed in **Table 3.1**.

Table 3.1 - Observed Flora List

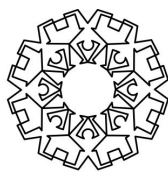
Family Name	Botanical Name	Common Name
ADIANTACEAE	<i>Adiantaceae aethiopicum</i>	Common Maidenhair Fern
SINOPTERIDACEAE	<i>Cheilanthes sp.</i>	Rock Fern
GLEICHENIACEAE	<i>Gleichenia dicarpa</i>	Pouched Coral Fern
DENNSTAEDTIACEAE	<i>Pteridium esculentum</i>	Bracken
BLECHNACEAE	<i>Blechnum nudum</i>	Fishbone Water Fern
PINACEAE	<i>Pinus radiata</i>	Radiata Pine
LAURACEAE	<i>Cassytha glabella</i>	Dodder
CARYOPHYLLACEAE	<i>Stellaria pungus</i>	Prickly Starwort
POLYGONACEAE	<i>Rumex crispus</i> *	Curled Dock
DILLENACEAE	<i>Hibbertia obusifolia</i>	Hoary Guinea Flower
	<i>Hibbertia linearis</i>	Guinea-flower
MALVACEAE	<i>Modiola caroliniana</i> *	Redflowered Mallow
URTICACEAE	<i>Urtica incisa</i>	Scrub Nettle
EUPHORBIACEAE	<i>Chamaesyce drummondii</i>	Caustic Weed
VIOLACEAE	<i>Viola betonicifolia</i>	Showy Violet
SALICACEAE	<i>Populus alba</i> *	White Poplar
	<i>Salix alba</i> *	White Willow
CLUSIACEAE	<i>Hypericum gramineum</i> *	Small St. John's Wort
CASUARINACEAE	<i>Casuarina cunninghamiana</i>	River She-oak
ROSACEAE	<i>Rubus parvifolius</i>	Small leaf Bramble/ Native Raspberry
	<i>Rubus discolor</i> *	Blackberry
	<i>Rosa rubiginosa</i> *	Sweet Briar
MALACEAE	<i>Malus domestica</i> *	Apple Tree
	<i>Crataegus monogyna</i> *	Hawthorn
AMYGDALACEAE	<i>Prunus persica</i> *	Peach Tree
PROTEACEAE	<i>Persoonia levis</i>	Broad leaf Geebung
	<i>Persoonia linearis</i>	Narrow leaf Geebung
	<i>Petrophile pulchella</i>	Conestick
	<i>Lomatia myricoides</i>	River Lomatia
	<i>Hakea sericea</i>	Needle Bush
	<i>Hakea dactyloides</i>	Broad Leaf Hakea
	<i>Banksia marginata</i>	Silver Banksia



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Table 3.1 - Observed Flora List

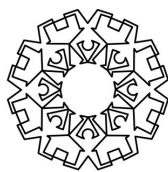
Family Name	Botanical Name	Common Name
MYRTACEAE	<i>Eucalyptus bridgesiana</i>	Apple Box
	<i>Eucalyptus mannifera</i>	Brittle Gum
	<i>Eucalyptus viminalis</i>	Ribbon Gum
	<i>Eucalyptus dalrympleana</i>	Mountain Gum
	<i>Eucalyptus rubida</i>	Candlebark
	<i>Eucalyptus macrorhyncha</i>	Red Stringybark
	<i>Eucalyptus radiata</i>	Narrow-leaved Peppermint
	<i>Eucalyptus dives</i>	Broad Leaved Peppermint
	<i>Eucalyptus fastigata</i>	Brown Barrel
	<i>Eucalyptus stellulata</i>	Black Sally
	<i>Eucalyptus pauciflora</i>	Snow Gum
	<i>Eucalyptus rossii</i>	Scribbly Gum
	<i>Leptospermum flavescens</i>	Tea Tree
	<i>Leptospermum obovatum</i>	Tea Tree
	<i>Leptospermum myrtifolium</i>	Myrtle Tea Tree
	<i>Leptospermum polygalifolium</i>	Yellow Tea Tree
	<i>Callistemon citrinus</i>	Crimson Bottlebrush
	<i>Baeckea linifolia</i>	Baeckea
HALORAGACEAE	<i>Gonocarpus tetragynus</i>	Raspwort
RUTACEAE	<i>Boronia pinnata</i>	Boronia
MIMOSOIDEAE	<i>Acacia melanoxylon</i>	Blackwood
	<i>Acacia implexa</i>	Hickory Wattle
	<i>Acacia paradoxa</i>	Kangaroo Thorn Wattle
	<i>Acacia gladiiformis</i>	Sword-leaf Wattle
	<i>Acacia falciformis</i>	Broad-leaved Hickory
	<i>Acacia buxifolia</i>	Box-leaf Wattle
	<i>Acacia dawsonii</i>	Poverty Wattle
	<i>Acacia decora</i>	Western Golden Wattle
	<i>Acacia decurrens</i>	Black Wattle
	<i>Acacia terminalis</i>	Sunshine Wattle
FABOIDEAE	<i>Acacia dealbata</i>	Silver Wattle
	<i>Indigofera australis</i>	Indigo
	<i>Desmodium varians</i>	Slender Tick-trefoil
	<i>Glycine clandestina</i>	Twining Glycine
	<i>Hardenbergia violacea</i>	False Sarsparilla
	<i>Lotus australis</i>	Australian Trefoil
	<i>Medicago polymorpha</i>	Burr Medic
	<i>Trifolium sp *</i>	Clover
	<i>Trifolium repens *</i>	White Clover
	<i>Trifolium campestre *</i>	Hop Clover
	<i>Trifolium glomeratum</i>	Cluster Clover



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Table 3.1 - Observed Flora List

Family Name	Botanical Name	Common Name
	<i>Trifolium arvense</i> *	Haresfoot Clover
	<i>Oxylobium ilicifolium</i>	Native Holly
	<i>Daviesia latifolia</i>	Broad Leaf Bitter-pea
	<i>Dillwynia phyllicoides</i>	Pea Flower
	<i>Dillwynia retorta</i>	Egg & Bacon
	<i>Dillwynia sericea</i>	Showy Parrot-pea
	<i>Bossiaea buxifolia</i>	Pea Flower
	<i>Cytisus scoparius</i> *	English Broom
GERANIACEAE	<i>Geranium homeanum</i>	Cransbill
STACKHOUSIACEAE	<i>Stackhousia monogyna</i>	Creamy Candles
SANTALACEAE	<i>Exocarpos cupressiformis</i>	Native Cherry
PITTOSPORACEAE	<i>Bursaria spinosa</i>	Blackthorn
	<i>Hydrocotyle</i> sp.	Pennywort
APIACEAE	<i>Hydrocotyle laxiflora</i>	Stinking Pennywort
	<i>Daucus glochidiatus</i>	Australian Carrot
CAMPANULACEAE	<i>Wahlenbergia graciis</i>	Sprawling Bluebell
	<i>Wahlenbergia stricta</i>	Tall Bluebell
	<i>Conyza albida</i>	Tall Fleabane
	<i>Gnaphalium americana</i>	Cudweed
	<i>Cassinia uncata</i>	Sticky Cassinia
	<i>Cassinia arcuata</i>	Biddy Bush/ Sifton Bush
	<i>Chrysocephalum scorpioides</i>	Button Everlasting
	<i>Chrysocephalum apiculatum</i>	Yellow Buttons
	<i>Bracteantha bracteata</i>	Golden Everlasting
	<i>Bidens pilosa</i> *	Cobblers Pegs
	<i>Arctotheca calendula</i> *	Capeweed
ASTERACEAE	<i>Cymbonotus lawsonianus</i>	Bears-ear
	<i>Cirsium vulgare</i> *	Spear Thistle
	<i>Silybum marianum</i> *	Variegated Thistle
	<i>Centaurea calcitrapa</i> *	Star Thistle
	<i>Hypochaeris glabra</i> *	Smooth Catsear
	<i>Tragopogon porrifolius</i> *	Salsify
	<i>Chondrilla juncea</i> *	Skeleton Weed
	<i>Taraxacum officinale</i> *	Dandelion
	<i>Sonchus asper</i> *	Prickly Sowthistle
	<i>Sonchus oleraceus</i> *	Common Sowthistle
SOLANACEAE	<i>Lycium ferocissimum</i> *	African Boxthorn
	<i>Solanum brownii</i>	Violet Nightshade
CONVOLVULACEAE	<i>Dichondra repens</i>	Kidney Weed
BORAGINACEAE	<i>Echium vulgare</i> *	Viper's Bugloss
EPACRIDACEAE	<i>Epacris paludosa</i>	Heath



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Table 3.1 - Observed Flora List

Family Name	Botanical Name	Common Name
	<i>Epacris microphylla</i>	Coral Heath
	<i>Melichrus urceolatus</i>	Urn Heath
	<i>Astroloma humifusum</i>	Native Cranberry
	<i>Monotoca scoparia</i>	Prickly Broom-Heath
	<i>Brachyloma daphoides</i>	Daphne Heath
SCROPHULARIACEAE	<i>Veronica plebeia</i>	Trailing Speedwell
PLANTAGINACEAE	<i>Plantago lanceolata</i> *	Ribwort (lambs tongue)
VERBENACEAE	<i>Verbena bonariensis</i>	Purpletop
LAMIACEAE	<i>Ajuga australis</i>	Australian Bugle
POTAMOGETONACEAE	<i>Potamogeton tricarinatus</i>	Floating Pondweed
	<i>Lomandra glauca</i>	Pale Mat-rush
LOMANDRACEAE	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
	<i>Lomandra multiflora</i>	Many-flowered Mat-rush
	<i>Lomandra filiformis</i>	Wattle Mat-rush
PHORMIACEAE	<i>Dianella revoluta</i>	Spreading Flax Lily
ASPHODELACEAE	<i>Bulbine bulbosa</i>	Bulbine Lily
ANTHERICACEAE	<i>Arthropodium milleflorum</i>	Pale Vanilla Lily
TYPHACEAE	<i>Typha orientalis</i>	Broad-leaved Cumbungi
	<i>Juncus sp.</i>	Rush
	<i>Juncus continuus</i>	Rush
JUNCACEAE	<i>Juncus subsecundus</i>	Rush
	<i>Juncus australis</i>	Rush
	<i>Juncus usitatus</i>	Common Rush
	<i>Juncus flavidus</i>	Tussock Rush
	<i>Schoenus sp.</i>	Bog-rush Species
	<i>Schoenus apogon</i>	Common Bog-rush
CYPERACEAE	<i>Lepidosperma laterale</i>	Variable Saw Sedge
	<i>Eleocharis sphacelata</i>	Tall Spike Rush
	<i>Eleocharis acuta</i>	Common Spike-rush
	<i>Carex appressa</i>	Tall Sedge
	<i>Carex inversa</i>	Knob Sedge
POACEAE	<i>Bothriochloa decipiens</i>	Red Grass
	<i>Cymbopogon refractus</i>	Barbed-wire Grass
	<i>Themeda australis</i>	Kangaroo Grass
	<i>Paspalum dilatatum</i> *	Paspalum
	<i>Pennisetum clandestinum</i> *	Kikuyu
	<i>Aristida ramosa</i>	Purple Wiregrass
	<i>Aristida vagans</i>	3 Awned Wiregrass
	<i>Cynodon dactylon</i>	Couch Grass
	<i>Austrodanthonia sp.</i>	Wallaby Grass
	<i>Chionochloa pallida</i>	Silvertop Wallaby Grass

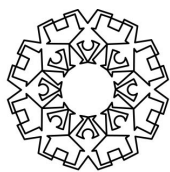


Table 3.1 - Observed Flora List

Family Name	Botanical Name	Common Name
	<i>Agrostis aemula</i>	Blown Grass
	<i>Aira sp.</i>	Hairgrass
	<i>Echinopogon sp.</i>	Hedgehog Grass
	<i>Avena fatua</i> *	Wild Oats
	<i>Holcus lanatus</i> *	Yorkshire Fog
	<i>Hordeum leporinum</i> *	Barley Grass
	<i>Elymus scaber</i>	Common Wheatgrass
	<i>Vulpia bromoides</i> *	Squirrel Tail Fescue
	<i>Vulpia myuros</i> *	Rat's Tail Fescue
	<i>Dactylis glomerata</i> *	Cocksfoot
	<i>Lolium perenne</i> *	Perineal Ryegrass
	<i>Briza maxima</i> *	Quaking Grass
	<i>Poa labillardieri</i>	Tussock Grass
	<i>Poa annua</i> *	Winter Grass
	<i>Poa sieberiana</i>	Snowgrass
	<i>Bromus cartharticus</i> *	Prairie Grass
	<i>Phalaris aquatica</i> *	Phalaris
	<i>Austrostipa scabra</i>	Rough Speargrass

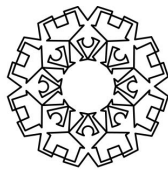
* denotes Introduced Species

3.1.4 FAUNA OF THE STUDY AREA

The contrast between communities on and adjacent to the study area is likely to provide habitat of varying quality to many common native species in the locality. The connectivity of woodland to broader, less impacted habitat indicates that woodland resources on the site has potential to provide less common and threatened species with refuge, movement and foraging resources.

The broad tracts of woodland and forest which extend into the Mount Walker and Blue Mountains areas are connective with the eastern side of the study area and are likely to influence the diversity of woodland species occurring in the local vicinity of the study area. The cleared agricultural and residential lands of the study area are low in habitat diversity. This presents a strongly contrasting habitat edge with surrounding woodland native vegetation communities. This contrast has the potential to provide resources to species which have adapted to a pasture dominated community and heightened human disturbance. The distinctly contrasting habitat is likely to discourse species which have specific woodland/ forest habitat niches, are less mobile or are more timid and susceptible to human interference.

It is likely that the high level of existing and prior ground disturbances across the cleared regions of the study area, levels of human associated disturbances, the lack of dense ground litter, the scarcity of loose rocky outcrops, stags, logs and hollow-bearing trees impact upon the diversity and habitat availability of species which are able to utilize the study area. Portions of the area do however play an important role in providing a woodland buffer-zone and connectivity in the immediate locality. The



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woodland communities and remnants of the study area also form a timbered refuge close to important watering points and access to broader areas of less disturbed woodland areas.

Three loosely linked, native movement corridors are present on or immediately adjacent to the study area. These include the following:

- The Marrangaroo Creek corridor. The timbered riparian zone of the Marrangaroo Creek is not continuous and is broken by agricultural land and major transport easements. The creek channel is connective with broader bushlands to the east and north of the study area as well the woodlands in the Cox's River and Mount Walker locality further westward from the site. The creek is near-perennial, with flows stopping only in the driest years. Small in-stream waterholes would remain.
- The remnant woodland on the hills located to the south of the study area providing stepping stones of woodland from the Mount Walker locality to much broader bushland communities east of the highway. It is likely that timbered areas remaining on the small hills either side of the highway (in the vicinity of Tanksley Hill) can provide a movement link for mobile species (ie. bats, birds).
- The scattered open woodland extending from the Marrangaroo weir locality northwards along the western side of the highway, loosely linking bushland associated with the Marrangaroo Ridge area (north of the study area). While this belt of scattered and open timber is broken by the main road and rail easements, it has the potential to provide a movement link for more mobile species with broader areas of bushland to the north-east.

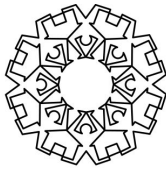
The habitat quality over much of the study area is likely to limit the diversity of smaller native terrestrial species and arboreal species dependant upon tree hollows and dense ground litter and vegetation. Larger farm dams, the Marrangaroo Creek and weir provide habitat opportunities for some waterfowl, fish and amphibian species.

Birds

A total of 209 bird species have been listed on the NSW Government 'Bionet' search tool as occurring on the Wallerawang Map Sheet. A total of 234 bird species are listed by the Australian Bird Atlas as recorded in a quadrant extending over a similar area to the Wallerawang map sheet. Records from these data-sets are a result of a large range of surveys and opportunistic sightings undertaken throughout many habitat types occurring within the map sheet. 44 species of birds were identified on or immediately adjacent to the study area over the field survey period.

Bird species were the most numerous and diverse class of animals observed. Habitat quality varied broadly, with more diverse habitat reflected by species observations in the timbered, sheltered gullies and foot slopes within the pastureland-woodland interface. No threatened bird species were identified during the field survey.

A high proportion of the study area offers very low bird habitat diversity. The open agricultural and residential areas would offer few resources for a diverse avifauna population. Refuges on open country such as small pockets of intact woodland are isolated and relatively exposed with low habitat



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diversity. Common, robust and territorial species such as Magpie, Noisy Miner, Starling and Sparrow were frequently seen within the smaller pockets of timber or isolated paddock trees. Smaller species common to open agricultural grassland communities are likely, however disturbances from human associated activities restrict favourable habitat. Habitat resources are also likely to be impacted by heightened intensities of land use in the study area.

Common recorded species included Australian Raven, Galah, Crested Pigeon, Brown Songlark, Weebill and less frequently; Yellow Thornbill, Kookaburra, Willie Wagtail and Pied Currawong. Raptor species included Black Shouldered Kite and Australian Hobby. Most farm dams contained water with the Marrangaroo Creek running slowly at the time of survey. Most waterbird species recorded from the site during the field survey came from the timbered Marrangaroo creek corridors. Species recorded included Pacific Black Duck, Wood Duck, Little Pied Cormorant and Eurasian Coot.

The interface between the grassland and broad woodland areas on and adjacent to the study area provide habitat to a broader population of bird species. A higher variety of species and larger populations were recorded from this interface zone. Habitat diversity increases deeper into the woodland and forest regions, especially where grazing impact is lower and nearby watering points are available. Larger trees are often located in the deeper sheltered gullies and creek-lines providing roost and nesting hollow resources. Hollow bearing trees suitable for nesting resources in sheltered or connective woodland areas are scarce. It is expected that the sheltered nature of the fringing forested areas provides species with refuge in periods of cold or poor weather.

The larger remnants of woodland are able to provide 'stepping stone' habitat for mobile bird species moving into and along the fringe of the broad woodland communities surrounding the study area. Bird species recorded within these woodland 'islands' and within the interface region between woodland and pastureland included Sulphur Crested Cockatoo, Gang-gang Cockatoo, Eastern Rosella, Kookaburra, White-eared Honeyeater, Superb Blue Wren, Black Faced Cuckoo Shrike, Pied Currawong and Grey Butcherbird. Larger and more diverse bird populations were observed in open woodland in the sheltered gully on the western boundary of the study area fronting Marrangaroo Creek.

The woodland and forest communities present around the edge of the study area are all directly connective to broader woodland and forest areas. The native communities present in these broader woodland areas are in relatively good condition and provide a very strong contrast to the grazed pastureland-woodland residential and pasturelands of the study area. Resources such as flowering eucalypts, permanent water and sheltered woodland habitat are all linked with the site. It was expected that this community would therefore provide favourable habitat to a range of woodland bird species, although this was not reflected by observed species during the field surveys which were mostly focused on the more open and cleared areas of the subject site. Mid and lower stratus are present and range in diversity from very open on elevated slopes and ridge-lines, to very dense and overgrown in deeper gullies and creek channels. Observed species recorded from the woodland and forest vegetation units included Common Myna, Azure Kingfisher, Eastern Whipbird, Noisy Friarbird, Yellow-tailed Black Cockatoo, Crimson Rosella, Spotted Pardalote, Weebill, Yellow Thornbill, White-eared Honeyeater, White-winged Chough and Red Capped Robin. These species were recorded from a variety of woodland and forest habitats.



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There is no waterbird habitat of significance on the study area. Farm dams are typically small, isolated with sparse fringing aquatic vegetation. The unnamed drainage depressions draining towards the Marrangaroo Creek are ephemeral and without intact riparian vegetation zones. Low-lying areas which may potentially become marshy during wet seasons had little evidence of established native wetland vegetation.

The Marrangaroo Creek channel varies widely in habitat quality for waterbird species. It is primarily a suitable movement corridor, providing frequent foraging and watering sites and links to broad forest areas. Much of the Marrangaroo Creek course is choked with dense stands of Blackberry and Broom and provides few areas of open water or easily accessible creek bank sites. Storage areas such as the Marrangaroo Weir and reservoirs on the Defence owned land have the potential to provide foraging areas, drought refuge and breeding sites. Little Pied Cormorants, Pacific Black Duck, Eurasian Coot and Wood Ducks were observed on the Marrangaroo Weir pool. It is located in a moderately sheltered valley and is wooded to the waterline on all of the eastern side. Areas on the eastern bank toward the weir wall are densely vegetated with a waterline fringe of Tea-tree species. Small open reed beds of Tall Spike Rush are present adjacent to the wall. It is unlikely that vegetation flanking the weir pool is substantial or sheltered enough for breeding purposes for a broadly diverse range of aquatic species which require broad, dense sedge or reed-bed habitat.

While it is expected that a broad range of bird species would be recorded as occurring on the study area, it is likely that a large number of these species would only occur as opportunistic visitors or be mainly restricted to the broader and less disturbed areas of woodland and forest surrounding the study area.

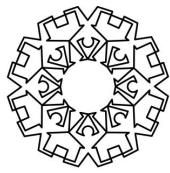
A total of 23 significant bird species are listed for the Wallerawang 1:100,000 Mapsheet. This listing is derived from a number of datasets including NPWS, Australian Museum, Birds Australia and Australian Government Department of Wildlife and Heritage. These species are listed in **Table 3.2**.

Any of these species could potentially opportunistically visit the study area during migration, foraging or accessing habitat. The potential of the study area in providing favourable habitats for these listed species is listed in **Section 4**.

Mammals

A total of 25 native mammal species (excluding bats) and 12 introduced mammal species have been listed on the NSW Government 'Bionet' search tool as occurring on the Wallerawang Map Sheet. Records from this data-set are a result of a large range of surveys and opportunistic sightings undertaken throughout many habitat types of the map sheet. A total of 13 species of mammals were identified on or immediately adjacent to the study area during the field survey periods.

Open pastureland and modified grasslands provide low quality habitat and are unlikely to support a diverse population of native mammals even in more favourable seasons. This is due to the limited ground habitat resources, the exposed nature of the landscape and the low connectivity of habitat across the open grazed, cropped and residential areas. Small isolated remnants and paddock trees offer negligible habitat. Larger more mobile and adaptive species such as macropods and wombats were observed across agricultural land, located well away from timbered slopes and ridges. Un-grazed



ground cover, shrubby lower stratum vegetation, hollow bearing logs and complex ground litter are either very scarce or not present on the pastureland and modified grassland areas. A range of introduced species were identified from this habitat type including hare, fox and cat. Feral predators are likely to occur in greater populations throughout the study area due to residential influence. This landscape offers negligible small native mammal habitat.

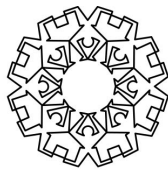
Habitat generally improves closer to the timbered slopes, ridges and gullies fringing the study area. While small mammal habitat remains poor in these areas, better seasonal conditions are likely to improve the availability of habitat and foraging resources. Accessible water and open areas of pastureland provide favourable habitat for larger species including macropods. Numerous Grey Kangaroos were observed across the agricultural areas of the subject site. Wallaby, Wombat, Echidna and Brush-tailed Possum were recorded in grassland/open woodland fringe located to the south of Marrangaroo Creek, southern edge of the study area and within open woodland on the western edge of the study area.

The riparian corridor along the Marrangaroo Creek channel varies broadly in terms of habitat richness for native mammal species. Areas of the corridor which are well connected to broader woodland habitat are likely to provide watering access points and movement habitat with moderate refuge for more robust and mobile species. The creek corridor is bounded partially by open agricultural lands with sections of the corridor broken by cleared farmland. The narrow corridor passing through open agricultural land is likely to be a focus for introduced species which would in-turn, impact upon local native mammal habitat resources. Wombat burrows and tracks are numerous along the lower creek channel. From the amount of diggings and well worn walk-ways it is likely that the creek course has a well established population of the species. Several isolated burrows were also observed on the open pastureland areas. Wombats are able to form walkways and burrow sites under the dense stands of blackberry and bracken which often exclude many other species.

The Platypus and Water Rat are locally known from the Marrangaroo Creek and Cox's River catchments. Riffle areas and pools occur within the channel which these species may utilise. Areas where the channel is narrow and is overgrown with weed species may provide less preferable habitat for these aquatic mammal species. Sites such as the Marrangaroo weir are likely to provide suitable pool, riffle and bank habitat for these species.

Habitat in broader woodland areas surrounding the study area is diverse with numerous habitat types present in a relatively small area. Habitat on slopes and gullies adjacent to the site include fallen timber, rocky outcrops and overhangs, moderately complex litter ground cover and a connective canopy. Hollow bearing trees and stags, while present within the community, are not common. The woodland site is directly connective with watering sites and much broader and sheltered woodland communities including woodland/ open forests to the east and west of the study area. While the field survey was not designed to obtain the occurrence/ non-occurrence data of mammal species within the locality, data-sets for the area and habitat appraisal indicates that resources for native mammal species increases with native vegetation complexity and condition.

A total of nine threatened mammal species (excluding bats) are listed for the Wallerawang 1:100,000 Mapsheet. This listing is derived from a number of datasets including NPWS, Australian Museum and Australian Government Department of Wildlife and Heritage. These species are listed in **Table 3.2**.



Bat species

A total of 29 bat species have been listed on the NSW Government 'Bionet' search tool as occurring on the Wallerawang Map Sheet.

The open pastureland and agriculturally modified grasslands provide suitable open-field foraging resources for bat species, however preferred roosting sites for breeding and wintering colonies and individual refuge is scarce. Any hollow resources are likely to be competed for by a range of hollow using species. Residential areas present some bat species with habitat in the form of structures suitable for roosts and lights attracting prey for insectivorous species.

The open woodland community structure, fringing pastureland and the surrounding broader woodlands increase the potential of the study area to provide good foraging and movement habitat for bat species. Higher levels of diversity and activity of bat species is likely to occur on community ecotones with a high level of habitat richness. Lower bat activity and diversity would occur across broader open areas.

The main factor in lowering the bat-habitat potential of the study area is a low occurrence of preferred roosting habitat in the form of hollow-bearing trees, hollow stags, old mines, rock overhangs and tunnels. The low availability of these habitats considerably lowers the potential of the site to provide favoured refuge or wintering roost habitat. It is expected that these resources are diverse and plentiful within broader woodlands and forest of the slopes, ridges and escarpments adjoining the study area. Lower densities and diversities of ground and shrub vegetation may also affect the quality and suitability of the study area for foraging.

The potential of the study area to provide preferred habitat for Flying Fox species is low. Species may use fringing woodland for movement between foraging areas. No established roosts or foraging areas were identified from the study area.

The primary use of the study area for bat species is likely to be foraging. Few intact corridors exist across the study area subsequently limiting the movement potential for woodland species across the site. Sheltered creek channels flanked by eucalypt woodland would also provide insect foraging habitat.

Adjacent woodland and forest communities with older-aged components are likely to provide species with a more diverse range of refuge and foraging habitat, not available in the study area. The open woodland fringe of the study area provides a sheltered buffer zone between more intact native habitat and the open pasturelands.

A total of seven threatened bat species are listed for the Wallerawang 1:100,000 Mapsheet. This listing is derived from a number of datasets including NPWS, Australian Museum and Australian Government Department of Wildlife and Heritage. These species are listed in **Table 3.2**.



Reptiles and Amphibians

A total of 20 frog species have been listed on the NSW Government 'Bionet' search tool as occurring on the Wallerawang Map Sheet. A total of 48 species of reptiles have been listed on the NSW Government 'Bionet' search tool as occurring on the Wallerawang Map Sheet.

The quality and diversity of potential reptile and amphibian habitat over the open pastureland and modified grassland areas is low. The absence of substantial long-term ground cover, logs and leaf litter minimises habitat diversity. It is likely that common robust species would inhabit this habitat type. Long standing water sources associated with human built structures or isolated timber remnants would provide more favourable habitat.

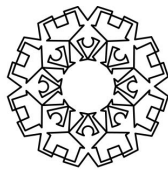
Isolated rocky outcrops on hill slopes and ridge lines were investigated to identify favourable reptilian habitat. These rocky outcrops are composed of numerous irregularly shaped rocks, clustered and mostly imbedded into the soil rather than loosely piled. A 'seam' of large rock outcropping running north to south along the central region of the study area consists of large conglomerate/ sandstone boulders and crowns. Areas of existing and prior agricultural land have been rock picked and piled in small heaps on the edge of open paddocks. Vegetation between rocks is sparse and often grazed. Bracken and blackberry have become established in less exposed and less accessible rocky sites. Reptilian traces within these rocky sites on open grazed areas were very low. Small common skink species (*Lampropholis sp.*) were observed. On previously grazed land, a high proportion of rock material is embedded into the soil without cavities or hollows underneath. Seasonal conditions, land use and grazing intensities are likely to influence foraging and refuge opportunities across the open pastureland areas. Isolated habitat such as rocky outcrops and small remnants are more likely to experience species extinctions during prolonged poor seasons due to the exposure, isolation and the low potential for migration of smaller species.

Reptilian habitat diversity and potential increases in the woodland areas, particularly those with lowered grazing impact. Rocky outcrops, diverse litter loads, fallen timber and areas of lower storey vegetation indicate that habitat is suitable for local reptile species. Opportunistic observations during field survey detected a more diverse species range.

In addition to the Marrangaroo Creek channel, several secondary and minor drainage depressions containing spring-fed waterholes, dams and aquatic associated habitat exist on the study area. Most depressions have been modified by channel straightening, clearing, contour banks, farm dams or fence lines. All channels exhibit signs of weed infestation and also bank and bed erosion.

Secondary drainage depressions across the study area contain patchy and very localised clumps of aquatic associated vegetation usually occurring as small areas of aquatic vegetation in the beds in ephemerally damp drainage depressions.

The Marrangaroo Creek channel has a near-perennial flow, with flow stopping in only the driest seasons. Permanent waterholes and vegetated areas of the main channel provide favourable long term habitat for amphibian species. Areas of the creek channel that are well sheltered by adjacent woodland and contain a diverse in-stream and bank habitat are likely to provide a favourable resource for many frog species. Areas of slower flow within the channel have large amounts of depositional



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sediment as a result of eroded soil material. Blackberry and bracken are also prolific in areas of the lower creek channel. The bed of the Marrangaroo Creek fluctuates from a muddy flat bottomed creek to rocky pools, small rapids and sandy bottomed waterholes. Sedges and aquatic vegetation occur along the creek channel however dense weed species compete heavily against these species.

These factors have the potential to impact upon amphibian habitat quality.

The Barking Marsh Frog and Common Eastern Toadlet were species recorded at nearly all farm dams on the study area. Amphibian diversity increased with habitat complexity and canopy cover. Five species were recorded from eastern and western ends of the Marrangaroo Creek Channel within the study area. These locations contained rocky/ sandy bottomed pools, in-stream branches and vegetation, overhead canopy cover, overhanging vegetation and steep banks. Recorded species included Bleating Tree Frog, Peron's Tree Frog, Common Eastern Toadlet, Eastern Banjo Frog, Barking Marsh Frog and Spotted Marsh Frog.

It is expected that the lesser impacted, damp forested gullies extending into broadly wooded areas adjacent to the study area, containing spring and soak fed waterholes provide a broader amphibian habitat resource in the locality.

Finfish

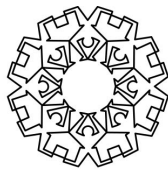
A total of 11 finfish species have been listed on the NSW Government 'Bionet' search tool as occurring on the Wallerawang 1:100,000 Map Sheet.

Based on the characteristics of the secondary drainage channels and feeder streams leading to the Marrangaroo Creek, the aquatic habitat classification in the vicinity of the study area is "Class 3 – Minimal fish habitat" (NSW Fisheries, January 1999).

The basis for this classification being the following:

- The channels are subject to highly ephemeral flows with in-stream barriers (eg. farm dams and fences) and provide poor refuge and feeding areas for aquatic fauna.
- The catchment area of each of the drainage channels is small and localised.
- Vegetation which is present in the drainage courses are representative of ephemeral aquatic systems. Most flora species include species which are tolerant of long dry periods or are fast growing and invasive exotic species.
- There are no established wetlands in the locality.
- The value of the locality as a spawning area is considered minimal due to the ephemeral flows and the seasonally restricted nature of flows.

Based on the characteristics of the drainage channel, the aquatic habitat classification of the Marrangaroo Creek channels in the vicinity of the study area are "Class 2 – Moderate fish habitat" (NSW Fisheries, January 1999).

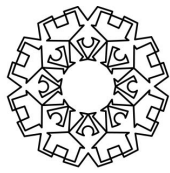


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The basis for this classification being the following:

- The channels are subject to near perennial flows with a clearly defined watercourse.
- Near-permanent pools and weir pool are present.
- The catchment area of the creek is moderately large and extends over an area of approximately 36 square kilometres with the head of the catchment located within open forest of the Blue Mountains plateau.
- Vegetation which is present in the drainage course is representative of disturbed perennial aquatic systems. Most flora species include species which are also tolerant of dry periods or are fast growing and invasive exotic species.
- There are no established wetlands in the immediate locality.
- The value of the locality as a spawning area is considered moderate due to the near permanent flows.
- The channel is blocked by large weir structures with weed thickets and fence-lines impeding in-channel movement.

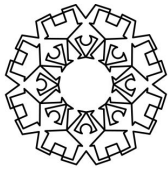
The primary fin-fish habitat of the study area is the Marrangaroo Creek. The channel within the study area ranges from a slightly incised, sandy stream to a rocky channel flanked by a steep and narrow meandering valley. Being near perennial in nature, the channel is likely to provide spawning and movement habitat. This habitat may be impacted by in-stream barriers and infestation by invasive weed species.



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Plate 7 - The Marangaroo creek corridor located downstream of 'Fernbrook'. The creek corridor varies broadly in width and vegetation structure. While this location appeared to provide a relatively weed-free channel, the riparian corridor measured less than 60 metres wide, being flanked by open grazing land on either side. The creek channel in this location contrasts strongly with the channel downstream of the Marrangaroo Wier. (Refer to **Plate 8**).



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Plate 8 - Downstream of the Marangaroo Wier. The creek is located in a relatively deep, steep sided valley. Blackberry and bracken grow densely along broad sections of the creek. While flanking woodland is in relatively good condition, weed infestations reduce the riparian habitat quality.

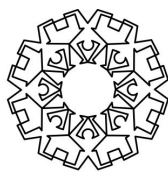
3.1.5 OBSERVED FAUNA SPECIES

The field surveys aimed to provide a 'snap-shot' survey of a relatively large area to gain an overview of existing communities, their condition and the diversity of habitat that is present on the site.

Opportunistic data of sightings/ vocalisation and trace analysis was recorded during the survey. This data was obtained to provide additional information on the diversity of species using particular vegetation communities or habitat units.

The potential of threatened fauna species use of the site was evaluated by recorded data and the potential of existing habitat (breeding, foraging and movement) in providing resources for threatened species. Species with the potential of occurrence based on bio-climatic distribution are also evaluated.

The aim of field reconnaissance surveys was to identify potential areas of future constraints for development based on habitat quality analysis.



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Species identified opportunistically during field survey are listed in **Table 3.2**. Coding in this table also indicates in which habitats the observations and detections were made. Coding used is G = Grasslands, OP = Open woodlands or open woodland interface (including pockets of open woodland remnant and the Marrangaroo Creek corridor) and W = Woodland.

One threatened fauna species was identified during the field survey, being the Gang Gang Cockatoo. This species was recorded within woodland well buffered from open pastureland.

All observed fauna species are listed in **Table 3.2**.

Table 3.2 - Observed Fauna List

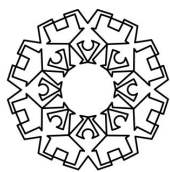
Amphibians					
Scientific Name	Common Name	G	OP	W	
<i>Crinia signifera</i>	Brown Froglet/ Common Eastern Toadlet	X	X	X	
<i>Limnodynastes dumerilii</i>	Banjo Frog		X	X	
<i>Limnodynastes fletcheri</i>	Barking Marsh Frog	X	X	X	
<i>Limnodynastes peronii</i>	Brown Striped Frog		X		
<i>Limnodynastes tasmaniensis</i>	Spotted Marsh Frog		X	X	
<i>Uperoleia laevigata</i>	Smooth Toadlet			X	
<i>Litoria caerulea</i>	Green Tree Frog			X	
<i>Litoria dentata</i>	Bleating Tree Frog		X	X	
<i>Litoria peronii</i>	Peron's Tree Frog			X	
Reptiles					
Scientific Name	Common Name	G	OP	W	
<i>Amphibolurus muricatus</i>	Jacky Lizard		X		
<i>Ctenotus robustus</i>	Fence Skink	X	X		
<i>Ctenotus taeniolatus</i>	Copper-Tailed Skink		X		
<i>Eulamprus quoyii</i>	Eastern Water Skink		X	X	
<i>Lampropholis delicata</i>	Grass Skink	X			
Mammals					
Scientific Name	Common Name	G	OP	W	
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna		X		
<i>Vombatus ursinus</i>	Common Wombat	X	X	X	
<i>Trichosurus vulpecula</i>	Common Brushtail Possum		X	X	
<i>Macropus giganteus</i>	Eastern Grey Kangaroo	X	X		
<i>Macropus rufogriseus</i>	Red-necked Wallaby			X	
<i>Wallabia bicolor</i>	Swamp Wallaby		X	X	
<i>Canis familiaris</i> *	Dog			X	
<i>Vulpes vulpes</i> *	Fox	X	X		
<i>Felis catus</i> *	Feral Cat	X	X		



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Table 3.2 - Observed Fauna List

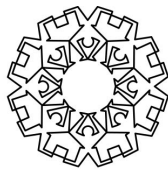
<i>Oryctolagus cuniculus</i> *	Rabbit		X	
<i>Lepus capensis</i>	Brown Hare	X		
<i>Sus scrofa</i> *	Pig			X
<i>Capra hircus</i> *	Goat	X	X	X
Birds				
Scientific Name	Common Name	G	OP	W
<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant		X	
<i>Threskiornis spinicollis</i>	Straw-necked Ibis		X	
<i>Elanus notatus</i>	Black-shouldered Kite			X
<i>Falco longipennis</i>	Australian Hobby	X	X	
<i>Chenonetta jubata</i>	Wood Duck	X	X	
<i>Anas superciliosa</i>	Pacific Black Duck	X	X	
<i>Coturnix ypsilophora</i>	Brown Quail	X		
<i>Fulica atra</i>	Eurasian Coot		X	X
<i>Vanellus miles</i>	Masked Lapwing		X	
<i>Geophaps lophotes</i>	Crested Pigeon		X	
<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo		X	X
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo		X	X
<i>Cacatua roseicapilla</i>	Galah	X	X	
<i>Platycercus elegans</i>	Crimson Rosella	X	X	
<i>Platycercus eximius</i>	Eastern Rosella		X	X
<i>Psephotus haematonotus</i>	Red-rumped Parrot	X	X	
<i>Podargus strigoides</i>	Tawny Frogmouth			X
<i>Dacelo novaeguineae</i>	Laughing Kookaburra		X	X
<i>Alcedo azurea</i>	Azure Kingfisher		X	
<i>Alauda arvensis</i>	Skylark	X		
<i>Hirundo neoxena</i>	Welcome Swallow	X	X	
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		X	
<i>Turdus merula</i> *	Blackbird	X		
<i>Petroica goodenovii</i>	Red-capped Robin		X	
<i>Eopsaltria australis</i>	Eastern Yellow Robin		X	
<i>Rhipidura leucophrys</i>	Willy Wagtail	X	X	
<i>Psophodes olivaceus</i>	Eastern Whipbird		X	X
<i>Cinclorhynchus cruralis</i>	Brown Songlark	X		
<i>Malurus cyaneus</i>	Superb Blue Wren		X	
<i>Smicrornis brevirostris</i>	Weebill		X	
<i>Acanthiza pusilla</i>	Brown Thornbill		X	



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Table 3.2 - Observed Fauna List

<i>Acanthiza nana</i>	Yellow Thornbill		X	X
<i>Anthochaera carunculata</i>	Red Wattlebird		X	X
<i>Philemon corniculatus</i>	Noisy Friarbird		X	X
<i>Lichenostomus leucotis</i>	White-eared Honeyeater		X	
<i>Pardalotus striatus</i>	Striated Pardalote		X	
<i>Passer domesticus</i> *	Sparrow	X		
<i>Sturnus vulgaris</i> *	Common Starling	X	X	
<i>Acridotheres tristis</i> *	Common Myna	X		
<i>Corcorax melanorhamphos</i>	White-winged Chough		X	
<i>Grallina cyanoleuca</i>	Magpie-lark		X	
<i>Artamus cyanopterus</i>	Dusky Woodswallow		X	
<i>Cracticus torquatus</i>	Grey Butcherbird	X	X	
<i>Strepera graculina</i>	Pied Currawong	X	X	
<i>Corvus coronoides</i>	Australian Raven	X	X	X
* Denotes Introduced Species G = Grassland OP = Open Woodland/Fringe W = Woodland				



Significant Species, Populations and Communities

4.1 ENDANGERED ECOLOGICAL COMMUNITIES AND ENDANGERED POPULATIONS

Two Endangered Populations are listed for the Wallerawang Mapsheet. These include *Pultenaea villifera* in the Blue Mountains LGA and *Keraudrenia corrolata* var. *denticulata* in the Hawkesbury Local Government Area. These populations do not occur in the study area.

A total of 42 Endangered Ecological Communities (EECs) are listed for the Wallerawang map sheet. The majority of these EECs have strong influences from the topography, elevation, vegetation units and climate of the upper Blue Mountains forests, woodlands, heaths, swamps and natural grasslands. The study area does not contain a listed EEC. The White Box Yellow Box Blakely's Red Gum Woodland is known from the Central Tablelands and Yellow Box (*Eucalyptus melliodora*) occurs within Talus-slope Woodland west of Lidsdale State Forest and also in the Ben Bullen locality. While *E. melliodora* may potentially occur as isolated specimens within communities associated with the study area, the composition and structure of on site vegetation cannot be defined as a White Box Yellow Box Blakely's Red Gum Woodland.

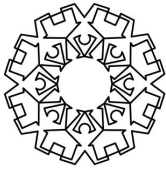
No Endangered Populations or Critical Habitat as defined and described by the Scientific Committee Determinations are located on the Wallerawang map sheet.

4.2 WORLD HERITAGE PROPERTIES

The Blue Mountains World Heritage area is located approximately 12km to the north of the eastern boundary of the Marrangaroo study area. The woodland communities to the east of the study area extend further eastward through forested sandstone plateau and escarpment terrain and are subsequently linked with the Blue Mountains National Park.

4.3 WETLANDS OF INTERNATIONAL IMPORTANCE

No Wetlands of either National or International Significance occur in the vicinity of the study area.



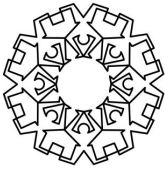
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4.4 SIGNIFICANT FLORA SPECIES

A total of 37 flora species are listed with special conservation significance from the Wallerawang 1:100,000 Mapsheet. The potential of these species to occur based on known occurrence or presence of favourable habitat in the study area is assessed in the following table. Other significant species may be detected with further targeted survey. Profiles for species with a likelihood of occurrence higher than 'low' are provided in **Section 4.4.1**.

Table 4.1 - Significant Species BioNet Flora Search

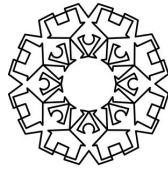
Scientific Name	Common Name	Status	Recorded in 10km Radius (NPWS datasets 2006)	Known Habitat Description	Likelihood of Occurrence in Study Area
<i>Actinotus helianthi</i>	Flannel Flower	P13	No	Old dunes and coastal heath also on very sandy soil in open forest	Low, lack of known or preferred habitat on study area.
<i>Apatophyllum constablei</i>		E1	No	Known from a rocky hillside at base of sandstone cliffs	Low, lack of known or preferred habitat on study area.
<i>Caustis flexuosa</i>	Curly Wig	P13	No	Sandy soil in established heath and open forest	Low, lack of known or preferred habitat on study area.
<i>Caustis pentandra</i>		P13	No	Sandy soil in established heath and dry open forest. On seasonally damp to dry habitats	Low, lack of known or preferred habitat on study area. Not identified from more likely areas of habitat
<i>Caustis flexuosa</i>		P13	No	Sandy soil derived from sandstone in established heath and open forest	Low to moderate. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Habitat may be present within lesser disturbed open woodland/ forest communities fringing the study area. Prior grazing and altered fire regimes are likely to impact upon suitable habitat or remove populations from site.



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Table 4.1 - Significant Species BioNet Flora Search

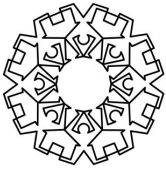
Scientific Name	Common Name	Status	Recorded in 10km Radius (NPWS datasets 2006)	Known Habitat Description	Likelihood of Occurrence in Study Area
<i>Caladenia tessellata</i>	Thick-lipped Spider Orchid	EPBC (V)	No	Grows on clay, loam and sandy soils	Low. Not known from the broader locality. Study area has long history of grazing impact likely to remove less common orchid populations
<i>Dicksonia antarctica</i>	Soft Treefern	P13	No	Moist gullies in wet sclerophyll forest to rainforest.	Low, lack of known or preferred habitat on study area.
<i>Lastreopsis hispida</i>	Bristly Shield Fern	E1	No	Rainforest habitat in Blue Mountains	Low, lack of known or preferred habitat on study area.
<i>Haloragodendron lucasii</i>		E1	No	Moist sheltered gullies, often at the base of rock faces with fern understorey.	Low, lack of known or preferred habitat on study area.
<i>Prostanthera cryptandroides</i>		V	No	Base of scree slopes and rocky areas on dry forested slopes and gullies.	Low, lack of known or preferred habitat on study area.
<i>Prostanthera stricta</i>		V	No	Sclerophyll forest, in sandy alluvium near watercourses	Low to moderate. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Habitat may be present within lesser disturbed open woodland communities. Prior grazing and weed infestation along the Marrangaroo Creek are likely to impact upon suitable habitat or remove populations from site.



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Table 4.1 - Significant Species BioNet Flora Search

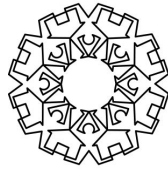
Scientific Name	Common Name	Status	Recorded in 10km Radius (NPWS datasets 2006)	Known Habitat Description	Likelihood of Occurrence in Study Area
<i>Lycopodium deuterodensum</i>	Bushy Clubmoss	P13	No	Sheltered moist areas in heath, open forest or rainforest margins. Usually on sandstone derived soils	Low, lack of known or preferred habitat on study area.
<i>Darwinia peduncularis</i>		V	No	Open forest, on or near sandstone outcrops and ridges.	Low. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Sparse habitat may be present within lesser disturbed and elevated open woodland/ forest communities fringing the study area.
<i>Eucalyptus cannonii</i>	Cannon's Stringybark	V EPBC (V)	No	Sclerophyll woodland on shallow rocky soils, often on rises. Ilford-Rylstone-Capertee districts	Low. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Species not known from locality. Known associated communities are not present on site.
<i>Eucalyptus pulverulenta</i>	Silver-leaved Gum	V EPBC (V)	No	Shallow soils with rocky outcrops and hillsides	Low to moderate. Not detected or known from immediate locality. Potential habitat is present within fringing woodland on elevated slopes and ridges.
<i>Dendrobium linguiforme</i>		P13	No	Grows on rocks and trees in sclerophyll forest and rainforest and in exposed rocky sites. Often in coastal sites.	Low, lack of known or preferred habitat on study area.
<i>Dendrobium speciosum</i>		P13	No	On rock surfaces, particularly on sandstone, usually in eucalypt forest. Chiefly in coastal districts	Low, lack of known or preferred habitat on study area..



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Table 4.1 - Significant Species BioNet Flora Search

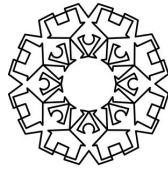
Scientific Name	Common Name	Status	Recorded in 10km Radius (NPWS datasets 2006)	Known Habitat Description	Likelihood of Occurrence in Study Area
<i>Dendrobium striolatum</i>		P13	No	Grows on rocks in exposed locations in sclerophyll forest and rainforest.	Low, lack of known or preferred habitat on study area.
<i>Dipodium hamiltonianum</i>		P13	No	Dry sclerophyll forest dominated by Eucalyptus and/or Callitris on acidic sandy soils.	Low. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Sparse habitat may be present within lesser disturbed and elevated open woodland/ forest communities fringing the study area..
<i>Dipodium punctatum</i>		P13	No	Wet forest to dry woodland. On variety of soils.	Low to moderate. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Habitat may be present within lesser disturbed and elevated open woodland/ forest communities fringing the study area.
<i>Dipodium roseum</i>		P13	No	Wet forest to dry woodland. On variety of soils.	Low to moderate. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Habitat may be present within lesser disturbed and elevated open woodland/ forest communities fringing the study area.
<i>Liparis reflexa</i>	Yellow Rock Orchid	P13	No	Seasonally moist rock faces, ledges and crevices.	Low, lack of known or preferred habitat on study area.
<i>Plectorrhiza tridentata</i>	Tangle Orchid	P13	No	Shady rainforest streams, attached hanging to small twigs and branches by slender roots.	Low, lack of known or preferred habitat on study area.



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Table 4.1 - Significant Species BioNet Flora Search

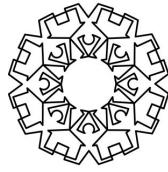
Scientific Name	Common Name	Status	Recorded in 10km Radius (NPWS datasets 2006)	Known Habitat Description	Likelihood of Occurrence in Study Area
<i>Sarcochilus hillii</i>	Little Gem Sarcochilus	P13	No	Moist open forest and marginal rainforest, frequently near streams growing on <i>Backhousia mytifolia</i> .	Low, lack of known or preferred habitat on study area.
<i>Todea barbara</i>	King Fern	P13	Yes	Shady creek banks and in rocky creek beds including rainforest gullies, near waterfalls and beside deep shaded streams.	Low, lack of known or preferred habitat on study area.
<i>Grevillea evansiana</i>		V	No	Open forest, ridge tops, rock to sandy soils. Low impact areas	Low. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Habitat may be present within lesser disturbed and elevated open woodland/ forest communities outside the study area.
<i>Lomatia silaifolia</i>	Crinkle Bush	P13	No	Heath and open forest on sandstone derived soils.	Low to moderate. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Habitat may be present within lesser disturbed and elevated open woodland/ forest communities fringing the study area.
<i>Persoonia acerosa</i>		V	Yes	Heath and open forest on sandstone derived soils.	Low to moderate. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Habitat may be present within lesser disturbed open woodland/ forest communities fringing the study area.



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Table 4.1 - Significant Species BioNet Flora Search

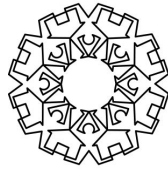
Scientific Name	Common Name	Status	Recorded in 10km Radius (NPWS datasets 2006)	Known Habitat Description	Likelihood of Occurrence in Study Area
<i>Persoonia hindii</i>		E1	Yes	Newnes plateau in a variety of dry sclerophyll forests and woodlands on sandstone soils	Low to moderate. Study area is outside of known range of species. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Habitat may be present within lesser disturbed and elevated open woodland/ forest communities fringing the study area.
<i>Persoonia marginata</i>		V	No	Dry sclerophyll forest on sandstone. Restricted to Capertee area.	Low to moderate. Study area is outside of known range of species. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Habitat may be present within lesser disturbed and elevated open woodland/ forest communities fringing the study area.
<i>Telopea speciosissima</i>	Waratah	P13	No	Forest on sandy soils	Low. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Sparse habitat may be present within lesser disturbed and elevated forest communities outside the study area..
<i>Xylomelum pyriforme</i>	Woody Pear	P13	No	Open forest, sandy, sheltered sites.	Low. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Sparse habitat may be present within lesser disturbed elevated forest communities outside the study area.
<i>Tmesipteris truncata</i>	Fork fern	P13	No	Moist rock crevices in cool, shady positions.	Low, lack of known or preferred habitat on study area.



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Table 4.1 - Significant Species BioNet Flora Search

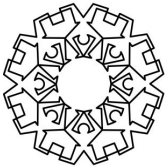
Scientific Name	Common Name	Status	Recorded in 10km Radius (NPWS datasets 2006)	Known Habitat Description	Likelihood of Occurrence in Study Area
<i>Pultenaea campbellii</i>	New England Bush Pea	EPBC (V)	No	Sclerophyll forest on well drained, light gravelly soil. Little to no stock grazing impacts	Low. Unlikely to occur on existing or prior open agricultural or cleared residential areas. No preferred habitat present on study areas. Sparse habitat may be present within lesser disturbed open woodland/ forest communities however soil type across study area is not suitable for species.
<i>Pultenaea glabra</i>	Smooth Bush-pea	EPBC (V)	No	Grows in dry sclerophyll forest with shrubby understorey on sandstone in deep gullies or well protected sites.	Low. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Sparse habitat may be present within lesser disturbed gully communities outside the study area.
<i>Boronia anethifolia</i>	Narrow-leaved Boronia	P13	No	Open forest on sandy soils	Low. Unlikely to occur on existing or prior open agricultural or cleared residential areas. No preferred habitat present on study areas. Sparse habitat may be present within lesser disturbed open woodland/ forest communities within sheltered valleys and gullies.
<i>Boronia deanei</i>	Dean's Boronia	V EPBC (V)	No	Swampy ground in wet heath and shrubland	Low, lack of known or preferred habitat on study area.
<i>Boronia floribunda</i>	Pale-pink Boronia	P13	No	Heath and dry sclerophyll forest on sandstone	Low to moderate. Study area is outside of known range of species. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Habitat on sandstone may be present within lesser disturbed open woodland/ forest communities fringing the study area.



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Table 4.1 - Significant Species BioNet Flora Search

Scientific Name	Common Name	Status	Recorded in 10km Radius (NPWS datasets 2006)	Known Habitat Description	Likelihood of Occurrence in Study Area
<i>Boronia microphylla</i>	Small-leaved Boronia	P13	No	Heath and dry sclerophyll forest on sandstone or granite.	Low to moderate. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Habitat may be present within lesser disturbed open woodland/ forest communities fringing the study area.
<i>Boronia rigens</i>	Stiff Boronia	P13	No	Heath and dry sclerophyll forest on sandstone and other acidic well drained substrates.	Low to moderate. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Habitat may be present within lesser disturbed open woodland/ forest communities fringing the study area.
<i>Boronia rubiginosa</i>		P13	No	Dry sclerophyll forest on skeletal sandstone derived soils or dunes.	Low, lack of known or preferred habitat on study area.
<i>Boronia ruppii</i>	Rupp's Boronia	E1	No	Dry sclerophyll forest on sandstone or serpentine, often rocky sites	Low to moderate. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Habitat may be present within lesser disturbed elevated open woodland on upper slopes and ridges fringing the study area.
<i>Boronia deanei</i>	Dean's Boronia	V	No	Wet heath, sheltered sites.	Low. Unlikely to occur on study area. Patches of riparian corridor with healthy understorey is disturbed by weed ingress and grazing impacts.
<i>Leionema sympetalum</i>		V	No	Restricted to exposed sandstone pergodas in dry sclerophyll forest.	Low, lack of known or preferred habitat on study area.



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Table 4.1 - Significant Species BioNet Flora Search

Scientific Name	Common Name	Status	Recorded in 10km Radius (NPWS datasets 2006)	Known Habitat Description	Likelihood of Occurrence in Study Area
<i>Philothea obovalis</i>		P13	No	Dry sclerophyll forest and heath on sandstone on moist soils and shady sheltered sites.	Low to moderate. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Habitat may be present within lesser disturbed open woodland gully communities with heath fringing the study area.
<i>Derwentia blakelyi</i>		V	Yes	Dry sclerophyll forest and heath on sandstone on moist sites.	Low to moderate. Unlikely to occur on existing or prior open agricultural or cleared residential areas. Habitat may be present within lesser disturbed open forest communities adjacent to the study area.



4.4.1 FLORA PROFILES

The following flora species were identified as having the potential to occur on or nearby the study area. These threatened flora species have been assigned a low to moderate likelihood of occurrence or higher.

- *Boronia floribunda* - Pale Pink Boronia
- *Boronia microphylla* - Small-leaved Boronia
- *Boronia rigens* - Stiff Boronia
- *Boronia ruppia* - Rupp's Boronia
- *Caustis flexuosa* - Curly Sedge, Old Mans Whiskers
- *Derwentia blakelyi*
- *Dipodium punctatum* - Hyacinth Orchid
- *Dipodium roseum*
- *Lomatia silaifolia* - Wild Parsley, Crinkle Bush
- *Persoonia acerosa*
- *Persoonia hindii*
- *Persoonia marginata*
- *Philothea obovalis* - Wax Flower
- *Prostanthera stricta*
- *Todea Barbara* - King Fern

***Boronia floribunda* - Pale Pink Boronia**

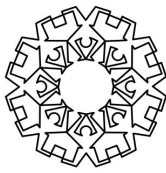
Boronia floribunda is a small aromatic shrub growing to 1 metre tall and is known for its abundant pale pink flowers with conspicuous hairy, yellow-white anthers. Flowering September to November. Leaves are divided into numerous narrow-oblong leaflets. The species grows in forest and heath, on sandy, well drained soils. The species is restricted to the coastal zone around Sydney and scattered throughout the Blue Mountains from Heathcoate, Newnes to Kings Tablelands. Potential habitat exists within less disturbed forest with heath located to the north and east of the study area.

***Boronia microphylla* - Small-leaved Boronia**

Boronia microphylla is a small shrub growing up to 1 metre in height and is usually found in sheltered moist areas. The appearance of the shrub is similar to other species of *Boronia* found in the general area but is distinguished by small leaflets which are less than 10 mm long. Flowers are deep pink, 4 petaled stars. The plant requires a moist, well drained, protected site. It is known from the upper Blue Mountains region, Nattai Tablelands and Mt Wilson, but also occurs from the south and north coastal districts, northern tablelands and central-western slopes. Potential habitat exists within less disturbed, sheltered gullies with forest located to the north-east of the study area.

***Boronia rigens* - Stiff Boronia**

Boronia rigens is a small shrub, growing to only 40 cm tall with very small, white flowers. The upright stems are softly downy and the leaves and stems often have a brownish appearance. Flowering occurs from July through to October. The known distribution of the species is widespread from the coast to the mountains. Recorded sites include La Perouse, Mt Colah and Blackheath. Its range also



extends along the southern tablelands and into Qld. Habitat is on exposed lateritic soils, with sandy heath, open forest and old dunes. Potential habitat exists on elevated slopes and ridges in less disturbed woodland located to the south and south-east of the study area.

***Boronia ruppia* - Rupp's Boronia**

Boronia ruppia is an aromatic shrub, 0.4 – 2 metres tall. Leaves are divided into 3 or 5 leaflets. Flowers are pale to bright pink and typically flowers in September through to December, however the species may also flower all year-round. The species is known from dry sclerophyll forest on sandstone or serpentine, often rocky sites. Potential habitat exists on better drained elevated slopes and rises in less disturbed woodland and forest located mainly to the south and east of the study area.

***Caustis flexuosa* - Curly Sedge, Old Mans Whiskers**

This distinctive sedge species grows in dry sclerophyll forest on sandy soils derived from sandstone or granite. It is distributed from the coast to the western slopes of the Blue Mountains. The species is perennial with short rhizome growing 30 to 80 cm tall. Flowers in spring to summer. The upper sheaths of the plant contain clusters of curved branchlets, with each branchlet dividing several times from the sheaths and the growing ends becoming fine and coiled. Potential habitat exists on better drained elevated slopes and rises in less disturbed woodland and forest located mainly to the south and east of the study area.

Derwentia blakelyi

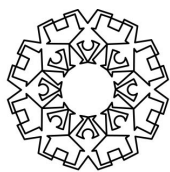
Derwentia blakelyi is a small glabrous and glaucous woody shrub, growing to approximately 50 cm. It has several erect, softly woody stems growing from a single rootstock. Flowers are bright blue to violet. The species dies back after fruiting. *Derwentia blakelyi* grows in eucalypt forest, between 650 and 950 metres altitude. It is known from the western Blue Mountains from Clarence to Peel River and Coricudgy Range. Potential habitat exists on better drained elevated slopes and rises in less disturbed woodland fringing the study area.

***Dipodium punctatum* - Hyacinth Orchid**

Dipodium punctatum is a small terrestrial orchid with no leaves, even when flowering. It occurs on sandy soils in scrub and open forest and is known from coast through to the tablelands and slopes of NSW. The species also occurs in Queensland, Victoria and Tasmania. The species grows to approximately 50 cm tall, with numerous pink to red-spotted flowers occurring in a terminal raceme. Flowering occurs chiefly in November to January. Potential habitat exists on slopes with well drained, sandy soils in less disturbed with minimal grazing history. This habitat is located on elevated footslopes and midslopes of rises to the east and south of the study area.

Dipodium roseum

Dipodium roseum is a relatively tall growing terrestrial orchid with no leaves. It occurs on a variety of soils in open forest (dry and wet). It is known from coast through to the western slopes NSW. The species also occurs in South Australia, Victoria and Tasmania. The species grows to approximately 100 cm tall, with numerous long pink to pink-spotted flowers occurring in a terminal raceme. Flowering



occurs December to March. . Potential habitat exists on slopes with well drained, sandy soils in less disturbed with minimal grazing history. This habitat is located on elevated footslopes and midslopes of rises to the east, north and south of the study area.

***Lomatia silaifolia* - Wild Parsley, Crinkle Bush**

Lomatia silaifolia is a low, erect stiff shrub growing to 50 -100 cm tall. It is identified by the much-divided, light green spreading leaves. The leaf segments are narrow and sharply toothed. It has creamy white flowers on long erect stems occurring well above the leaf mass. The plant is known to occur from the coast to the mountains, extending to the north coast of NSW and Northern Tablelands of Queensland. The species occurs in heath and open forest on sandstone derived soils. The plant has also been found in burnt areas and clearings within native woodland. Potential habitat exists on better drained elevated slopes and rises in less disturbed woodland and forest located mainly to the south and east of the study area.

Persoonia acerosa

Persoonia acerosa is an erect to spreading shrub, growing to 0.5 – 2 metres tall. The shrub has a spreading growth form with crowded, upward pointing leaves. Yellow flowers are crowded along the upper branchlets. Flowering occurs from March to May. *Persoonia acerosa* grows on heath and open forest on sandstone derived soils, often well drained and sandy from 550 – 1000 metres ASL. The species is restricted to the central Blue Mountains, south to Hill-Top in central-eastern NSW. Potential habitat exists on better drained elevated midslopes and ridges in less disturbed woodland and forest located mainly to the south and east of the study area.

Persoonia hindii

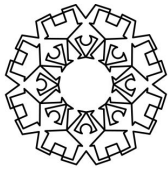
Persoonia hindii is an erect, spreading, multi-stemmed shrub growing to 0.3 to 1 metres tall. It is a suckering shrub, with extensive, linear, stolon-like rhizomes which lie about 5cm under the soil. The small alternate leaves are succulent. The plant flowers in January to March with deep yellow flowers. *Persoonia hindii* is restricted to the Newnes Plateau in a variety of dry sclerophyll forests and woodlands types on sandstone soils. Potential habitat exists on well drained elevated slopes, ridges and plateaus in less disturbed open woodland located mainly to the east of the study area.

Persoonia marginata

Persoonia marginata is a spreading to decumbent shrub with small elliptic to ovate shaped leaves.. The younger branchlets are covered in fine, dense hairs. The species flowers in spring to mid summer with small yellow flowers. It grows in dry sclerophyll forest on sandstone in heavier, clayey, gravelly loam derived from Permian rocks. The species is restricted to Capertee area between Kandos and Portland. Potential habitat exists in less disturbed open woodland on loam located within lower sheltered depressions to the south and south-west of the study area.

***Philotheca obovalis* - Wax Flower**

Philotheca obovalis is a small shrub usually growing to less than 1 metre in height. It has small elliptical to spoon shaped leaves with warty oil glands on the under-surface. Flowers are small, waxy



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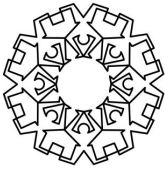
and white, flowering from late winter to late spring. The species grows on a well drained soil in dry sclerophyll forest and heath on sandstone, often occurring in moist soils and on shady sheltered sites. Potential habitat exists within drainage depressions on well drained slopes in less disturbed open woodland. This habitat occurs within minor gullies in the rises located mainly to the south and east of the study area.

Prostanthera stricta

Prostanthera stricta is an erect, bush and aromatic shrub, growing to 1 to 2 metres tall. The species is known from Mount Vincent and Genowlan Mountain on the Central Tablelands. The shrub has a moderately dense layer of hairs growing across the branches. Leaves are small and tapered. Pale mauve to deep purple flowers appear in spring to summer. The species occurs in areas receiving rainfall of 600-700 mm annually. It has been recorded growing on steep rocky side-slopes with cliff-lines, sandstone platforms or gentle slopes with exposed sandstone. The species is also known from deep well drained soils of sandstone origin such as alluvial deposits, sand bars or at the base of sandstone cliff-lines. Potential habitat occurs on damp sandstone escarpments and cliff-lines located on elevated escarpments to the north of the study area.

***Todea Barbara* - King Fern**

Todea Barbara is a large thick set fern that resembles a tree fern. It is commonly recorded from shady creek banks and rocky creek beds but will also occur in other wet locations such as caves, splash zones and rocky crevices. The distribution of the species extends from Qld to S.A and Tasmania. The species can grow over a metre tall bearing several large crowns of fronds, each growing to 2 metres in length and appearing bright green and leathery. Potential habitat occurs within wet sandstone based gullies and elevated damp areas located mainly to the north and north-east of the study area.



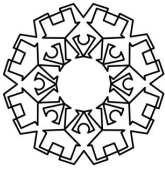
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4.5 SIGNIFICANT FAUNA SPECIES

A total of 52 fauna species are listed with a special conservation significance from the Wallerawang 1:100,000 Mapsheet. The potential of these species to occur based on known occurrence or presence of favourable habitat in the study area is assessed in the following table. Other significant species may be detected with further targeted survey. Profiles for species with a likelihood of occurrence higher than 'low' are provided in **Section 4.5.3**.

Table 4.2 - Significant Species BioNet Fauna Search

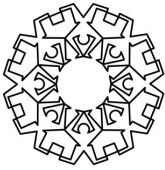
Scientific Name	Common Name	Status	Recorded in 10km Radius	Known Habitat Description	Likelihood of Occurrence on the Study Area
Amphibians					
<i>Mixophyes balbus</i>	Stuttering Frog	TSC (V)	No	Wet forests, near slow flowing streams, moist gullies.	Low. While disturbed moist gully habitat may be present within the lower reaches of the Marrangaroo Creek, the vegetation structure of the area does not include wet forest habitat..
<i>Pseudophryne australis</i>	Red-Crowned Toadlet	TSC (V)	No	Confined to Hawkesbury Sandstone formation, on elevated drainage lines in dry eucalypt forest and heath on sandstone ridges and upper gullies.	Low. Drainage gullies of the study area cross the lower alluvial flats and gullies of a closed basin valley formation. Habitat does not consist of Hawkesbury Sandstone formation.
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	EPBC (V)	No	Known from hanging swamps on sandstone shelves or in native habitat associated with perennial streams on sandstone soil that support heath vegetation.	Low. While native perennial stream habitat may be present within the lower reaches of the Marrangaroo Creek, native vegetation has been impacted. Preferred habitat not present on study area.



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Table 4.2 - Significant Species BioNet Fauna Search

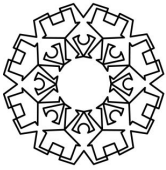
Scientific Name	Common Name	Status	Recorded in 10km Radius	Known Habitat Description	Likelihood of Occurrence on the Study Area
<i>Litoria littlejohni</i>	Littlejohn's Frog	EPBC (V)	No	Inhabits forest woodland and heath from 100 to 950 mt ASL. Species has been recorded from a broad range of aquatic associated habitat from perennial streams to temporary pools in forested areas. Sites are often in areas of undisturbed natural vegetation. The species may also occupy semi-disturbed habitat including ditches, dams and reservoirs.	Moderate. This species occupies a broad range of habitat. Creeks and pools on the study area are directly linked to less disturbed woodland with extensions of natural drainage systems.
Birds					
<i>Lophoictinia isura</i>	Square-tailed Kite	TSC (V)	No	Broad woodland to heath woodland on ridges and forested gullies. Nest sites located on timbered watercourses Passerine prey items	Low to moderate potential of occurrence. No preferred nesting or refuge habitat on study area. Adjoining woodland habitat is likely to be connective with lesser disturbed nesting and foraging habitat. Species may opportunistically include site in foraging range.
<i>Climacteris picumnus</i>	Brown Treecreeper	TSC (V)	Yes	Mature eucalypt woodland, intact ground stratum	Moderate due to existing areas of suitable foraging and movement habitat. Open woodland fringing the study area is connective with broad areas of habitat.
<i>Grantiella picta</i>	Painted Honeyeater	TSC (V)	No	Casuarina and eucalypt forest with mistletoe.	Low due to no or limited preferred foraging, nesting or movement habitat available. Species not recorded in area.



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Table 4.2 - Significant Species BioNet Fauna Search

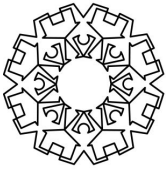
Scientific Name	Common Name	Status	Recorded in 10km Radius	Known Habitat Description	Likelihood of Occurrence on the Study Area
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater	TSC (V)	No	Forest woodland of eucalypt, paperbark, tree lined watercourses of arid regions.	Low to Moderate potential of occurrence. Foraging and sub-optimal; nesting habitat available in immediate locality of study area. Invasive and competitive bird populations are likely to impact upon species in isolated and more open woodland areas on open agricultural land. Species may include study area in large foraging range.
<i>Xanthomyza phrygia</i>	Regent Honeyeater	TSC (E1)	No	Mature stands and woodland of high nectar producing ironbark and box-eucalypt species.	moderate. Limited preferred foraging habitat across study area. Important food communities not present. Species is likely to use broader woodland areas for movement.
<i>Pyrrholaemus sagittatus</i>	Speckled Warbler	TSC (V)	No	Intact eucalypt woodland with dense understorey of shrubs and grasses.	Low to moderate. Limited preferred habitat on study area. Habitat may exist within ungrazed woodland-grassland fringe and on foot slopes with shrubby open woodland communities adjacent to the study area .
<i>Stagonopleura guttata</i>	Diamond Firetail	TSC (V)	Yes	Forest/ woodland with grassy groundcover/ water	Moderate potential for opportunistic visitation to study area. Small woodland and grassland bird populations are weak across the study area. The species may potentially use ungrazed areas of perennial watercourses.
<i>Melanodryas cucullata</i>	Hooded Robin	TSC (V)	Yes	Lightly timbered open woodlands.	Low potential of occurrence. Open woodland remnants of study area provides sub-optimal habitat for smaller woodland birds due to competitive and aggressive species. Human disturbance across the study area is high. Species may utilise less disturbed fringing woodland and forest habitat adjacent to the site.



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Table 4.2 - Significant Species BioNet Fauna Search

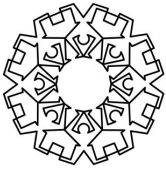
Scientific Name	Common Name	Status	Recorded in 10km Radius	Known Habitat Description	Likelihood of Occurrence on the Study Area
<i>Pomatostomus temporalis temporalis</i>	Grey Crowned Babbler	TSC (V)	No	Mature open woodland with grassy groundcover	Moderate potential to occur. Fringing woodland communities are connective with much broader woodland habitat. Populations of aggressive and territorial bird species are present within more patchy or isolated open woodland areas. Connective habitat may be included in family-group territory extending from broader woodland areas.
<i>Calyptorhynchus lathami</i>	Glossy-black Cockatoo	TSC (V)	Yes	Substantial sized forest areas with Casuarina foraging resources. Large hollows.	Low due to scarcity of feeding sites and exposure across open areas of the study area. Moderate potential for movement habitat throughout fringing woodland communities.
<i>Callocephalon fimbriatum</i>	Gang Gang Cockatoo	TSC (V)	Yes	Dense, wet, tall forests of mountains and gullies.	Moderate. Open exposed areas present few resources. Woodland fringe adjoining broader bushland provided suitable movement and foraging opportunities.
<i>Lathamus discolor</i>	Swift Parrot	TSC (E1)	No	Open eucalypt forest, usually box/ironbark or box/ red gum. Good flowering events.	Low to moderate due to poor foraging habitat across open pastureland community. Preferred eucalypt communities not present. Mobile species moves widely along Dividing Range, fringing broader woodlands would be included in favourable movement habitat
<i>Neophema pulchella</i>	Superb Parrot	TSC (V)	No	Mature eucalypt woodland and remnants. Tree hollows. Important habitat in Grassy-Box/Gum/Ironbark communities. Intact corridors.	Low to moderate. Species has not been recorded in local area. Preferred and important communities not present, however opportunistic foraging and movement resources available adjacent to the study area.



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Table 4.2 - Significant Species BioNet Fauna Search

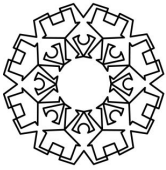
Scientific Name	Common Name	Status	Recorded in 10km Radius	Known Habitat Description	Likelihood of Occurrence on the Study Area
<i>Ninox strenua</i>	Powerful Owl	TSC (V)	No	Sizable areas of mature dense eucalypt forest and woodland.	Low to Moderate. Study area may be within recorded owl's home range. Limited preferred prey items on open pastureland community. Lack of preferred nesting habitat on study area however adjacent broad woodland and forests contains habitat.
<i>Ninox connivens</i>	Barking Owl	TSC (V)	No	Mature woodland/ large hollows	Low to moderate. Low foraging and nesting resources across open pastureland of study area, Study area may provide opportunistic foraging and movement along woodland fringes however more favourable habitat within immediate locality is common.
Fish					
<i>Macquaria australasica</i>	Macquarie Perch	Fisheries (V)	No	Well shaded streams and deep rock pools with shallow riffles. Generally in upper parts of catchments in more pristine streams.	Low. Creek has in-stream barriers and is moderately impacted by surrounding agricultural lands and prior impacts to the creek channel.
<i>Maccullochella peelii peelii</i>	Murray Cod	EPBC (E)	No	Occurs naturally in the waterways of the Murray-Darling Basin in a wide range of warm water habitats that range from clear, rocky streams to slow flowing turbid rivers and billabongs.	Low. Creek has in-stream barriers and is moderately impacted by surrounding agricultural lands and prior impacts to the creek channel.
Insects					
<i>Paralucia spinifera</i>	Bathurst Copper Butterfly	TSC (E1)	Yes	Blackthorn understorey scrub generally above 900mt ASL, In open or broken woodland with west to northerly aspect receiving full sun.	Low to moderate. No preferred habitat on open pastureland. Fringing woodlands contain patches of Busaria which may present available existing or future habitat.



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Table 4.2 - Significant Species BioNet Fauna Search

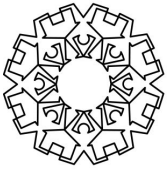
Scientific Name	Common Name	Status	Recorded in 10km Radius	Known Habitat Description	Likelihood of Occurrence on the Study Area
<i>Petalura gigantea</i>	Giant Dragonfly	TSC (E1)	No	Permanent bogs and swamp with larger, relatively deep swamps preferred. High water quality and moderate vegetation cover.	Low. No preferred habitat on study area, no swampy habitat likely to occur on study area with good water quality. Most ephemeral swampy areas are accessed by grazing stock.
Mammals					
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	TSC (V) EPBC (V)	No	Variety of habitats including rainforest, mangroves, paperbark swamps, wet and dry forests and cultivated areas	Low. Species may opportunistically use intact woodland corridors and fringes of study area for movement however no preferred foraging resources are present on site. No existing roosts known from area.
<i>Chalinolobus dwyeri</i>	Large Pied Bat	TSC (V) EPBC (V)	Yes	Typically dry sclerophyll forest and woodland. Also recorded from a variety of habitat from rainforest to sub-alpine forest.	Moderate. Species may potentially use woodland fringes for movement and foraging. Species habit over open agricultural land is unknown. Abundance of woodland habitat in locality.
<i>Falsistrellus tasmaniensis</i>	Great Pipistrelle	TSC (V)	Yes	Hollow tree trunks and cave roosts. Sclerophyll forests from Great Dividing Range to coastal habitat. Preference for wet habitats with canopy over 20mt.	Moderate. Species may potentially use woodland fringes for movement and foraging. Species habit over open agricultural land is unknown. Species may use timbered creek courses for foraging. Abundance of woodland habitat in locality.
<i>Miniopterus australis</i>	Little Bent-wing Bat	TSC (V)	No	Predominantly cave roosting. Preference for well timbered areas including a range of habitat including rainforest, wet and dry forest, Melaleuca swamps and coastal forests.	Low to Moderate. No roost habitat on study area. Species may potentially use denser areas of the woodland fringe for movement and foraging. Species unlikely to forage over open land. Preferable forest habitat present in forested sheltered gullies in locality



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Table 4.2 - Significant Species BioNet Fauna Search

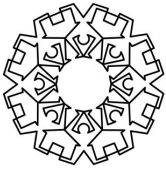
Scientific Name	Common Name	Status	Recorded in 10km Radius	Known Habitat Description	Likelihood of Occurrence on the Study Area
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing Bat	TSC (V)	Yes	Predominantly cave roosting but also use build structures. The species may also use large internal tree cavities. Broad range of habitat from rainforest and tall forest to open grassland	Moderate. Species may potentially use woodland fringes for movement and foraging. Abundance of woodland habitat in locality.
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	TSC (V)	Yes	Hollow tree roosts, disused buildings. Preference for moist gullies associated with mature coastal forest. Also known from gullies associated with dry sclerophyll. Typically found below 500mt but may occur at higher altitudes in milder climate areas.	Low to Moderate. Species may potentially use timbered gullies adjacent to the study area for movement and foraging. Species not recorded in local area.
<i>Nyctophilus timoriensis</i>	Eastern Long-eared Bat	EPBC (V)	Yes	Inhabits dry open woodlands and around River Red Gums that line watercourses and lakes. Roosts in tree hollows, under loose bark, in the mud nests of Fairy Martins, and in buildings.	Moderate. Species may potentially use woodland fringes for movement and foraging. Abundance of woodland habitat in locality.
<i>Dasyurus viverrinus</i>	Eastern Quoll	TSC (E1)	No	Broad home ranges of forest, scrub, heath land, open land.	Low to moderate. Potential habitat and home range adjacent to site. Likely high populations of feral predators and high levels of human disturbance.
<i>Dasyurus maculatus</i>	Tiger Quoll	TSC (V) EPBC (E)	No	Open forest/woodland/ heath/riparian woodland with large natural remnant areas and broad links. Low feral predator population.	Low. Area may be included in larger home range however competition with feral predators is likely to be high. Lack of preferred den sites in study area. High levels of human disturbance



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Table 4.2 - Significant Species BioNet Fauna Search

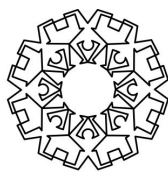
Scientific Name	Common Name	Status	Recorded in 10km Radius	Known Habitat Description	Likelihood of Occurrence on the Study Area
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	TSC (E1) EPBC (V)	No	Woodland and forest with complex rocky outcrops, cliffs and ledges. Low predator impacts.	Low. No preferred habitat on study area. High predator population across site. Habitat present in adjoining ranges and escarpments.
<i>Petaurus australis</i>	Yellow-bellied Glider	TSC (V)	No	Broad areas of tall-mature wet eucalypt woodland/ forest with intact connective links. Hollows. Low predator populations.	Low. Preferred community structure not present. Likely high populations of predators.
<i>Petaurus norfolcensis</i>	Squirrel Glider	TSC (V)	No	Mature trees with hollows. Connective woodland. Dry sclerophyll forest and woodlands, coastal forest and rainforest.	Low to Moderate. Species may potentially use timbered gullies and slopes adjacent to the study area for movement and foraging. Species is likely to be restricted to areas with more mature woodland (hollows).
<i>Phascolarctos cinereus</i>	Koala	TSC (V)	No	Eucalypt forest and woodland. Feed tree species, connective habitat with broad age diversity in woodland.	Low to Moderate. Agricultural and residential areas do not contain suitable habitat. Species recorded in broader locality. Feed trees species present on study area. Connective woodland present with broader, more favourable habitat.
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo	EPBC (V)	No	Rare, patchy coastal distribution on mainland. Highly susceptible to feral predator populations. Requires dense cover in sclerophyll forest for shelter and adjacent open understorey areas for foraging.	Low. Feral predator populations expected to be high in vicinity of study area. Species not known from locality. Preferred habitat not available on site.
<i>Aepyprymnus rufescens</i>	Rufous Bettong	TSC (V)	No	Coastal and subcoastal. Grassy coastal forest, dry forest with established understorey.	Low. No preferred habitat on study area. High predator population across site. Habitat may be present in adjoining ranges and escarpments.



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Table 4.2 - Significant Species BioNet Fauna Search

Scientific Name	Common Name	Status	Recorded in 10km Radius	Known Habitat Description	Likelihood of Occurrence on the Study Area
<i>Bettongia penicillata</i>	Brush-tailed Bettong	TSC (E4)	No	Dry sclerophyll forest with dense understorey.	Low. No preferred habitat on study area. High predator population across site. Heightened levels of human disturbance and impact Habitat may be present in adjoining ranges and escarpments.
Reptiles					
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	TSC (E1) EPBC (V)	No	Nocturnal and confined to Hawkesbury sandstone formation. Inhabits crevices and under large slabs on ridges or scree slopes.	Low. No preferred habitat on study area. Habitat may be present on elevated rocky ridges, plateau edges and escarpments adjoining the study area.
<i>Eulamprus leuraensis</i>	Blue Mountains Water-skink	TSC (E1) EPBC (E)	No	Riparian and swampy areas in intact montane forests and heaths.	Low. No preferred habitat on study area. Marrangaroo creek unlikely to contain preferred habitat. Habitat may be present in shelter gullies extending upslope of the study area, particularly in heath dominated drainage lines..
<i>Varanus rosenbergi</i>	Rosenburgs Goanna	TSC (V)	No	Coastal heath, humid woodland, wet/dry sclerophyll forest. Logs, intact ground stratum. Rocky crevices, hollow logs and burrows.	Low to moderate. No preferred habitat on study area. Potential habitat may be present on elevated scree slopes, rocky ridges, plateau edges and escarpments with woodland adjoining the study area.



4.5.1 MIGRATORY SPECIES

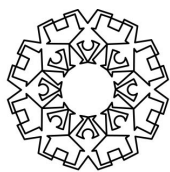
Migratory Non-Wetland Species

Table 4.3 assesses the likelihood of occurrence for listed migratory (non-wetland) species generated from the Protected Matters Search Report (Department of Environment and Heritage, 2006). This table also indicates, for these species, recordings in the broader locality from the Department of Environment and Conservation's Wildata listings from the Wallerawang 1:100,000 map sheet.

Species with a low to moderate likelihood of occurrence or higher are discussed in further detail in **Section 4.5.3**.

Table 4.3 - Likelihood of Occurrence for Listed Migratory (Non-Wetland) Species

PMSR Predicted Species	Wildata Sitings Wallerawang 1:100,000	Known Habitat description	Likelihood of Occurrence
White-bellied Sea-Eagle - <i>Haliaeetus leucogaster</i>	No	Usually coastal, may use flooded inland swamps, lagoons, floodplains. May visit inland along larger rivers.	No history for species in district. No preferable habitat of larger water bodies and rivers in area.
White-throated Needletail - <i>Hirundapus caudacutus</i>	Yes	High open spaces of sky, high above almost any habitat	Moderate due to area being a small part of the eastern mountain chain in NSW which forms part of the species migration route.
Black-faced Monarch - <i>Monarcha melanopsis</i>	No	Favours rainforest, and wet mangrove habitat. Species may also occur in eucalypt forests and woodland linking preferred habitat	Low due to no wet sclerophyll forest or rain forest habitat. Study area is west of predicted migration areas.
Satin Flycatcher – <i>Myiagra cyanoleuca</i>	No	Forest and woodland, mangrove and coastal heath scrubs. Species favours dense, wet gullies in tall eucalypt forest.	Low due to the absence of tall wet eucalypt forest habitat. Study area is on extreme western edge of predicted range.
Rufous Fantail – <i>Rhipidura rufifrons</i>	Yes	Rainforest, dense wet eucalypt and monsoon forest. Native swamps, riverside vegetation on open country during migration.	Low. Predicted range is predominantly restricted to coastal eastern Australia and adjacent ranges. No habitat of wet forest or mangrove. Creek corridor is unlikely to provide movement resources.
Regent Honeyeater - <i>Xanthomyza phrygia</i>	Yes	Preference for Ironbark forest but also within Yellow-gum, box, and river oak.	Low to moderate, Poor foraging habitat. Preferred eucalypt community not present. Species may use broader woodland links for foraging movement or connective resources to nearby nesting districts.



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Migratory Wetland Species

Table 4.4 assesses the likelihood of occurrence for listed migratory (wetland) species generated from the Protected Matters Search Report. This table also indicates, for these species, recordings in the broader locality from the Department of Environment and Conservation's Wildata listings from the Wallerawang 1:100,000 Map sheet.

Table 4.4 - Likelihood of Occurrence for Listed Migratory (Wetland) Species

PMSR Predicted Species	Wildata Sitings Wallerawang 1:100,000	Known Habitat Description	Likelihood of Occurrence
Latham's Snipe, Japanese Snipe - <i>Gallinago hardwickii</i>	No	Low, dense vegetation around wetlands in shallows. Occurs in reed beds, sedges and heaths. Occasional visitor to salt marshes and irrigated crops.	Low. No wetlands or sedge vegetated shallows habitat in locality. Habitat of flooded grasslands unlikely to be present.
Painted Snipe – <i>Rostratula benghalensis</i> s. lat	No	Surrounds and shallows of well vegetated wetlands. Prefers dense low cover.	Low. No well vegetated shallows or wetlands in locality. No preferred habitat on site.

No major wetland or waterbird habitat occurs in the locality of the study area. No swamps or artificial wetlands listed as supporting large numbers or diverse populations of waterbirds are present in the area.

The study area does not support wetlands or swamps with preferable wetland habitat. Preferable wetland habitat includes diverse and well established fringing vegetation, shallows, mud-flats or wading areas and long standing water bodies.

The closest Nationally Important and RAMSAR wetland areas, significant to waterbird populations and diversity, are remote from the study area with no significant populations of these listed species recorded. The closest listed sites include Towra Point Wetland at Sydney and Hunter Estuary Wetlands near Newcastle.

4.5.2 LISTED MARINE BIRD SPECIES

Table 4.5 assesses the likelihood of occurrence for listed marine bird species generated from the Protected Matters Search Report. This table also indicates, for these species, recordings in the broader locality from the Department of Environment and Conservation's Wildata listings from the Wallerawang 1:100,000 Map sheet.



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Table 4.5 - Likelihood of Occurrence for Listed Marine Bird Species

PMSR Predicted Species	Wilddata Sitings Wallerawang 1:100,000	Known Habitat Description	Likelihood of Occurrence
Fork-tailed Swift <i>Apus pacificus</i>	No	Low to very high airspace over a variety of habitats. Rainforest to semi-desert. Active in front of summer storm fronts and thermals. Species keep within regions where rainfall is between 130 and 25mm	Low. Species move northwards along the western flanks of the Great Dividing Range. May occur in airspace over study area but no habitat of importance for species on site..
Great Egret, White Egret <i>Andrea alba</i>	No	Wetlands, flooded pastures, large dams, estuarine mudflats and mangroves. Species uses a wide range of habitat	Low. Few important foraging resources. No wetland or swamp habitat. Localised pasture inundation likely to be very short lived.
Latham's Snipe, Japanese Snipe - <i>Gallinago hardwickii</i>	No	Low, dense vegetation around wetlands in shallows. Occurs in reed beds, sedges and heaths. Occasional visitor to salt marshes and irrigated crops.	Low. No wetlands or sedge vegetated shallows habitat in locality. Habitat of flooded grasslands unlikely to be present.
White-bellied Sea-Eagle - <i>Haliaeetus leucogaster</i>	No	Usually coastal, may use flooded inland swamps, lagoons, floodplains. May visit inland along larger rivers.	No history for species in district. No preferable habitat of larger water bodies and rivers in area.
White-throated Needletail - <i>Hirundapus caudacutus</i>	Yes	High open spaces of sky, high above almost any habitat	Moderate due to area being a small part of the eastern mountain chain in NSW which forms part of the species migration route.
Swift Parrot - <i>Lathamus discolor</i>	Yes	Forests and woodlands with regularly flowering, nectar rich flowering trees.	Low to moderate, Poor foraging habitat. Preferred eucalypt community not present. May use broader woodland links for movement
Black-faced Monarch - <i>Monarcha melanopsis</i>	No	Favours rainforest, and wet mangrove habitat. Species may also occur in eucalypt forests and woodland linking preferred habitat	Low due to no wet sclerophyll forest or rain forest habitat. Study area is west of predicted migration areas.

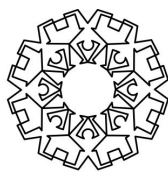


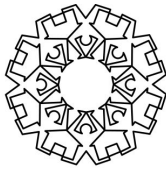
Table 4.5 - Likelihood of Occurrence for Listed Marine Bird Species

PMSR Predicted Species	Wilddata Sitings Wallerawang 1:100,000	Known Habitat Description	Likelihood of Occurrence
Satin Flycatcher – <i>Myiagra cyanoleuca</i>	No	Forest and woodland, mangrove and coastal heath scrubs. Species favours dense, wet gullies in tall eucalypt forest.	Low due to the absence of tall wet eucalypt forest habitat. Study area is on extreme western edge of predicted range.
Rufous Fantail – <i>Rhipidura rufifrons</i>	Yes	Rainforest, dense wet eucalypt and monsoon forest. Native swamps, riverside vegetation on open country during migration.	Low. Predicted range is predominantly restricted to coastal eastern Australia and adjacent ranges. No habitat of wet forest or mangrove. Creek corridor is unlikely to provide movement resources.
Painted Snipe - <i>Rostratula benghalensis</i> s. lat.	No	Surrounds and shallows of well vegetated wetlands. Prefers dense low cover.	Low. No well vegetated shallows or wetlands in locality. No preferred habitat on site.

4.5.3 FAUNA PROFILES

The following fauna species were identified as having the potential to occur on or nearby the study area. These significant fauna species have been assigned a low to moderate likelihood of occurrence or higher.

- Bathurst Copper Butterfly (*Paralucia spinifera*)
- Littlejohn's Tree Frog, (*Litoria littlejohni*)
- Rosenburg's Goanna (*Varanus rosenbergi*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Greater Long-eared Bat (*Nyctophilus tmorensis*)
- Little Bent-wing Bat (*Miniopterus australis*)
- Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Great Pipistrelle (*Falsistrellus tasmaniensis*)
- Koala (*Phascolarctos cinereus*)
- Squirrel Glider (*Petaurus norfolcensis*)



GEOLYSE

- Eastern Quoll (*Dasyurus viverrinus*)
- Square-tailed Kite (*Lophoictinia isura*)
- Barking Owl (*Ninox connivens*)
- Powerful Owl (*Ninox strenua*)
- Gang Gang Cockatoo (*Callocephalon fimbriatum*)
- Superb Parrot (*Polytelis swainsonii*)
- Swift Parrot (*Lathamus discolor*)
- White-throated Needletail, (*Hirundapus caudacutus*)
- Diamond Firetail (*Stagonopleura guttata*)
- Regent Honeyeater (*Xanthomyza phrygia*)
- Black-chinned Honeyeater (*Melithreptus gularis gularis*)
- Speckled Warbler (*Pyrrholaemus sagittatus*)
- Grey Crowned Babbler (*Pomatostomus temporalis temporalis*)
- Brown Treecreeper (*Climacteris picumnus*)
- Macquarie Perch (*Macquaria australasica*)

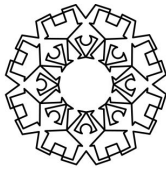
Bathurst Copper Butterfly (*Paralucia spinifera*)

The Bathurst Copper Butterfly is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*.

The Bathurst Copper Butterfly is a small species with a wingspan of approximately 20 millimetres. The bronze, blue and purple suffusions on the wings are variable and most prominent when sunning.

The distribution of the butterfly is specifically limited by elevation. All sites where the butterfly has been located are above 900 metres elevation. Its host plant, native Blackthorn (*Bursaria spinosa subsp. lasiophylla*), is an altitudinal variant of the widespread and common species and is generally only found above 900 metres. The attendant ant species is restricted to regions above 900 metres in altitude. Some sites occur on the crest of the tablelands where they are exposed to regular winter snow events. Other sites occur on foothills and valley floors where cold air drainage patterns result in regular severe frosts. A commonality between sites is that they are subjected to extremes of cold.

East of Lithgow the sandstone complex supports a much higher density and diversity of understorey shrubs that largely preclude the host native Blackthorn. The most significant areas of potential habitat remain south of Oberon.



GEOLYSE

Preferred habitat includes the exposure of *Bursaria spinosa ssp lasiophylla* to direct sunlight for a large portion of the day, due to orientation and / or canopy openness. The majority of sites have a westerly to northerly aspect. Sites located on south facing slopes are generally high enough and flat enough to ensure that they also receive full sun.

Structurally the vegetation generally has a sparse to moderately dense tree canopy component, with a grassy and sparsely shrubby understorey. The two-layered understorey comprises tall shrubs (including the Native Blackthorn) in the higher stratum and tussock grasses and scattered low shrubs in the lower stratum. Fire is likely to have contributed to maintaining this open habitat at many sites.

In addition to the loss of habitat through clearing operations, threatening processes include weed invasion, vehicular access and recreational vehicle use, dust from traffic, change in fire regimes, grazing, collection and habitat fragmentation.

The species is opportunist which takes advantage of favourable habitat when and where available. The relatively fast growth characteristics of *Bursaria* indicate that a site can become potential favourable habitat over several years. Small localised areas of existing or favourable habitat also have the potential to be easily removed by fire, woodland thinning or localised clearing events.

Habitat of importance - Open to sparse woodland sites above 900 metres with *Bursaria spinosa* with a flat or westerly to northerly aspect providing long exposure to daylight sun.

Littlejohn's Tree Frog (*Litoria littlejohni*)

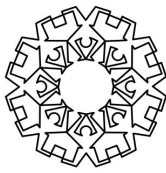
Litoria littlejohni is listed as vulnerable under the Environmental Protection and Biodiversity Conservation Act 1999.

It is similar in appearance to the Jervis Bay Tree-frog, *Litoria jervisiensis*. The species has a distinctive call (a series of rapidly repeated low, drawn-out whistles).

Littlejohn's Tree Frog is confined to eastern NSW and north-eastern Vic. It inhabits forest, coastal woodland and heath from 100 - 950 m above sea level and does not appear to be associated with any specific vegetation types. Breeding habitat has been recorded to include rocky streams and semi-permanent dams, still water in dams, ditches, isolated pools and flooded hollows, permanent dams, ponds and creeks, temporary pools in forested areas, deep permanent pools of slow creeks (in hanging swamps) or slow, rock-lined rivers, and in fire dams within undisturbed natural vegetation.

Non-breeding habitat is unknown.

Breeding in Littlejohn's Tree Frog is unusual, being mostly in autumn, but the species will also breed after heavy rainfall in spring and summer. It appears to breed in wet forest margins, which may be wet heath or ephemeral wet areas. Males call during breeding from elevated positions on vegetation beside or above water. Clusters of up to 60 eggs are attached to submerged twigs, stems or branches, often near the banks of still pools in clear, slowly flowing streams. The tadpoles are black or very dark grey with dark grey bellies, up to 65 mm in length.



Threats to the species include disturbance that may limit dispersal from small populations (increasing the risk of local extinction); clearing of native vegetation and reduced habitat availability and inappropriate fire practices (including pre- and post-logging burns and control burning) that may disturb breeding habitat.

Rosenburg's Goanna (*Varanus rosenbergi*)

Rosenburg's Goanna is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*.

The Rosenberg's goanna is one of the largest reptiles found in the Sydney Region growing to a length of 1.4m. They are dark grey to blackish above, with many fine yellow and cream speckles. Dark bands cross the back, and the tail is banded with cream or yellow.

This species is typically found in coastal heaths, humid woodlands, and wet and dry sclerophyll forests. The monitor is a mostly terrestrial species, day-active, and shelters in burrows and rock crevices, however can climb trees to escape predation. Diet comprises reptiles, insects, small mammals, and carrion. The oviparous monitor lays eggs, in a burrow to incubate. Little else is known of their breeding patterns.

Young are vulnerable to predation by foxes. Sightings are common of younger individuals in areas that have been fox-baited compared to unbaited areas

Threats to this species include Loss of habitat to development and Agriculture and its destruction pose the greatest threat to Heath Monitors in the Warringah Local Government Area. Foxes, cats and dogs may also prey on Young Heath Monitors.

Habitat of importance - Connective woodland with rocky outcrops, escarpments and crevices capable of supporting prey.

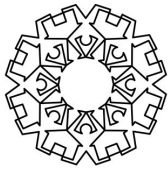
Greater Broad-nosed Bat (*Scoteanax rueppellii*)

The Greater Broad-nosed Bat is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*.

The species' stronghold is in the gullies and river systems draining the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland in tropical Queensland, but extends to the coast over much of its range.

It usually flies slowly and directly at a height of 3-6 metres catching beetles and other large, slow-flying insects. The Greater Broad-nosed Bat also preys on other bats.

Although inhabiting a variety of habitats from woodland through moist and dry eucalypt forest to rainforest, it rarely occurs at altitudes above 500 meters except in areas with a milder climate. The preferred habitat of this species appears to be old growth cool temperate or wet sclerophyll forests. This species roosts in tree hollows or buildings.



GEOLYSE

Very little is known about the reproductive cycle of this species, however it probably follows the typical Vespertilionid pattern. A single young is born in January.

Potential threats include the loss of hollows found within old-mature growth forests, habitat loss through clearance for agricultural and forestry purposes, fire (wild and prescribed), insecticides both directly and indirectly (on their food source).

Habitat of importance - Intact tall forest or woodland community with old-mature structure components (eg. trunk and limb cavities)

Greater Long-eared Bat (*Nyctophilus timoriensis*)

Nyctophilus timoriensis is listed as vulnerable under the Environmental Protection and Biodiversity Conservation Act 1999.

Recent studies indicate that, in addition to the Tasmanian subspecies, three geographically distinct forms exist across southern Australia, indicating that what is called *Nyctophilus timoriensis* may represent a species complex. Apart from its occurrence in the tall forests of far south-western Western Australia and Tasmania, it is generally associated with the woodland and mallee across the arid and semi-arid regions (Strahan, ed, 1995). The species has also been recorded across southern mainland Australia.

The species spends part of its foraging time on the ground hunting for insect prey. Flight is slow and fluttery but agile.

Known habitat primarily includes dry open woodland communities and around River Red Gums that line watercourses and lakes on the inland plains of the semi-arid zone. This species roosts in a range of habitats including tree hollows, under loose bark, in the mud nests of Fairy Martins, and in buildings. Threats to this species include clearing, grazing and predation.

Potential threats to the species include the loss of hollows found within old-mature growth forests, habitat loss through clearance for agricultural and forestry purposes, fire (wild and prescribed), insecticides both directly and indirectly (on their food source).

Habitat of importance - Connective and intact woodland community with old-mature structure components (eg. trunk and limb cavities).

Little Bent-wing Bat (*Miniopterus australis*)

The Little Bent-wing Bat is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*.

The species is distributed along the east coast of Australia from Cape York to northern New South Wales.

The Little Bent-wing Bat is a predominantly recorded as a cave dwelling species which congregate into maternity colonies during the summer and disperse to wintering roosts during the winter. Roosts can include caves, mines, disused tunnels.



The species hunts for insects, manoeuvring between shrub and canopy layers of densely wooded areas. Potential threats to the species include destruction or interference of subterranean roosts, habitat clearance for agriculture, urban developments, forest fragmentation and predation by feral animals.

Habitat of importance - Subterranean habitat connective with intact native woodland or forest communities.

Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*)

The Eastern Bentwing Bat is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*.

The distribution of the Bent-wing Bat is essentially coastal and its foraging areas are associated with major drainage systems. The species uses a broad range of habitats throughout this range.

The species is recorded primarily as a cave dwelling species. The species may also use suitable human constructed tunnels, culverts and buildings. Subterranean habitat is important for established maternity caves. In spring, adult females accumulate in caves to give birth and nurse their young. The internal characteristics of maternity caves retain heat and humidity, providing suitable nurseries for young bats. In mid to late summer, the bats begin to disperse to several caves which they will use to over-winter. Studies indicate that individuals can move considerable distances (up to 870km in a little over two months).

Potential threats to the species include interference, collapse or destruction of established maternity colonies, human disturbance to wintering bats and the widespread use of pesticides.

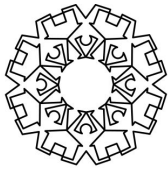
Habitat of importance - Suitable caves for maternity colonies.

Large-eared Pied Bat (*Chalinolobus dwyeri*)

The Large Pied Bat is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*.

The range and distribution of the Large Pied Bat is not fully known. The species appears to be uncommon in New South Wales and rare within its range in Queensland. It has been recorded from scattered localities extending from Nowra to the Blackdown Tablelands in Queensland.

Habitat for the Large Pied Bat is poorly understood. In New South Wales this species occupies a range of vegetation types, including dry and wet sclerophyll forest, Callitris dominated forest, tall open eucalypt forest with a rainforest sub-canopy, sub-alpine woodland and sandstone outcrop country. In Queensland the species has primarily been recorded from higher altitude moist tall open forest adjacent to rainforest. Little is known about the roosting requirements of this species but natural roosts may depend heavily on sandstone outcrops. It has been recorded using in disused mine shafts, caves, overhangs and disused Fairy Martin nests. It also possibly roosts in tree hollows. Habitat for maternity sites is not known.



GEOLYSE

Potential threats for the species include the destruction or interference of subterranean roosts, disturbance of sandstone escarpments by underground coal mining, habitat clearance for agriculture, urban developments, reduction in the availability of suitable hollows, forest fragmentation and predation by feral animals.

Habitat of importance - Intact forest or woodland habitat with suitable underground or escarpment roost habitat.

Great Pipistrelle (*Falsistrellus tasmaniensis*)

The Great Pipistrelle is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*.

The Great Pipistrelle or Eastern False Pipistrelle is a wide ranging bat species distributed from south-eastern Queensland, in a strip down eastern NSW through to far south-west Victoria. It also occurs within Tasmania.

On the mainland the species inhabit sclerophyll forests. They prefer habitat where the trees are greater than 20 metres tall. Normally the species roosts in larger tree hollows in the higher rainfall forests within its range, as well as caves and abandoned buildings. The species roosts communally in small colonies ranging from 3 to more than 36 bats. Foraging is typically around or just below the canopy in open woodland or over water. Foraging movements can cover a large area of forest. Some populations migrate while others hibernate during the coldest months. Threats to this species include firewood and timber harvesting and subsequent loss of large hollow bearing roosting trees and predation by feral animals.

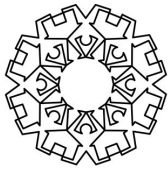
Habitat of importance - Intact tall forest or woodland community with old-mature structure components (eg. trunk and limb cavities)

Koala (*Phascolarctos cinereus*)

The Koala is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*.

The Koala occupies a vast but fragmented range in eastern Australia. While the harsh winter excludes it from the montane forests along the backbone of the Great Dividing Range it is widely distributed on either side. The species is dependent and closely associated with eucalypt forest and woodland and has local and regional preferences of feed trees. In the southern areas the preferred species are Manna Gum (*E. viminalis*), Swamp Gum (*E. ovata*) and Blue Gum (*E. globulus*); while Red Gums (*E. camaldulensis* and *E. tereticornis*), Tallwood (*E. microcorys*) and Grey Gum (*E. punctata*) are important in the north.

Koalas live in societies and are highly territorial. In stable breeding groups individual members of a koala society maintain their own home range areas. A home range varies in size depending on the habitat quality of bushland. Koala populations only occur if suitable habitat is available. Threats to the species include clearing, selective tree removal, grazing, disease, predation, shooting and road kills.



GEOLYSE

Habitat of importance - Broad areas of eucalyptus woodland or forest with adequate feed species. Intact and connective links between broken or fractured woodland areas. Natural fire regime. Low feral predator populations.

SEPP 44 Koala Habitat

The study area is located within the Lithgow Shire and is covered by State Environmental Planning Policy No. 44 – Koala Habitat Protection.

The woodland communities that are present across the study area have regions where the strata component is comprised of up to 15% of listed or regionally known feed tree species. Scribbly Gum (*Eucalyptus rossii*) and Ribbon Gum (*Eucalyptus viminalis*) are both present within the woodland communities of the slopes and ridges fringing the cleared pastureland and modified grasslands of the study area.

Ecological data within 20km of the study area indicates that areas in the region have potential koala habitat. Two listings are recorded for the locality. The closest sightings in the Wallerawang 1:100,000 Mapsheet area include a sighting from just north of the Lithgow urban area located approximately 3km to the south-east of the study area, and a sighting in the vicinity of the Zig Zag Railway, located approximately 6km to the south-east. Both sightings are located within open forest associated with Blue Mountains sandstone plateau vegetation types. These recorded sites are flanked or surrounded by broader forest areas.

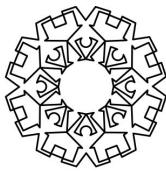
While the floristic composition of the tree stratum within the communities flanking the study area may potentially provide foraging resources for Koalas, no previous recordings or known evidence of presence has been recorded from the vicinity of the study site. There is no record of breeding females or evidence of a resident population in the immediate vicinity of the study area. Less accessible woodland communities containing preferred feed trees are linked to the study area. The woodlands present in the vicinity of the study area may provide koala populations with habitat.

Squirrel Glider (*Petaurus norfolcensis*)

The Squirrel Glider is similar to its more common relative, the Sugar Glider, but has a bushier, more softly furred tail and is almost double the weight. The underparts are white compared to the creamy-greyish colour of the Sugar Glider. An average adult Squirrel Glider is 48cm long, including the tail of 27 cm, and weighs 200-260 grams. Gliders have a fold of skin on each side of the body between the front and hind limbs, enabling them to glide through the air for up to 90 metres between trees.

The Squirrel Glider inhabits dry sclerophyll forest and woodland in south-eastern Australia where it is absent from the dense coastal ranges. However, in northern NSW and Queensland it occurs in coastal forest and in some wet forest areas bordering on rainforest. This species occurs in a variety of wet and dry sclerophyll forest types including open forest, low forests and woodlands. Forest Red-gums, Spotted Gums, Ironbarks, Box and Bloodwoods are often present in areas occupied by Squirrel Gliders.

The Squirrel Glider requires abundant hollow bearing trees and a mix of eucalypt, acacia and banksia within its home vegetation community.



GEOLYSE

Threats to this species include clearing, logging, grazing, feral predation and loss of genetic diversity (Ayres *et al.*, 1999). Retention of mature, hollow-bearing trees and the recruitment of young trees is important for this species.

Habitat of importance - Mature- old growth woodland/ forest with hollows and connective habitat. Good flowering events during winter of preferred feed species. Smooth barked eucalyptus within home vegetation community

Eastern Quoll (*Dasyurus viverrinus*)

The Eastern Quoll (*Dasyurus viverrinus*) is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*. The species once ranged over a large area of south-eastern Australia until a drastic decline in the early 1900's.

The species occupies a variety of habitats including sclerophyll forest, scrub, heathland, rainforest and can even include areas of cultivated land in its home range. In NSW the species occurs on both sides of the Great Dividing Range.

The species nests in rock shelters, small caves, hollow logs and tree hollows. It may utilise several den sites within its home range. The home range for this species has been estimated at between 80 ha and 20km² (NPWS, 1999).

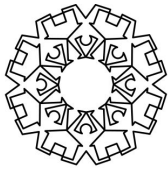
The species is an opportunistic carnivore, with insects and grubs making up most of its prey items. It also feeds on ground nesting birds and small mammals. Carcasses of larger animals are also scavenged. Threats to the species include clearing, fragmentation of habitat, loss of large hollow logs and den sites, predation by cat and fox, spread of disease, baiting and trapping.

Habitat of importance - Suitable den sites including large hollow logs, caves and rock outcrops. Abundance of prey items. Large areas of relatively intact native vegetation for foraging and dispersal.

Square-tailed Kite (*Lophoictinia isura*)

The Square Tailed Kite is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*. The Square Tailed Kite is found throughout the Australian mainland, primarily within 250 kilometres of the coast and only rarely occurs inland along wooded watercourses and in central Australia. The species breeds in south-western Australia and in wetter regions of southern and eastern Australia.

Their preferred habitat is open eucalypt forest and woodland. The species is typically solitary or occurs in well dispersed pairs on a broad home territory. The species is commonly associated with ridge and gully forests dominated by *Eucalyptus longifolia*, *E. maculata* or *E. elata* with a shrubby understorey. Pairs bond for life. Preferred nesting sites are along water-courses. The species build a large nest up to one metre in diameter, usually located on high horizontal branches between 12 to 25m above the ground. The species is a tree-top hunter, preying on small birds, insects and reptiles. It also robs nests, plucking young birds from their nests on the wing. The species is a buoyant and manoeuvrable flyer, occasionally soaring high on thermals. The species is threatened by agricultural associated clearing in preferred habitat, shooting and disturbance to nesting trees.



Habitat of Importance - Broad areas of eucalypt woodland and open forest with tall timbered watercourses.

Barking Owl (*Ninox connivens*)

The Barking Owl (*Ninox Connivens*) is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*. There are no published estimates for the abundance or population densities of the Barking Owl in NSW. For the species, breeding pairs may be spaced at <1km to 10km.

Breeding occurs from July-November. Nest holes are typically 20-25 cm deep in a trunk or spout of a tree at least 3m off the ground. Two to three eggs are laid and incubation takes 34-39 days. Young fledge in about seven weeks. The species inhabit well-forested hills and flats, Eucalypt savannas and Riverine woodlands. It can sometimes be found roosting in rainforests but requires more open country for hunting and hollow eucalypts for breeding.

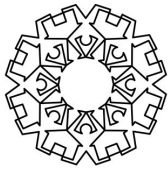
Habitat is typically dominated by eucalypts, often red gum species and, in the tropics, paperbarks *Melaleuca* species. It usually roosts in or under dense foliage in large trees including rainforest species of streamside gallery forests, River She-oak (*Casuarina cunninghamiana*), other *Casuarina* and *Allocasuarina* species, eucalypts, *Angophora* or *Acacia* species. Roost sites are often near watercourses or wetlands. It typically breeds in hollows of large eucalypts or paperbarks, usually near watercourses or wetlands.

The Barking Owl hunts opportunistically for terrestrial, arboreal and aerial prey between dusk and dawn and occasionally in daylight. The species feeds upon a variety of birds, mammals and large insects. It also preys on some of the common native and introduced birds such as rosellas and starlings, and eats many insects in the warmer post-breeding months. Vertebrates seem to be important in its diet during winter and breeding.

The Barking Owl prefers to hunt in woodland clearings, along waterways and other open spaces (Australian Museum, 2004). The species also takes prey from amongst canopy foliage and woodland floor. Rabbits are frequent prey items in rabbit-infested areas where there are few other suitably-sized mammals. The species prefers native arboreal mammals including small gliding possums, caught in the tree canopy.

Barking Owls are seasonal breeders, nesting in late winter or spring. The nest site is a large open hollow, often vertical or sloping, in the trunk or sometimes a spout of a eucalypt or *Melaleuca*. Fledged young can be seen with their parents from October to January. They are dependent on the adults for up to 4 months and begin to disperse at the end of summer.

Listed threats include habitat fragmentation, loss and degradation of temperate woodland areas, logging and firewood harvesting, predation by foxes and feral cat, owl mortality through collisions with barbed-wire fences, overhead wires and vehicles and poisons



Habitat of Importance - Mature forest and woodland habitat, in particular forest and woodland near rivers, streams, drainage lines and swamps. Substantial-sized forest or woodland blocks and smaller forest fragments within a few kilometres of larger areas of habitat are essential for breeding. Remnant forest connective to woodland vegetation along roads, tracks, creeks or paddock boundaries are important to maintain connectivity across the landscape.

Powerful Owl (*Ninox strenua*)

The Powerful Owl is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*. The Powerful Owl (*Ninox Strenua*) is the largest owl found in Australia, with an overall head-tail length of 60-65cm. Adults are mottled dark grey-brown above and white below, with bold grey-brown bars across the chest. The Powerful Owl can be identified by its characteristic double-note call. Occasionally, only a single note call, which is used to signal territory and to maintain contact with its mate, is used.

The Powerful Owl is concentrated along the forested coastal ranges of the eastern seaboard between Rockhampton in Queensland, south to the Victorian/South Australian border. It also occurs on the western slopes of the Great Dividing Range and in the drier box-ironbark forests and woodlands. Exceptional records from further inland are an indication that the species is able to move over long distances.

In Victoria, the Powerful Owl has been recorded from most of the eastern side of the Great Dividing Range and also from the adjoining inland slopes. The species favours denser vegetation, including rainforest, wet sclerophyll forest and forest with moist gullies. There are also records of birds roosting in softwood plantations. Throughout its range the Powerful Owl generally favours dense gullies for roosting and breeding sites. It prefers older forests where large tree hollows provide nesting sites and arboreal prey items are plentiful.

Nesting sites are located in large tree hollows, typically within or below the foliage. Trees selected for nesting are at least 50cm diameter and more commonly over 150cm in diameter. Nesting takes place in winter with the young remaining dependant for up to eight months of age. During February and March young owls disperse and establish new territories. The species is sedentary, living singly or in pairs, within a large permanent territory covering between 300ha to 1500ha in size. Territory sizes often depend upon the availability of prey.

The Powerful Owl is an opportunistic, nocturnal hunter that preys mainly on arboreal or semi-arboreal marsupials. Most prey items are hollow dwelling and require an intact shrub stratum. The Common Ringtail Possum, Sugar Glider and Brushtail Possums are often the primary prey species for the Powerful Owl. Birds, insects and some terrestrial mammals are also taken opportunistically, with some prey species being characteristic of open country; indicating that Powerful Owls may forage on forest margins. The owl forages throughout the mid-canopy, snatching prey from foliage and branches on the wing in banking swoops. The species requires approximately the equivalent of a large possum every two to three days to survive.

Threats to the species include clearing of forest and conversion to an open landscape, intensive forestry activities, intense wildfire, poisoning, disturbance and predation by foxes.



Habitat of Importance - Mature dense forest and woodland habitat with large hollow bearing trees. Substantial-sized forest and woodland blocks with intact lower stratum able to support adequate populations of prey.

Gang Gang Cockatoo (*Callocephalon fimbriatum*)

The Gang Gang Cockatoo (*Pyrrholaemus sagittatus*) is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*.

Gang-gang cockatoos are a relatively distinctive small cockatoo species. The birds are primarily slate-grey, with the males easily identified by their scarlet head and wispy crest. Their call has been likened to a creaking gate or cork being pulled from a bottle.

The Gang-gang Cockatoo is distributed from southern Victoria through south- and central-eastern New South Wales (NSW). In NSW, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. Isolated records are known from as far north as Coffs Harbour and as far west as Mudgee (Chambers, 1995).

In summer, the Gang-gang Cockatoo occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. The species may also occur in sub-alpine habitats. In winter, the Gang-gang Cockatoo occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. The species in general, and crèches of young birds in particular, undertake nomadic as well as seasonal movements and may occur at apparently random locations.

The species requires hollows in the trunks or large limbs of large trees in which to breed. Breeding usually occurs in tall mature sclerophyll forests that have a dense understorey, and occasionally in coastal forests. Nests are most commonly recorded in eucalypt hollows in live trees close to water.

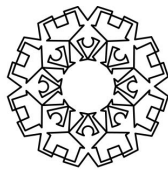
The Gang-gang Cockatoo has declined dramatically within NSW. The causes of this apparent reduction in the distribution and abundance are not precisely known. The late age at which it first breeds and the species' dependence and specificity in its preferences for tree hollows may have rendered it vulnerable to decline as a result of habitat loss and degradation.

Clearing of native vegetation, which is listed as a Key Threatening Process in Schedule 3 of the Threatened Species Conservation Act, and degradation of habitat e.g. as a result of altered fire regimes, reduces the availability of tree hollows and may reduce the abundance of optimum foraging and roosting habitat.

Habitat of Importance - Connective, well timbered forest to woodland with mature growth attributes.

Superb Parrot (*Polytelis swainsonii*)

The Superb Parrot (*Polytelis swainsonii*) is listed as Vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*. This slender, bright green coloured parrot species has a distinctively long tail and congregates in small groups throughout the year while foraging for seeds on the ground and also on eucalypt blossom.



The species occurs in central and eastern inland NSW and northern-central Victoria. Within NSW there are two main centres of breeding distribution. One concentration is in the Riverina district including Griffith, Wagga and Deniliquin, where birds may be present all year round. The second region occupies the south-west slopes region bounded by Cowra, Yass, Grenfell, Young and Coolac.

Superb Parrots are mostly active during early morning and late afternoon during feeding periods. The species is highly mobile and undertake distinct movements between breeding and non-breeding parts of its range each year. The species in the NSW south-west slopes region nests in eucalypt woodlands of either riverine woodland or Box/Gum woodland (Yellow Box/ Blakely's Red Gum/ White Box/Red Box) - typically prolific flowering eucalypts with copious nectar production. The species are also associated with grasslands and wheat-belt farming areas. Foraging sites during breeding season are closely associated with box woodland, riparian red gum forest or cereal crops. While foraging, the species may move up to 15km from the nest site. The species nest in a tree hollow or hollow limb spout, often at a great height. Breeding season is from September to December.

While the Superb Parrot may use broken remnants as corridors they rarely cross broad areas of open ground. The species is a swift and manoeuvrable flyer within woodland community. While foraging, small groups move through the tree tops and mid-stratum keeping in contact with a range of calls.

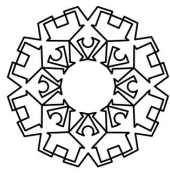
Threats to the species include clearing of woodland timber and remnants. Clearing impacts on food sources (particularly in riparian or box woodland), movement through corridors and nesting access by removal of mature hollow bearing trees. Other threats include habitat degradation by grazing, cultivation, nesting competition between parrots and other hole-nesters, illegal trapping and accidental death (eg. vehicle impact of birds feeding on spilt grain on roadsides).

Habitat of Importance - Mature and intact areas of riverine forest (including River Red Gum) and mature and intact connective areas of box/ gum grassy woodlands. Connective woodlands (for foraging) with suitable nesting hollows.

Swift Parrot (*Lathamus discolor*)

The Swift Parrot is listed as Vulnerable under Schedule 2 of the *NSW Threatened Species Conservation Act 1995*. The Swift Parrot (*Lathamus discolor*) is a small fast-flying, insectivorous parrot which occurs in eucalypt forests in south eastern Australia. Bright grass green in colour, the swift parrot has patches of red on the throat, chin and forehead, which are bordered by yellow. It gives a distinctive alarm call of 'kik-kik-kik' (usually given while flying), a streamlined body, long tail and flashes of bright red under the wing enable the species to be readily identified.

Swift Parrots breed in Tasmania and migrate to mainland Australia in Autumn. During Winter the parrots are semi-nomadic, foraging in flowering eucalypts mainly in Victoria and NSW. In Victoria, Swift Parrots are found in the dry forests and woodlands of the box-ironbark region on the inland slopes of the Great Dividing Range. In NSW the Swift Parrot forages in the western slopes region along the inland slopes of the Great Dividing Range and also uses forests on the coastal plains from southern to northern NSW.



The principal (over Winter) habitat on the mainland is the box-ironbark forests and woodlands inland of the Great Dividing Range in Victoria and NSW. Box-ironbark forest is a vegetation type dominated by yellow gum, red ironbark and grey box in central Victoria, and mugga ironbark and grey box in north-east Victoria and on the western slopes of NSW. The box-ironbark habitats occur across a range of landforms, but drainage lines account for a high number of foraging sites. A variety of grassy woodland vegetation types are also used in these areas including white box grassy woodland, grey box grassy woodland and grey box/yellow gum woodland. Certain forest types on the coastal plains along the eastern seaboard are also important foraging habitats. In lowland coastal forests of NSW Swift Parrots forage in flowering swamp mahogany, spotted gum and red bloodwood.

Habitat of Importance - Mature box Ironbark woodland and forests and mature box-grassy woodlands with favourable flowering resources. Connective woodland and forest areas to favourable foraging areas.

White-throated Needletail (*Hirundapus caudacutus*)

The White-throated Needletail (*Hirundapus caudacutus*) is listed as Migratory Terrestrial Species under *Environmental Protection and Biodiversity Conservation Act 1999*. The species is a large swift, often mistaken in flight as a small bird of prey.

While the White-throated Needletail breeds in the Northern Hemisphere, it migrates to the eastern edge of Australia in summer where it disperses to eastern highlands, coastal plains, offshore islands and intermediate hinterland. The moderately common species follows the eastern mountain chain of Queensland, NSW and Victoria from October and returns to the north in mid-March. The species is a fast, mobile flyer with keen eyesight even in twilight. The species breeds in northern Asia from May to August.

The species often occurs in large numbers over Eastern and Northern Australia. They spend a large percentage of their time on the wing, stopping to roost in trees. The species feeds predominantly on flying insects, often feeding in thermal currents above bushfires and storm-fronts.

Diamond Firetail (*Stagonopleura guttata*)

The Diamond Firetail (*Stagonopleura guttata*) is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*. It is a striking finch species with a bright red bill, and red eyes and rump. It has a grey back and head, and ashy-brown wings.

The Diamond Firetail is widely distributed across NSW, with a concentration of records from the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina. It is not commonly found in coastal districts.

The species is found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Eucalyptus pauciflora Woodlands, open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. It is often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. It has also been recorded in towns and near farm houses.



The species feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). The Diamond firetail is usually observed in flocks of between five to 40 birds. Groups separate into small colonies to breed, between August and January.

The Diamond Firetail is thought to be sedentary, with some populations moving locally, especially those occurring the south of the species range.

The nest is a globular structure built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. Birds roost in dense shrubs or in smaller nests built especially for roosting.

Habitat of Importance - Connective native vegetation with intact understorey strata comprised of shrubs and grasses.

Regent Honeyeater (*Xanthomyza phrygia*)

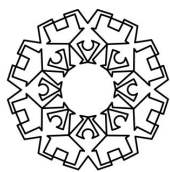
The Regent Honeyeater (*Xanthomyza phrygia*) is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*. The Regent Honeyeater is distributed through eucalypt woodland and open forest on both flanks of the Great Dividing Range, north to Brisbane and south-west to Bendigo. The species distribution is now extremely patchy.

This species occurs in a wide variety of habitat types. The Regent Honeyeater most commonly shows preference for box-ironbark woodlands and open forest. They occur frequently in broad valleys extending into timbered ranges. Other important habitat includes Swamp Mahogany forests and riverine She-oak (*Allocasuarina*) woodlands. The species is a specialist feeder with a diet comprising of nectar and arthropods'. The species has been recorded feeding on nectar in several key eucalypt species including Mugga Ironbark, White Box, Yellow Box, Yellow Gum and Blakely's Red Gum. Remnant stands of timber, roadside reserves, travelling stock routes and street trees also provide habitat for Regent Honeyeaters at certain times.

The species is highly mobile throughout the year with the exception of breeding periods. Many pairs breed in small remnants of open forest on farmland and roadside reserves. In Winter the species disperses widely in small groups to areas with plentiful foraging resources. In Spring they concentrate to the main breeding areas around Chiltern, Benalla area in Victoria and the Capertee Valley, Bundarra District and Warrumbungles in NSW. Other sites regularly visited include Canberra, Mudgee and Gosford areas in NSW. There is also evidence of a coast-ward movement during the non-breeding period, particularly when dry conditions prevail on the inland slopes of the Great Dividing Range (Environment Protection and Biodiversity Conservation).

Threats to the species include clearing of available habitat, lack of replacement regeneration and logging of box-ironbark woodland, removal of large-flowering eucalypts, competition with other honeyeater species and tree dieback.

Habitat of Importance - Mugga Ironbark, White Box, Yellow Box and Yellow Gum growing on fertile soils on gently sloping foothills and plains. Stands of these species growing on high quality sites are important for copious and predictable nectar production.



Black-chinned Honeyeater (*Melithreptus gularis gularis*)

The Black Chinned Honeyeater is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*. The eastern form of the Black-chinned Honeyeater is found predominantly west of the Great Dividing Range in a narrow belt through NSW into southern Queensland, and south into Victoria and South Australia where it occurs in eucalypt woodlands. In NSW, the species is mainly found in woodlands containing box-ironbark associations and River Red Gum. Black-chinned Honeyeaters are also known from drier coastal woodlands of the Cumberland Plain, Western Sydney and in the Hunter, Richmond and Clarence Valleys.

The species is a medium-sized green and white bird with a black head. The species builds compact, cup-shaped nests and feeds on arthropods, nectar and lerp from eucalypt foliage and bark. Black-chinned Honeyeaters were widely distributed and occurred naturally at low densities.

The species is threatened by clearance and the fragmentation of woodland habitat. As the species occurs at low densities and is only found in relatively large remnants or broad areas of woodland, this further exacerbates the species vulnerability.

Black-chinned Honeyeaters are likely to experience high levels of competition from aggressive honeyeater species such as Noisy Miners or White-plumed Honeyeaters. In addition, increased nest predation is expected from increasing populations of predators such as Pied Currawongs and Australian Ravens, particularly in smaller remnants.

Habitat of Importance – Connective woodland habitat with regular flowering events and insect populations. Foraging habitat with low populations of competitive and territorial bird species.

Speckled Warbler (*Pyrrholaemus sagittatus*)

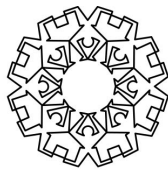
The Speckled Warbler (*Pyrrholaemus sagittatus*) is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*. The speckled Warbler is a small camouflaged woodland bird distributed along the south-eastern region of Victoria to central Queensland.

The species occurs in woodland habitat which possesses a moderately dense understorey of grasses and shrubs, often on rocky ridges and gullies. The species forages, nests and moves throughout the lower stratum of the community. It feeds on insects, larvae and other invertebrate of the leaf litter. The bird also feeds on seeds. Threats to the species include nest predation, grazing, kangaroos and rabbits, clearing for pasture and cropping and grazing.

Habitat of Importance - Eucalypt dominated vegetation with a moderately dense understorey comprised of shrubs and grasses.

Grey Crowned Babbler (*Pomatostomus temporalis temporalis*)

The Grey Crowned Babbler (*Pomatostomus temporalis temporalis*) is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*. The species is a highly gregarious species, forming close, noisy family groups.



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The eastern form of the Grey-crowned Babbler formerly ranged throughout eastern Australia from South Australia, through Victoria and broadly through NSW and central Queensland. The species is now extinct in South Australia, coastal Victoria and the ACT. In NSW, the Grey-crowned Babbler occurs on the western slopes and plains but was less common at the higher altitudes of the tablelands. Isolated populations are known from some coastal woodlands.

Grey-crowned Babbler habitat includes open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs, and an intact ground cover of grass and forbs. The species builds conspicuous dome-shaped nests and breeds co-operatively in sedentary family groups of 2-13 birds. Grey-crowned Babblers are insectivorous and forage in leaf litter and on bark of trees.

The Grey-crowned Babbler has declined in numbers and disappeared from large parts of its range.

The Grey-crowned Babbler is threatened by clearance and the fragmentation of habitat including removal of dead timber. The species occupies woodlands on fertile soils of plains and undulating terrain. Habitat degradation threatens Grey-crowned Babblers, particularly as a result of weed invasion and grazing by stock. Increased abundance of competitors, such as Noisy Miners, and nest predators, including the Pied Currawong and Australian Raven threaten Babbler foraging efficiency and breeding success.

Habitat of Importance - Broad, open forest and woodland with connective links to substantial remnants and islands. Intact shrubby and grass understorey components. Low predator and competitive species within habitat

Brown Treecreeper (*Climacteris picumnus*)

The Brown Treecreeper (*Climacteris picumnus victoriae* - eastern subspecies) is listed as a vulnerable species under the *Threatened Species Conservation Act, 1995*.

The eastern subspecies of the Brown Treecreeper is distributed through central NSW on the western side of the Great Dividing Range and sparsely scattered to the east of the Divide in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys.

The species is communal and sedentary. Small family groups may hold a large territory of 5-10 ha. The species spends a large amount of time foraging through ground litter, fallen logs and spiral up tree trunks feeding on insects, larvae and ants. The family group remain vocal during foraging, keeping in contact with each other.

Other treecreeper species that overlap in range with the Brown Treecreeper include the White-browed Treecreeper (*Climacteris affinis*) and the White-throated Treecreeper (*Cormobates leucophaeus*).

The Brown Treecreeper is a widely distributed species and can be locally common. It is found in the drier open forests and woodlands of eastern Australia. The species retains its home territory all year round. The Brown Treecreeper breeds from June to January each year. During this season pairs often have two broods of two to three young. The nest is a collection of grasses, feathers and other soft material, placed in a suitable tree hollow or similar site.



Threats include clearance and the fragmentation of woodland habitat, removal of dead timber, habitat degradation, loss of hollow bearing trees, grazing by stock in woodland areas, increased competition with aggressive honeyeater species and increased levels of nest predation that are a consequence of fragmentation of habitat (NPWS, 11/01).

Habitat of Importance - Mature trees in open eucalypt woodland communities with intact ground stratum components (eg. leaf litter, ground logs etc). Remnant forest and woodland vegetation adjacent to large wooded areas to allow for species dispersal and access to habitat diversity.

Macquarie Perch (*Macquaria australasica*)

This species is a moderate sized fish of the cooler upper reaches of the Murray-Murrumbidgee River system and south eastern coastal streams. It is found in at least two western NSW impoundments, Wyangala and Burrinjuck, and several impoundments in the ACT. It has also been reported in the Barmah Lake system.

The Macquarie Perch is a moderate-sized fish growing to 46 cm and 3.5 kg, but commonly not more than 20-25 cm and 1.5 kg. It varies in appearance from almost black or dark silvery grey to bluish grey to pale grey-brown.

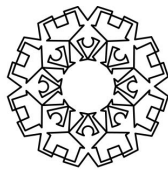
The Macquarie Perch is a riverine, schooling species. It prefers deep, rocky holes with considerable cover. Spawning occurs just above riffles (shallow running water). Populations may survive in impoundments if able to access suitable spawning sites.

Macquarie Perch inhabiting reservoirs undertake an upstream spawning migration in mid spring to early summer when waters temperatures reach c. 16.5°C. Migration may not be necessary in stream dwelling fish.

Insects and their larvae form a substantial part of the diet of this species. The species is basically a bottom feeder and only takes a small proportion of its food at the water surface.

Threats to the species include silts of spawning sites, competition from introduced fish and blocked migration routes by dams and weirs.

Habitat of importance - Streams in relatively good condition. Deep, rocky pools with good overhead cover.



Future Planning Considerations

5.1 INTRODUCTION

It is expected that any future development would progress with ecological assessment carried out on a site by site basis while also considering the cumulative impact of development throughout the area over time.

The primary ecological aim of any development within the Marrangaroo study area would be to maintain or improve the terrestrial and aquatic biodiversity of the area by protecting remnant vegetation, providing adequate buffers between development and sensitive habitat and enhancing native habitat.

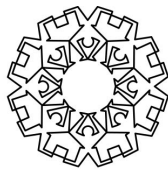
5.2 DEVELOPMENT CONSTRAINTS

Woodland edge buffer zones of a minimum 25 metres should be established between development areas and native bushland adjoining broader woodland and forest communities. This buffer zone may need to be increased following specific ecological site assessment to protect specifically sensitive vegetation or habitat. The internode between open pastureland and woodland is an important habitat resource for many native species. Locally significant species including the Gang Gang Cockatoo, Bathurst Copper Butterfly, Regent Honeyeater and Brown Treecreeper are known to occur in this habitat type.

The Marrangaroo Creek course should be protected by a minimum buffer zone of 50 metres from either side of the channel with allowance for native vegetation associated with the riparian corridor. This would serve to protect the existing structure of the woodland corridor associated with the creek and lower impact upon movement, foraging, refuge and aquatic habitat.

Prominent drainage depressions, unnamed creeks and feeder streams should be protected by a minimum 20 metre buffer either side of the course. This buffer zone would serve to protect the Marrangaroo Creek catchment. Opportunities may exist to establish wetland retention basins on farm dam, soaks and spring sites within smaller drainage channels.

Future planning should incorporate small open woodland pockets, clumps of scattered trees and 'fingers' of native vegetation into the development design. Future planning for compensatory plantings and rehabilitation areas would aim to develop green belts throughout the development area and enhance existing movement corridor and buffer zones. Drainage courses and feeder streams across existing pasturelands provide a good basis for rehabilitation and green belt establishment.



5.3 HABITAT AND NATIVE VEGETATION BUFFER ZONES

Much of the Marrangaroo study area is characterised by open agricultural or residential lands bounded by a woodland fringe. This woodland is often associated with less arable soils or topography and consists of regrowth and small areas of remnant vegetation.

Often, the zone at where cleared land and woodland meet has a clearly defined edge, however impact and degradation of native communities is greatest at this boundary. This degradation is caused by a number of factors including easier access by grazing stock, weed ingress, feral animals, tree and understorey removal, hazard reduction burns, changes in hydrology, erosion, rubbish dumping and irresponsible earthworks. Impacts and disturbances are reduced further into the bushland areas, especially where access becomes limited or difficult due to vegetation or topography.

Fringing native vegetation on the study area has been effected by all of these impacts. Main degradation factors include weed invasion and grazing impact.

Habitat degradation of the woodland fringe from many of these factors is likely to continue with future development of the study area. Certain habitats including gully woodland and creek corridor habitat are likely to be more sensitive to disturbance from any future development. The protection of woodland and creek corridor areas requires conservation of a surrounding area of vegetation to act as a buffer zone. Habitat within the buffer zone may already be impacted, but such a buffer will serve to protect more sensitive areas, providing it is wide enough.

On the Marrangaroo study area much of the open land/ woodland interface has been modified, however the role of fringing woodland as a buffer-zone and habitat resource cannot be overlooked. In areas where broad areas of bushland front pastureland or modified grassland, fringing vegetation provides potential movement resources for significant species such as the Regent Honeyeater, Superb Parrot, Black-chinned Honeyeater, Microbat species and the Barking Owl. This fringing vegetation also provides significant foraging refuge and home-range for species including the Copper Butterfly, Gang Gang Cockatoo, Brown Treecreeper and Microbat species.

Minimum buffer zones should be established to protect these habitats and communities. Recommended minimum buffers from distinct open woodland/ woodland fringes should be at least 25 metres wide. A recommended buffer-zone around riparian corridors should be a minimum 50 metres wide. Feeder streams should have a minimum 20 metre buffer-zone either side of the channel. These recommended zones should be regarded as minimum recommended distances, with site appropriate buffer zones delegated in response to further refinement of any plans and subsequent survey. These appropriate zones would need to be assessed on a site-by site basis. Recommended buffer areas may need to be increased in certain areas of the study area to take account of significant micro-habitat, local topography or riparian corridor condition. Management of buffer areas would primarily serve to manage adjoining habitat. It is likely that these areas would require sympathetic management in order to return sites to a better ecological condition. Management may require control of weeds, feral animals, policing improper use (ie. dumping, trail bike riding) and fire hazard control.



5.4 FUTURE SURVEY EFFORT

This study provides an overview of the ecological communities and the potential for significant species to use or occur within the area. The identification of significant sites which may provide habitat resources for species or contain significant flora and fauna requires site by site assessment through field surveys by a qualified and experienced ecologist and botanist.

Assessment would be required for any area proposed to be developed which contains native vegetation, or occurs on the fringe of a native vegetation community.

5.5 CATCHMENT PROTECTION

The primary catchment of the study area is that of Marrangaroo Creek. The study area encompasses several shallow feeder streams and deeper drainage depressions. Immediately upstream and downstream of the study area, the Marrangaroo catchment is bounded and protected by native woodland and sandstone escarpment communities and is likely to provide habitat to rare and sensitive flora.

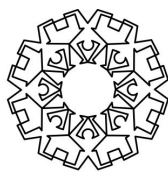
Part of the Marrangaroo study area catchment is located on open pastureland and residential land. The primary creek course is protected for some of its length by a narrow, broken riparian woodland zone, however grazing practices continue into the wetted channel.

The potential development of the study area is likely to modify the hydrological characteristics of the catchment. Greater areas of runoff, concentrated catchment and modified drainage works and modification to the natural topography of the area occur as a result of urban development to a natural landscape. As a result, downstream areas can be subject to concentrated and elevated flow regimes with the potential for subsequent contamination and erosion hazards.

Development of the study area would necessitate addressing all potential impacts on the whole of the catchment, during and after the development phase. This includes carrying out monitoring and implementing water management programs both on and off site. This is important for the viability and welfare of species and communities that rely on the catchment.

Any area of development should aim to protect and enhance the existing natural waterways both within and downstream of the study area. Key strategies to achieve this include the retention or establishment of a continuous zone of native vegetation along streams with suitable setback zones for development. Water flow and quality in streams need to be maintained to allow stream biodiversity to be retained.

These strategies may require the design and construction of wetland retention basins and ponds on secondary feeder streams to control runoff pollution from development areas, protection of waterways and feeder streams from grazing stock and weed invasion.



5.6 WEEDS AND FIRE

Weeds are often associated with site clearing and development. The ground flora across the study area is largely influenced by exotic pasture-related plants, prolific common native species and exotic weed species. Areas of disused and poorly managed land are commonly infested with species such as Blackberry, English Broom, Radiata Pine and Phalaris. These areas include roadsides, rail-easements, creek channels and patches of the woodland/ pastureland fringe.

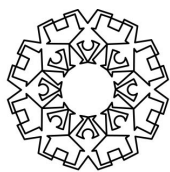
Weed invasion associated with development may be potentially caused by physical site disturbance, increased or changed moisture levels and runoff, increased nutrient caused by runoff, clearing of canopy stratum and increase in the physical distribution of weed seeds.

Weed control measures would need to be undertaken as part of any future development to ensure that environmental impacts are minimised. Different measures would be required across different sites, especially along watercourses. Regular monitoring is also required during and post development and should be included as part of routine care for buffer zones and important habitat. The processes involved in implementing weed control are also varied. A proven process is the local establishment and involvement of bushcare groups or the community fostering of specific catchment areas.

Several noxious weed species were identified from the study area. The following table lists all noxious weed species listed for the Lithgow LGA and indicates species observed on the study area.

Table 5.1 - Noxious Weeds of Lithgow LGA

Common Name	Scientific Name	Category	Detected On/ Adjacent To Site
African boxthorn	<i>Lycium ferocissimum</i>	W2	X
African love grass	<i>Eragrostis curvula</i>	W3	
Alligator weed	<i>Alternanthera philoxeroides</i>	W1	
Bathurst Noogoora Californian Cockle burrs	<i>Xanthium spp.</i>	W2	X
Black knapweed	<i>Centaurea nigra</i>	W1	
Blackberry	<i>Rubus fruticosus (agg. spp.)</i>	W3	X
Broomrape	<i>Orobancha spp.</i>	W1	
Cabomba	<i>Cabomba spp.</i>	W4g	
Columbus grass	<i>Sorghum x alnum</i>	W2	
Dodder	<i>Cuscuta campestris</i>	W2	X
Gorse	<i>Ulex europaeus</i>	W2	
Green cestrum	<i>Cestrum parqui</i>	W2	



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Table 5.1 - Noxious Weeds of Lithgow LGA

Common Name	Scientific Name	Category	Detected On/ Adjacent To Site
Harrisia cactus	<i>Harrisia spp.</i>	W4f	
Hawkweed	<i>Hieracium spp.</i>	W1	
Hemlock	<i>Conium maculatum</i>	W2	
Horsetail	<i>Equisetum spp.</i>	W1	
Johnson grass	<i>Sorghum halepense</i>	W2	
Karoo thorn	<i>Acacia karroo</i>	W1	
Kochia	<i>Kochia scoparia</i>	W1	
Lagarosiphon	<i>Lagarosiphon major</i>	W1	
Longstyle feather grass	<i>Pennisetum villosum</i>	W2	
Mexican feather grass	<i>Nassella tenuissima syn Stipa tenuissima</i>	W1	
Miconia	<i>Miconia spp.</i>	W1	
Nodding thistle	<i>Carduus nutans</i>	W3	
Pampas grass	<i>Cortaderia spp.</i>	W2	
Parthenium weed	<i>Parthenium hysterophorus</i>	W1	
Prickly pears	<i>Opuntia spp.</i>	W4f	
Privet - broadleaf	<i>Ligustrum lucidum</i>	W4b	
Privet - narrowleaf	<i>Ligustrum sinense</i>	W4b	
Rhus tree	<i>Toxicodendron succedaneum</i>	W2	
Salvinia	<i>Salvinia molesta</i>	W1	
Scotch English broom	<i>Cytisus scoparius</i>	W2	X
Senegal tea plant	<i>Gymnocoronis spilanthoides</i>	W1	
Serrated tussock	<i>Nassella trichotoma</i>	W3	
Siam weed	<i>Chromolaena odorata</i>	W1	
Silverleaf nightshade	<i>Solanum elaeagnifolium</i>	W2	
Spiny burrgrass	<i>Cenchrus incertus</i>	W2	
Spotted knapweed	<i>Centaurea maculosa</i>	W1	
St John's wort	<i>Hypericum perforatum</i>	W3	X
Star thistle	<i>Centaurea calcitrapa</i>	W2	

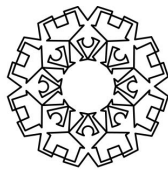


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Table 5.1 - Noxious Weeds of Lithgow LGA

Common Name	Scientific Name	Category	Detected On/ Adjacent To Site
Sweet briar	<i>Rosa rubiginosa</i>	W3	X
Tree of heaven	<i>Ailanthus altissima</i>	W2	
Water hyacinth	<i>Eichhornia crassipes</i>	W1	
Water lettuce	<i>Pistia stratiotes</i>	W1	
Wild radish	<i>Raphanus raphanistrum</i>	W2	
Willows	<i>Salix spp.</i>	W4g	X
Key:			
Category	Description		
W1	W1 The presence of the weed on land must be notified to the local control authority and the weed must be fully and continuously suppressed and destroyed.		
W2	W2 The weed must be fully and continuously suppressed and destroyed.		
W3	W3 The weed must be prevented from spreading and its numbers and distribution reduced.		
W4a	W4a The weed must not be sold, propagated or knowingly distributed and any part of the weed must be prevented from growing within 3 metres of the boundary of a property.		
W4b	W4b The weed must not be sold, propagated or knowingly distributed and any existing weed must be prevented from flowering and fruiting.		
W4c	W4c The weed must not be sold, propagated or knowingly distributed and the weed must be prevented from spreading to an adjoining property.		
W4d	W4d The weed: (a) must not be sold, propagated or knowingly distributed; and (b) must be fully and continuously suppressed and destroyed unless it is: · listed on the state heritage register under the Heritage Act 1977; listed for preservation or protection as a heritage item under an Environmental Planning Instrument under the Environmental Planning and Assessment Act 1979; listed for preservation or protection in a tree preservation order of the council for the Local Government area; · included for preservation or protection in a Plan of Management for a local government area under section 40 of the Local Government Act 1993; or · included for preservation or protection in a noxious weed policy or a noxious weed control program approved by the local control authority for the area for which it is the local control authority.		
W4e	W4e The weed must be fully and continuously suppressed and destroyed. All reasonable precautions must be taken to ensure produce, soil, livestock, equipment and vehicles are free of the weed before sale or movement from an infested area of the property.		
W4f	W4f The weed must not be sold, propagated or knowingly distributed. Any biological control or other control program directed by the local control authority must be implemented.		
W4g	W4g The weed must not be sold, propagated or knowingly distributed.		

Source: <http://www.agric.nsw.gov.au>



Fire has been an important factor in the community structure of the woodlands and forest communities surrounding the study area. Fire has been largely suppressed from the open pastureland areas and isolated woodland islands of the study area.

The fire ecology of sandstone vegetation defines life-cycles and long-term survival of various native species and populations. Plant species diversity is generally maintained with a moderate fire intensity, summer to autumn fire occurring in native vegetation at intervals of between 10 to 30 years. Priority will always be given to the protection of life and property, however the maintenance and conservation of important flora and fauna habitat surrounding the study area using local bushfire risk management plans should be considered.

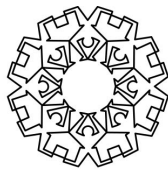
5.7 FERAL ANIMALS

The strong influence of residential areas, agricultural areas, the woodland/ pastureland fringe and publicly accessed infrastructure and roads has increased the populations of introduced species and feral predators throughout the study area. Several species were recorded across the site during field reconnaissance including fox, cat, dog, pig, goat and rabbit. Introduced predator species threaten native species populations and can cause localised native species extinctions especially on small woodland bird, reptile and mammal populations.

Other introduced species such as pig and rabbit can degrade habitat by removal of plant species, damage to vegetation, ground-surface damage, spread of weed species and spread of disease.

Programs should be instigated with an understanding of feral populations and the existing native communities that serve to control all pest animals across the study area.

This includes control programs for foxes and feral cats and strict regulation on cat and dog ownership within the study area. Wildlife within the broad areas of natural bushland adjacent to the site has the potential to be significantly impacted by increases in both feral and 'domestic' cat numbers often associated with urban development. It is strongly recommended that a substantial effort is made to educate the public on the environmental problems associated with cats and that local council adopts a policy that restricts the keeping of domestic cats so close to the bushland fringe.



5.8 LAND REHABILITATION, HABITAT CORRIDORS AND GREEN BELTS

The protection of important habitat, riparian corridors and established buffer zones should not rest on the exclusion of development from these areas. Active development should also aim to promote the rehabilitation of disturbed and degraded land, and where possible increase the extent of native communities and habitat in the area.

Key areas to be considered for future rehabilitation include:

- Gaps and narrows in the vegetation of the Marrangaroo Creek channel, especially where it crosses open agricultural land;
- Areas which have been inappropriately cleared in the past such as prior wet or swampy land;
- Steep slopes prone to surface erosion; and
- Gaps within important bushland corridors or between important bushland 'islands'.

'Locally genetic' seed banks or plant material would preferably be used for all revegetation and restoration work. Regeneration areas should be maintained and monitored for at least 12 months after establishment, removing weeds and maintaining adjacent bushland. Natural regeneration should be encouraged through suppression of weeds, surface preparation and exclusion of stock.

Compensatory planting programs should be initiated where suitable nominated land is revegetated with locally indigenous species to compensate for the loss of vegetation from the site.

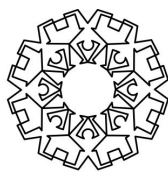
Revegetated or rehabilitated areas can also be planned and designed to improve corridor and movement habitat. Links between areas of previously broken bushland in the area play an important role in increasing the mobility of fauna populations through the landscape.

Smaller pockets of open woodland within a developed area serve to provide resident native species with refuge, foraging and movement. They also protect and increase levels of biodiversity within degraded systems. Retained smaller islands or timber also contribute significantly to the landscape character. Areas of woodland islands exist on the study area, primarily along drainage depressions and as narrow fingers of bushland extending from broader woodland communities. The retention of this vegetation is important, especially if existing species are mature and representative of original parent vegetation units.



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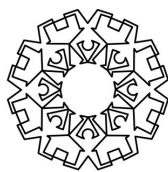
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Appendix C

CONSULTATION LETTERS & AGENCY CORRESPONDENCE



CITY OF LITHGOW COUNCIL

180 Mort Street, Lithgow, NSW, 2790. Telephone: (02) 6352 1077
ABN: 59 986 092 492

SMH : MAJ

Contact: Environmental Services

18 January, 2006

Dear Sir/Madam

MARRANGAROO LAND USE STUDY/LOCAL ENVIRONMENTAL STUDY

It is advised that Lithgow City Council is currently undertaking a Land Use Study/Local Environmental Study over 1,100 ha of land in the Marrangaroo locality. The land is located five minutes from the Lithgow CBD between the urban centres of Lithgow and Wallerawang and is dissected by both the Great Western Highway and Rail line. The area has mixed existing land use including residential, rural pursuits, motel, service station, defence ammunitions depot, light industrial and past mining activity. Other notable uses in the area are the Lithgow Correctional Centre and the Trout Farm Tourist facility. The area is held in a large number of fragmented ownerships, predominantly private. The study area is shown on the attached map.

The purpose of the project is to identify the "highest and best use" of the lands in terms of its suitability and capability, the community's needs and expectations, environmental impact and the efficient and economic allocation of resources to service the land. Given the significant development pressures currently being experienced, the Study may recommend zoning alterations to facilitate future land use. Although this request for comments/information does not formally represent a S.62 (EP & A Act, 1979) Consultation, it would be appreciated if you could provide comments as if it were to ensure that all relevant matters are considered within the Study and at an early stage of the planning process. It will also expedite any possible future rezoning proposal to respond to any identified needs. Please note formal S.62 Consultation will occur if and when necessary at a later date.

Council has engaged the Consultant firm Geolyse P/L to undertake this project on Council's behalf.

Council is seeking any comments/information your Department may have on matters relevant to the preparation of the land use study/local environmental study and the potential future development of the land.

A stakeholders meeting for government authorities and public agencies will be held on Thursday, 2 February 2006 at the Lithgow City Council chambers, 180 Mort St Lithgow. The meeting has been scheduled for 10.00am – 12 noon and a light lunch will be provided. Your attendance at, and RSVP for this meeting would be appreciated.

Address Correspondence to: General Manager, PO Box 19, Lithgow, 2790
Fax No.: (02) 6351 4259 • Email: glcc@lithgow.nsw.gov.au
Website: www.lithgow.com

As Council and the Consultant have a tight timeframe in which to deliver the land use plan, it would be appreciated if you could provide any written comments no later than 16th February, 2006 to ensure that all matters are considered early in the planning process.

In the event that this letter has been sent to the wrong department/section or officer of your department, it would be appreciated if you could let Council know to ensure it and future correspondence of this type reaches its intended recipients.

Please do not hesitate to contact Mr Ian Rufus who is available personally on (02) 63549913, Monday to Friday, in Council's Environmental and Planning Services Division should you require any additional information in relation to this matter. In the absence of Mr Rufus you may contact Mr Andrew Muir on (02) 63549918.

Yours faithfully



Mr Andrew Muir
Manager of Environmental and Planning Services

for Mr Paul Anderson
GENERAL MANAGER

Government Authorities and Infrastructure Providers invited to comment on the Local Environmental Study for Marrangaroo

- Aboriginal Land Council
- Agility
- Australian Rail Track Corporation Ltd
- Bathurst Regional Council
- Central West Region NSW State Emergency Service
- Centre for Population Health Sydney West Area Health Service
- Department of Defence
- Department of Education and Training
- Department of Environment and Conservation
- Department of Planning
- Department of Primary Industries
- Department of Primary Industries (Fisheries)
- Department of Primary Industries (Forests)
- Department of Primary Industries (Minerals)
- Department of State and Regional Development
- Hawkesbury/Nepean Catchment Authority
- Integral Energy
- Mid West Regional Council
- NSW Ambulance Service
- NSW Fire Brigade
- NSW Heritage Office
- NSW Police Service
- Roads and Traffic Authority Regional Office
- Rural Lands Protection Board
- State Water Corporation
- Sydney Catchment Authority
- Telstra Group

16 February 2006

Manager of Environmental and Planning Services
City of Lithgow Council
PO Box 19
Lithgow NSW 2790

Attention: Mr Andrew Muir

Dear Sir,

Re: Marrangaroo Land Use Study/ Local Environmental Study

Agility acknowledges your letter and subsequent plans dated 18 January 2006, and would like to thank Council for the opportunity to comment on the local environmental study area.

To confirm, Agility is a wholly owned entity of the Australian Gas Light Company (AGL) and manages portfolios related to AGL Gas Networks (AGLGN) and the Australian Pipeline Trust (APT) of which AGL has a 30% stake. Agility has an interest in the above documentation and would like to provide you with some comments in reference to your future development strategy:

- ◆ AGLGN own and operate natural gas reticulation infrastructure required under the NSW Gas Supply Act 1996 with operating pressures as required to supply the community in the Greater Lithgow LGA. Agility can provide further details of the reticulation network on request.
- ◆ The Young to Lithgow high-pressure natural gas pipeline is owned by APT and operated by Agility. This pipeline operates under licence 17 (identified by DP 499029 & DP 499040) which is issued under the legislative provisions of the NSW Pipelines Act 1967. The pipeline is located in a 20 metre wide easement. The 150mm ID pipeline operates at 9930 kPa maximum allowable operating pressure and is the major gas transmission supply to the Central West of New South Wales. It is operated in accordance with the current Australian Standard AS2885. See attached alignment sheet.
- ◆ The APT natural gas metering station and AGLGN pressure regulation station are situated adjacent to the Great Western Hwy on Lot 2 DP251361. These two facilities are operated by Agility. These two facilities are collectively known as the Lithgow Trunk Receiving Station (TRS).

The Young to Lithgow pipeline and the Lithgow TRS were constructed in accordance with Australian Standards for high pressure pipelines. The design of these assets incorporated safety measures that were commensurate with the existing land use. Any proposal to increase the current land use or population density of the area adjacent to the pipeline or TRS (within a 300 metre radius) would increase the safety risk to society. This risk is associated with the potential for a release and ignition of high pressure natural gas from the pipeline or the TRS.

To formally assess any change in land zoning and subdivisional prospects, a pipeline risk assessment is necessary to evaluate the risk to society, and identify mitigation measures. AS-2885 provides an established framework for the development of these types of risk assessments. The assessment considers the potential for events that may lead to the loss of containment, interruption of supply or damage to the environment. In the case of loss of containment the specific issues of gas release rates and measures to prevent rupture as outlined in the soon to be released Australian Standard AS2885. 2005.

When Lithgow Council are considering and planning proposed developments adjoining to the gas pipeline, the following guidelines on pipeline safety, operational and maintenance issues need to be considered:

1. The pipeline integrity and safety must be ensured from damage arising from potential third-party activities both during and in the post project construction period. As the pipeline is a single feed to the Central West region, the reliability of supply is paramount.
2. There are multiple agencies crossing the pipeline and the easement. Potential pipeline failure of either pipeline will have the knock-on effect on the other pipeline. The consequent effects may include human injury, property damage, environmental harm and loss of supply.
3. Pipeline operations requires the pipeline and easement must be kept clear for surveillance, pipeline inspection and testing, and emergency responses.
4. Structures that are to be planned on the easement including buildings, fences, sheds, trees etc are to be submitted in writing to Agility for approval.
5. Other civil services such as roads, drainage, utilities, subgrade infrastructure and design considerations that are proposed within the pipeline and easement corridor must be approved by Agility in writing. Agility would prefer that any infrastructure crossing of the easement is made perpendicular to the pipeline alignment.

We trust that the above information will be of assistance to you in your planning of future development within your local government area. Agility is willing to meet with your representatives to discuss this further.

Should you require further information please do not hesitate in contacting either myself on 8977-6911 or Mr James Maldon, Senior Land Services Officer on 8977 6534.

Yours Faithfully

Chris Butler
Land Services Manager
Agility Management Pty Ltd



AUSTRALIAN RAIL TRACK CORPORATION LTD

General Manager
City of Lithgow Council
180 Mort St
Lithgow NSW 2790

Via email: glcc@lithgow.nsw.gov.au

Attention: Mr Andrew Muir

RE: Marrangaroo Land Use Study/Local Environmental Study

Thank you for the referral of the above matter for our comments and for the extension of time provided to complete our submission.

Under the Country Regional Network Management Agreement signed in September 2004, Australian Rail Track Corporation Ltd (ARTC) acts as agent to the NSW Government for the management of certain non metropolitan railway lines in NSW.

This includes the Main Western Line beyond Bowenfels (east of that location, RailCorp is responsible). The proposed Land Use Study/LES area adjoins the Western line between rail references 161.500 km and 164.000 km.

We have reviewed the study area and request that the following issues be addressed in the study.

1. Level Crossings – Government and ARTC policy

Level crossings represent a significant safety risk to passengers, train crews, pedestrians and motor vehicle occupants – with regard to safety alone; grade separation is preferable to a level crossing.

It is NSW Government policy to minimise the number of level crossings on the State's rail network. Level crossings are closed and removed at every opportunity.

Within the study area, ARTC notes that clause # 13 and 14 of Development Approval for DA 426/03 (217 lot residential subdivision) specifies that a new road overbridge be provided at developer's cost. Once this alternate access is provided, the Oakey Forest Road level crossing is expected to be closed.

2. Noise and Vibration

ARTC needs to ensure appropriate land use and planning considerations are considered when new developments in the vicinity of the rail corridor are assessed. Occupants of the land, both residential and commercial, adjoining the rail corridor may encounter rail-related noise and vibration. Rail-related vibration can jeopardise structural integrity and residential comfort. To ameliorate its effects early in the development process, ARTC recommendations should be considered together with noise attenuation measures as part of the DA procedure. ARTC recommends that Council encourage applicants of any development, especially residential subdivisions near rail corridors, to seek advice on rail-related noise and vibration at the design stage from qualified acoustics and structural engineers.

The RailCorp publication *Rail Related Noise and Vibration; Issues to Consider in Local Environmental Planning - Development Applications and Building Applications* provides information on likely noise and vibration impacts and preventative measures. Chapter 3 of the publication recommends the guidelines for council policy in preparing LEPs, which complies with the mitigation of rail-related noise and vibration standards.

In reviewing development application notifications, the following would be a typical response where noise and vibration needed to be addressed in the DA conditions for the proposed development. In summary:



ARTC is concerned that the future occupants of the development will encounter rail-related noise and vibration from the adjacent rail corridor. Rail noise and vibration can seriously affect residential amenity and comfort, and jeopardise the structural safety of buildings, and should be addressed early in the development process.

ARTC have published the following documents as part of a joint initiative aimed at managing rail noise and vibration impacts associated with development near the rail corridor:

Interim Guidelines for Councils – consideration of rail noise and vibration in the planning process. This aims to assist local government in considering and assessing rail noise and vibration as part of their strategic planning and development control functions.

Guidelines for Applicants - consideration of rail noise and vibration in the planning process. This aims to assist those involved in the planning and design of developments near the rail corridor.

These documents are available at: www.railcorp.nsw.gov.au/about_railcorp/environmental_guidelines

In assessing the application, Council is encouraged to adopt the recommendations given in Part B – Development Assessment Process of the Guidelines for Councils.

Should the development be within 60 metres of an active rail corridor, and it is Councils opinion that the development, as designed, is likely to be significantly impacted upon by Rail noise and vibration, then Rail requests the following clause be inserted in the conditions of consent.

An acoustic assessment is to be submitted to council prior to the issue of a construction certificate demonstrating how the proposed development will comply with ARTC Interim Guidelines for Applicants in the consideration of rail noise and vibration from the adjacent rail corridor.

Note: Section 11 of the Guidelines for Councils provides recommended conditions of consent for specific development categories such as multi-unit residential within the acoustic assessment area. Council should extract the relevant conditions from this section and insert in the development consent.

In addition to noise and vibration clauses, ARTC wishes to advise that other key issues can impact on rail corridor. These include drainage and appropriate fencing.

3. Drainage

ARTC wishes to advise that run-off or stormwater discharge from development sites onto the rail corridor is unacceptable, both during and after construction and installation. Any run-off or waste arising from the development activities needs to be properly disposed of and must not be allowed to enter onto the rail corridor unless prior agreement has been reached with ARTC.

ARTC looks to Council to ensure that stormwater is not diverted onto the rail corridor as the result of developments. Alternatively, Council may choose to impose one of the following conditions of consent (ARTC will specify which clause is appropriate):

- *Given the site's location next to the rail corridor, drainage from the development must be adequately disposed of/managed and not allowed to be discharged into the corridor unless prior approval has been obtained from ARTC.*
- *During excavation the Applicant is to observe extreme care to prevent water from collecting on or near ARTC infrastructure. It is possible that if water were to pond adjacent to the infrastructure, services could be interrupted. If this were the case, the applicant/contractor would be liable for the ARTC expenditure involved with restoring or maintaining alternative services.*

4. Fencing

To ensure that unauthorised entry into the rail corridor is prevented from an adjoining development, ARTC may request Council to impose one of the following conditions of consent:



A Standard Condition:

- *The existing common boundary fence is considered adequate and must remain intact throughout the construction works and thereafter. Should enhancements be desired Rail must be contacted to ensure adequate safety measures are taken whilst work is carried out.*

B Standard Condition:

- *The current fencing separating this development from the rail corridor is to be replaced with a 2 metre high fence at the Developer's cost. Details of the type of fencing and the method of erection are to be submitted to ARTC for review and comment prior to the fencing work being undertaken. ARTC will provide supervision for the erection of the new fencing.*

C Standard Condition:

- *To ensure that graffiti can be easily removed, that fencing along the rail corridor is to be coated with anti-graffiti paint or other coating.*

D Optional Condition:

- *If development is to occur at this site, the current [stock] fence must be replaced to prevent unauthorised entry onto the rail corridor. Currently, there is already a high rate of vandalism/high incidence of trespass on ARTC's Facilities and this will likely increase as more homes are built in the area. Rail will require the erection of 1.8 metre security fence along the boundary of the rail corridor and this should be done at the developer's cost as a condition of consent.*

5. Heritage Structures

The disused viaduct and the operational viaduct at Marrangaroo are both on ARTC's s170 Heritage Register and the State Heritage Register.

The curtilage includes the structures and extends for a distance of 20 metres in all directions.

The s170 also includes the former railway formation between Newnes Junction and Sodwalls, i.e. around Marrangaroo this includes the approaches to the aforementioned disused viaduct and the formation and disused tunnel beneath the Mudgee Road (just outside the study area).

6. High Voltage transmission line

ARTC wishes to advise of the existence of a RailCorp 66 kV transmission line, which is outside the rail corridor managed by ARTC, in parts of the study area. For information about this matter, please contact RailCorp.

Thank you for consulting ARTC on this matter and please contact me if you have any further questions. I look forward to seeing the draft LEP on public exhibition.

Should you require further information, please don't hesitate to contact me.

Yours faithfully

A handwritten signature in blue ink, reading 'Derek J. Rogers', is positioned above the printed name.

Derek Rogers

Development Planning Officer, Sydney

10 March 2006

Plan of the ARTC Arrangements in NSW

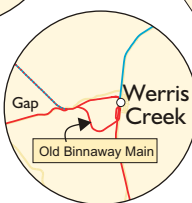
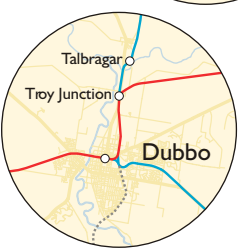
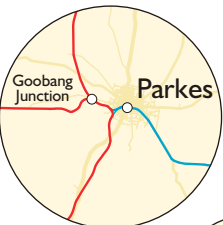
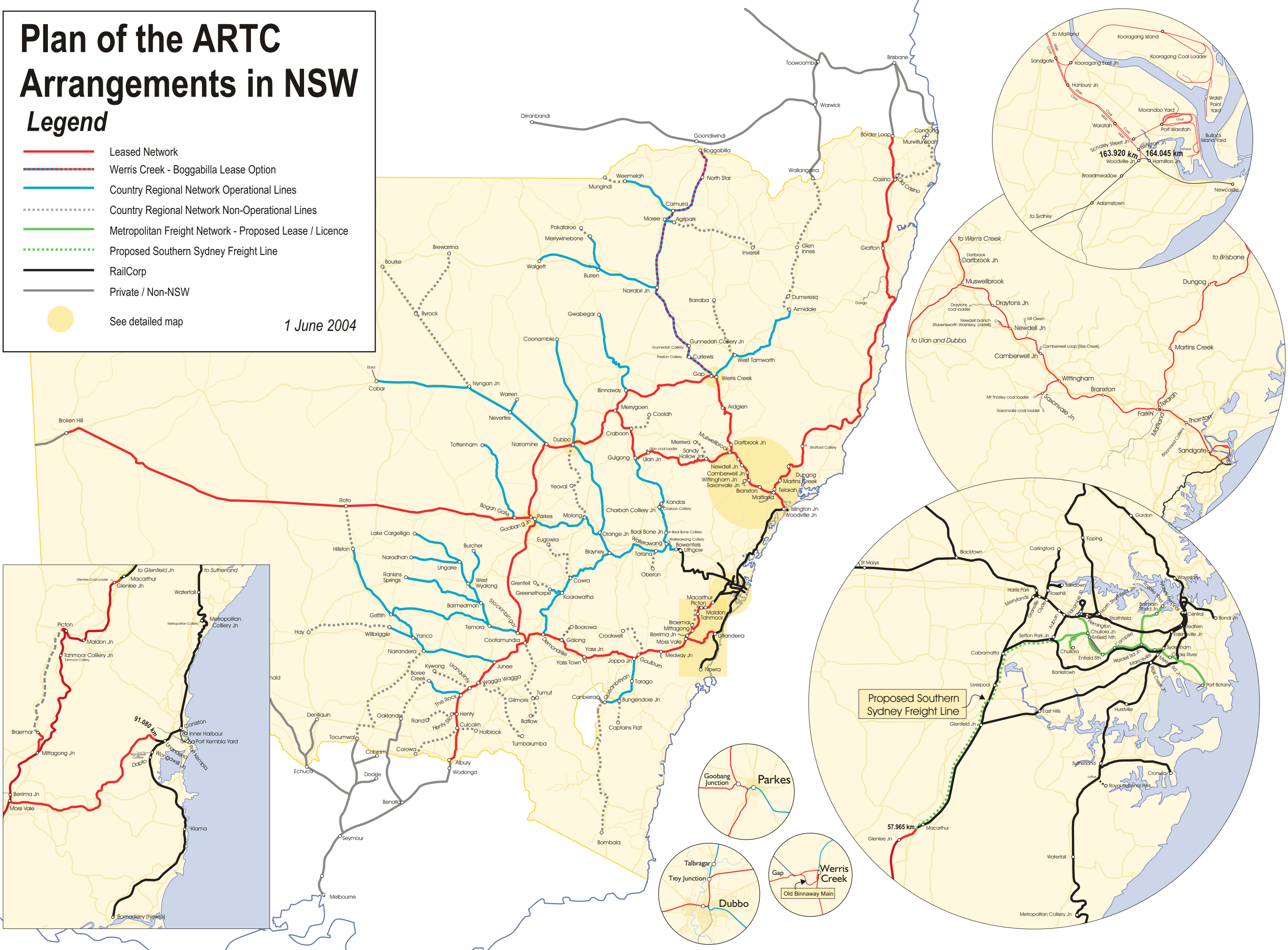
Legend

- Leased Network
- Werris Creek - Boggabilla Lease Option
- Country Regional Network Operational Lines
- Country Regional Network Non-Operational Lines
- Metropolitan Freight Network - Proposed Lease / Licence
- Proposed Southern Sydney Freight Line
- RailCorp
- Private / Non-NSW



See detailed map

1 June 2004





Australian Government
Department of Defence

**Corporate Services and
Infrastructure - Sydney
West / South**

Level 3, Interdell Building
Corner George and Scott Streets
Liverpool NSW 2170

Tel: +61 2 8777 5124
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2006/1018776/1
CSI - SWS/OUT/2006/14

13 February 2006

Mr Andrew Muir
Manager of Environmental and Planning Services
City Of Lithgow Council
PO Box 19
Lithgow NSW 2790

Dear Mr Muir,

MARRANGAROO LAND USE STUDY/LOCAL ENVIRONMENTAL STUDY

I refer to your letter of 18 January 2006, seeking comment on a Land Use Study/Local Environmental Study over 1,100 ha of land in the Marrangaroo locality. The eastern portion of the study area is land managed by the Department of Defence.

The Defence land is essentially used as a tri-service explosive ordinance training area. It also accommodates an Army Reserve unit, a cadet unit and a small closed training area. The site is utilised for Defence activities throughout the year. The time and frequency of Defence activities can fluctuate depending on operational requirements.

Noting that Defence training results in the generation of noise and vibration, Defence is concerned that the redevelopment of the study area could result in urban encroachment on Defence's land and subsequent complaints from future residents.

Defence requests any redevelopment of the study area to incorporate appropriate buffers and offsets from Defence land. Furthermore, Defence recommends that Section 149 Certificates for future lots identify that the land is subject to noise and vibration from Defence activities.

Yours sincerely,

Warren Smith
Property Manager
CSI – SWS
(02) 8777 5125



Department of
Environment and Conservation (NSW)

now incorporating the Environment Protection Authority

Your reference : SMH:MAJ
Our reference : 260261A17
Contact : Chris Marshall

The General Manager
City Of Lithgow Council
PO Box 19 Lithgow 2790

North West Branch

8 February 2006

Attention: Ian Rufus

Dear Ian,

I refer to Council's letter dated 18 January 2006 seeking comment on **Marrangaroo Land Use Study/Local Environmental Study (LES)**.

Please note that, although the Environment Protection Authority (EPA) is now a part of the Department of Environment and Conservation (DEC), certain statutory functions and powers continue to be exercised in the name of the EPA.

The DEC also has responsibilities, which were formerly administered by the NPWS, under the:

- *National Parks and Wildlife Act 1974* - namely the protection and care of Aboriginal objects and places, the protection and care of native flora and fauna and the protection and management of reserves; and the
- *Threatened Species Conservation Act 1995*, which aims to conserve threatened species of flora and fauna, populations and ecological communities to promote their recovery and manage processes that threaten them.

The DEC generally focuses its assistance to Council on planning matters at the landscape and whole of council level with particular attention to studies, strategies and local environmental plans (LEP). It is able to assist Council in these matters with guidance on relevant issues to be addressed and as well as providing direction on the relevant state policy and statutory frameworks to be applied.

In the context of the proposed Marrangaroo LES area the DEC is able to provide you with the following advise.

Integration

The LES should clearly demonstrate how existing and proposed land use at Marrangaroo integrates with the settlement and land use strategies for the whole of the Lithgow Council area. The DEC is aware that Lithgow City Council is about to begin to develop a new whole of Council land use and settlement strategy and it is currently not clear how the Marrangaroo LES will relate to this broader framework.

It is essential that the LES establish a clear case for any extension of settlement and development in the Marrangaroo area. Such a case, if it does exist, should be based on the validity of the opportunities within the context of managing the values of the area to achieve a clearly established long-term vision for settlement and development in Lithgow Council areas well as the wider region.

Values Based Planning.

In preparing the LES, you are strongly encouraged to engage the community in the clear definition of the values they hold for Lithgow in general and in particular the locality of Marrangaroo. Engagement in this process will help the community to define and understand the issues that need to be addressed in the LES and will help build community support for the outcomes of the LES. A consistent focus and promotion of these values throughout the process will ensure that the community sees how their values shape the debates as well influencing the trade-off and offset decisions in the planning process and any Local Environmental (LEP) amendment or Development Control Plans (DCP) that may flow from that LES.

In particular the DEC recommends that Council effectively engage it's Aboriginal community during this process to identify it's particular values. The DEC is able to assist with advise on how to communicate with the Aboriginal community as well as how to carry out an Aboriginal Cultural Heritage Regional Study.

The LES should provide a clear picture of the current status and trends of the community values in relation to development.

The DEC strongly recommends that the LES provide map-based direction for development, formed around objectively stated criteria for opportunities that emerge from the process. This will involve the identification of areas and items of natural and cultural heritage value and the application of appropriate management arrangements to protect these values. Such a map-based approach should also include a clear priority statement for the protection of these areas.

Natural and Cultural Heritage

Natural Heritage

The DEC recommends recognition of biodiversity in the LES as a fundamental value to be protected and enhanced.

The DEC can supply fauna prediction data and recorded fauna sightings data to assist. Please refer to the attached guidelines in Attachment 1 for information on accessing this data. Specific information regarding Threatened Species can now be accessed at the website www.threatenedspecies.environment.nsw.gov.au.

Aboriginal Cultural Heritage

In addition to the previously advised matter of consulting with the Aboriginal community and preparing a regional study of Aboriginal cultural value, it is essential that the Aboriginal heritage within the area is conserved and appropriately managed within the statutory mechanisms that currently apply, including the planning and approvals process and the *National Parks and Wildlife Act 1974*

You may wish to enter a data license agreement with DEC to access the AHIMS (Aboriginal Heritage Information Management System), formerly known as the Sites Register database. This will allow you to determine the location of, and general information about, currently recorded sites in the area. Please refer to the attached guidelines in Attachment 2.

The DEC also suggests that you consider the publication "Aboriginal Cultural Heritage: Standards and Guidelines". This may be purchased by contacting the DEC Cultural Heritage Division on (02) 9585 6571.

Environmentally Sensitive Lands

The DEC recommends that you specifically identify environmentally sensitive land within the LES area and define appropriate protection measures for them including:

- DEC estate
- Remnant native vegetation
- Public land, particularly crown land with existing native vegetation
- All wetlands, creek lines and land within 100 metres of rivers
- Threatened species, populations, communities and their habitats
- All potential archaeological sites and Aboriginal objects and places
- All wildlife corridors, roads and reserves containing native vegetation
- All significant scenic landforms
- All flood-prone lands

The DEC also recommends the Biodiversity Planning Guide for NSW Local Government (2001) which can be accessed from the following website of the NSW Local Government Association <http://www.lgov.org.au/site/policy/1000150/1000165.html>. The Guide explains how to achieve biodiversity conservation objectives using existing planning processes and instruments, and includes suggested conservation mechanisms such as zoning provisions.

It is important that the LES address the relationship of the values associated with these matters in the study area to those in the both neighbouring lands and the wider region. Your attention is drawn in particular to nearby DEC estate at Mount Walker as well as Gardens of Stone and Wollami National Parks. Guidance on development matters adjoining DEC land is provided in Attachment 3.

Regulating Pollution

The DEC is particularly concerned that effective zoning and development control occurs in relation to land uses adjoining and nearby to existing and potential scheduled activities under the Protection of the Environment Act (POEO). This will ensure that those scheduled activities can be effectively regulated by way of environment protection licence through the DEC. Licensed activities such as quarries already exist within the study area and potential exists for other developments that will require sensitive siting and protection from conflicting land use. A list of POEO licences in the area of the Lithgow City Council can be found at, <http://www.environment.nsw.gov.au/prpoeo/searchregister.aspx>

Further, the DEC is the Appropriate Regulatory Authority (ARA) for council premises, including those considered below the threshold required for POEO licensing purposes. Consequently the DEC requires that careful consideration be given to potentially problematic premises in terms of potential neighbour conflicts, in particular sewage treatment plants and landfills including both existing and planned.

The DEC is aware that Council also has an important responsibility as an ARA under POEO and will have similar concerns with land uses that may involve them as ARA are effectively located by the planning process to avoid potential problems for Council in that role.

Other Specific Environmental Protection Issues

You should also ensure that the following specific issues are addressed in the LES:

- The protection of surface water quality and river flow regimes in the context of government endorsed, environmental values. The specifics of these environmental values can be accessed at: [http, //www.planning.nsw.gov.au/programservices/pdf/hawkesbury_final.pdf](http://www.planning.nsw.gov.au/programservices/pdf/hawkesbury_final.pdf)
- The specifics of groundwater quality management can be accessed at www.dlwc.gov.au/care/water/wr/pdfs/quality-policy.

The LES should demonstrate clearly how proposed development and settlement changes at Marrangaroo would contribute to protecting or achieving these endorsed environmental values.

- The reduction and management of waste.
- The management of on site sewage in the context of the Environment & Health Guidelines - On-Site Sewage Management for Single Households. *Department of Local Government. February 1998.*
- The identification and management needs of any land contamination as defined in the Planning Guidelines SEPP55 –Remediation of Land.
- The relationship of settlement pattern changes to existing land use and the management needs to address potential neighbour conflicts over such issues as noise, dust, odour and chemical use.
- The management of site and soil disturbance and associated pollution hazards during development and with expected ongoing land use.
- The management of any other pollution hazards in relation to development sites.
- The definition of flooding extent and frequency on potentially affected land in terms of environmental sensitivity.

I trust you find this submission of assistance with your project and would appreciate it if you could keep the DEC informed of its progress and of opportunities to input and assist. If you have any further enquiries regarding this matter please contact me at the Bathurst Office of the DEC by telephoning (02) 63327603.

Yours sincerely

Chris Marshall
Senior Regional programs Officer
Environment Protection & Regulation Division
Department of Environment and Conservation

NSW DEPARTMENT OF ENVIRONMENT AND CONSERVATION

GUIDELINES FOR DEVELOPMENTS ADJOINING DEC LAND

These guidelines have been prepared by the NSW Department of Environment and Conservation (DEC) for use by Councils when assessing development and/or building applications on land which adjoins or impacts on land managed by the DEC. It is anticipated that the application of these guidelines will mean that Council will need to refer fewer Development Applications adjoining DEC land to the Department for comment.

The DEC manages land reserved or dedicated under the *National Parks and Wildlife Act 1974* and includes areas such as National Parks, Historic Sites, Wilderness areas, Nature Reserves, Regional Parks and State Recreation Areas.

Council's should consider the following issues when assessing proposals adjoining DEC land:

- Corridor Values,
- Erosion and Sedimentation,
- Stormwater Runoff to DEC Land,
- Management Implications and Impacts,
- Fire,
- Boundary Encroachments, and
- Visual Impact

This should be in addition to a consideration of the potential impact of a proposal on native fauna, native flora, threatened species and Aboriginal heritage, and the potential that these attributes will occur on the adjoining DEC land, and may be indirectly impacted by a development proposal.

The potential for cumulative impacts from developments along DEC boundaries should be considered in addition to case by case considerations.

1. Corridor Values

Vegetated areas adjoining DEC land play a complimentary role in providing essential linkages for the maintenance of biodiversity and minimise potential edge effects on DEC land. The vegetated areas may have a role in maintaining the viability of local populations and species as well as providing valuable wildlife refuge areas.

It is recommended that the corridor values or connective importance of any vegetation on the subject land be considered. Development in areas of native vegetation adjoining DEC land can often result in fragmentation of habitat corridors or isolation with other areas of native vegetation in the locality.

The DEC prefers that vegetation on adjoining land that exhibits these corridor values should be retained and, where necessary, rehabilitated.

2. Erosion and Sedimentation

Removal of vegetation and disturbance of groundcover from construction activities will expose the soil and increase the risk of erosion. Erosion of sediments may subsequently be transported downstream into DEC land and deposited into creeks, rivers, wetlands and other aquatic habitats.

Changes to the hydrological behaviour of streams outside the reserve system can impact on lands managed by the DEC. Developments may change the hydrology by increasing the intensity and frequency of flows as a result of clearing vegetation and increasing the area of impermeable surfaces. This can result in damage to downstream aquatic habitat by scouring the bed and banks of water courses. Developments may also cause a concentration of flows thereby increasing erosion potential downstream.

Accordingly, appropriate erosion and sedimentation control measures should be implemented prior to construction and be maintained for the duration of construction. In some cases, it will be necessary to prepare detailed sediment and erosion control plans (soil and water management plans) for the proposed development.

The DEC suggests that clearance of native vegetation be kept to a minimum, areas of vegetation be fenced off during construction and disturbed areas be rehabilitated and stabilised as soon as possible following construction.

3. Stormwater Runoff to DEC Land

The DEC considers the discharge of stormwater to areas of DEC land poses a threat to downstream environments by dispersing weed propagules, altering the nutrient composition and pollutant levels and potentially causing erosion and sedimentation within watercourses. The discharge of stormwater may also impact on Aboriginal sites, which are frequently located in close proximity to water courses. These potential impacts from stormwater have a range of implications for management of DEC land including weed eradication and site rehabilitation.

The DEC considers that:

- development proposals for areas adjacent to DEC land should incorporate stormwater detention systems, on the subject area, to minimise stormwater discharge rates and prevent localised erosion; and
- Councils should assess alternatives to discharging polluted stormwater to DEC lands.

The design of the stormwater treatment measures should be based on treatment objectives that are commensurate with the values of the downstream environment. Where stormwater does enter DEC lands 'best practice' stormwater treatment measures should be utilised to maximise on-site pollutant retention and removal and infiltration and sub-surface discharge of stormwater. In some cases it may be necessary to prepare a stormwater management plan for the proposed development.

The DEC advises that the stormwater detention requirements of the Council shall apply, unless those requirements allow a higher rate of discharge than that calculated using the following criteria:

- stormwater detention systems shall limit the post-development flow resulting from a rainfall event with intensity corresponding to a 1 in 100 year Average Recurrence Interval, to the flow which would result from a pre-development rainfall event with intensity corresponding to a 1 in 5 year Average Recurrence Interval. Rainfall intensities shall comply with *Australian Rainfall and Runoff, 1987*.

Stormwater quality shall comply with the *Protection of the Environment Operations Act 1997*. Sedimentation control shall comply with the state government endorsed Department of Housing publication 'Managing Urban Stormwater – Soils and Construction' to prevent sediment flowing from that property onto DEC estate.

As a general rule, infrastructure associated with stormwater treatment should not be located on DEC land and stormwater outlets shall disperse the flow over an area equivalent to that which would occur pre-development. Proposals where stormwater treatment measures are proposed within DEC land are subject to assessment under Part 5 of the *Environmental Planning and Assessment Act, 1979* and approval by the DEC.

4. Management Implications and Impacts

Development adjoining DEC land has the potential to affect the operation or management of DEC land. Adjoining development may place additional pressure on maintenance of access, management of Aboriginal sites, weed management and pest control. Development may result in increased informal and inappropriate access (eg trail bikes), disturbance from domestic pets, the spread of exotic weeds and impacts to the amenity of DEC lands. These impacts may have significant conservation and resource implications for the management of DEC land.

In assessing proposals, Councils should consider the impacts associated with development adjoining DEC land. The Department considers that site layout and design should seek to minimise any adverse environmental impacts on DEC land.

Public and DEC staff access to DEC land should not be compromised by adjoining developments.

The DEC recommends consideration of the establishment of an appropriate buffer between any development and DEC land. Where managed effectively, a buffer may minimise the impact to conservation values of DEC land.

Where a buffer is not available, consideration should be given to developing appropriate conditions that minimise the potential edge effects from development or building. This might mean planning the development around a particular stand of vegetation, siting a building back from the DEC boundary or recommending a suitable type of boundary fencing.

5. Fire

For any proposals adjoining DEC land, Councils will need to undertake an assessment of the fire risk, in accordance with the guidelines *Planning for Bushfire Protection NSW Rural Fire Service and Planning NSW December 2001*. The assessment should address appropriate fire management practices for the area. Councils should also ensure that the provisions of the *Rural Fires and Environmental Assessment Legislation Act 2002* and the *Rural Fires Act 1997* are implemented within the area proposed for development. Further consultation with the NSW Rural Fire Service may be required regarding this particular matter.

The DEC does not support clearing within DEC land for the creation of fuel reduced zones to protect adjoining development. Accordingly, appropriately designed fire protection zones and firefighting access tracks should be located on the land proposed to be developed.

6. Boundary Encroachments

Councils should ensure that where a proposal shares a common boundary with DEC land, the subject boundary has been accurately surveyed to ensure there is no encroachment to DEC land as a result of the proposed development.

7. Visual Impact

Councils should take into account the visual impact of development adjacent to DEC land to ensure that it is sympathetic with the bushland surrounds and does not impact upon the recreational amenity of users. This may include measures such as landscaping with local native plant species, implementing buffer areas and use of appropriate colours and building materials.

For Further Information

For further information please contact:

Senior Regional Programs Officer
Bathurst Region
Department of Environment and Conservation
P.O. Box 1388
Bathurst NSW 2795

Ph - (02) 63327603

ENVIRONMENTAL ASSESSMENT GUIDELINES FLORA AND FAUNA

INTRODUCTION

The *Environmental Planning and Assessment Act (1979)* (EP&A Act) requires that proponents of a development/activity and the Consent/Determining Authorities adequately assess the impact of a development or activity in any Environmental Impact Assessment (EIA) documents. These EIA documents include:

- Statement of Environmental Effects (SoEE), or
- Review of Environmental Factors (REF), or
- Environmental Impact Statement (EIS).

These are introductory, generic specifications of the Department of Environment and Conservation (DEC) for an adequate assessment of the impacts of a development proposal on native flora and fauna (ie including protected and threatened species). However, the DEC recognises that the scale and complexity of the project will to some extent, dictate the level of information that is required to address the questions posed below. Consequently, flora and fauna assessments need to be tailored to suit the proposal. For example, a development which is proposed on land which has already been totally (or substantially) cleared should address the issues raised below but the amount of work required to address these issues may be substantially less than if the area comprised undisturbed bushland and, therefore, of more significant wildlife habitat value. A preliminary assessment, including a desktop investigation and a preliminary site inspection, may indicate the need for a detailed survey of the site.

Aboriginal cultural heritage and archaeological sites may still be present on substantially disturbed areas and appropriate assessment of these is required. (Please refer to separate Cultural Heritage Assessment Guidelines included.)

It is up to the proponent (and later the consent and/or determining authorities after appropriate consultation) to determine the detail and comprehensiveness of assessment required to form legally defensible conclusions regarding the impact of the proposal. The scale and intensity of the proposed development should dictate the detail of investigation.

It is important that all conclusions are supported by adequate data and that these data are clearly presented in EIA documentation.

The DEC will consider the following issues when reviewing an EIA document:

1. **Concerns** - What are the DEC's concerns regarding the conservation of natural and cultural heritage in accordance with the relevant legislation? Is the proposal likely to affect natural and cultural heritage? How?
2. **Provision of Information** - Is adequate information provided for a valid assessment of the impacts?
3. **Validity of Conclusions** - Has the proponent arrived at valid conclusions as a result of the assessment of impacts?
4. **Recommended Conditions to Consent** - Should Consent or Approval be granted, what conditions (if any) are required to ensure that the project is developed, and thereafter managed in accordance with natural and cultural heritage conservation and the provisions of legislation administered by the DEC?

Thus the EIA document should fully describe the existing environment including flora and fauna, so that future impacts can be properly assessed and then reviewed (eg during the public participation phase).

FLORA

Background

The Australian flora comprises many endemic taxa and is therefore unique in the world.

The DEC is concerned at the extent to which vegetation has been cleared and otherwise modified in Western NSW. This high level of modification has been highlighted in the National State of the Environment Reports (1996 and 2001). Evidence strongly suggests that many plant species and communities are threatened with extinction.

Although the proposed site may be disturbed by various landuses, any remnants of native vegetation are of significant natural heritage value, including riparian and wetland areas. The area of vegetation and habitat at the proposed site may provide an area of high biological diversity, high conservation value or may not be well represented or protected elsewhere. It may also act as a corridor or migratory route for wildlife, drought refuge habitat or have other important values.

The NSW community places a high value on those areas of native vegetation that remain. The DEC is committed to the protection, appropriate management, and where necessary, rehabilitation of native vegetation. For these reasons, the DEC considers that careful planning should precede any development that involves further vegetation clearance or other significant impact within areas of remnant vegetation.

Report Requirements

The EIA documentation should include a report on the flora that includes the following:

- detailed location map and identification of the area surveyed (including the location of photographs, transects, areas of significance etc),
- at least one of the following: a land satellite image, vegetation communities map, aerial photograph, or a remnant vegetation map,
- a complete plant list (including scientific names of those plants) of all tree, shrub, ground cover and aquatic species, categorised according to country of origin (ie., native vs exotic),
- a detailed description of vegetation structure (in terms of a scientifically accepted classification system) and spatial distribution (i.e. plant densities and patterning) on the site, including a vegetation map,
- describe the condition and integrity of the vegetation including a description of any past disturbance,
- an account of the likely original vegetation communities (pre-, or at early settlement), and an assessment of the likely regional distribution of the original communities,
- an assessment of whether the plant communities are adequately represented in conservation reserves or otherwise protected,
- an account of the hydrology of the area and how this relates to the dynamics of the vegetation communities,
- a list of **known** and **likely** threatened species as listed under Schedules 1 & 2 (*Threatened Species Conservation Act 1995*) which might occur at the site. The DEC database needs to be accessed and the likelihood of occurrence of threatened flora species determined,
- an assessment of the impacts of the proposal on flora, on-site and off-site (eg siltation, water availability or drainage changes) and measures to mitigate these impacts,
- an assessment of the significance of the impact of the development at both the site and at the regional scale,
- a detailed rehabilitation/management plan including a list of the plant species to be used during rehabilitation (if required),
- detail methodologies used and a list of the reference literature cited, and
- any other issues that may be considered relevant.

The above guidelines will provide some of the information necessary to conduct an 'Eight Part Test of Significance' required for threatened flora and fauna under Section 5a of the *EP&A Act*, should threatened species be likely or known to occur in the locality of the subject development proposal. Similarly, it will provide some of the information required if an application is found to be necessary under the *Native Vegetation Conservation Act (1997)*. However the above relates mostly to the specific environmental assessment processes under the *EP&A Act* and does not constitute an 'Eight Part Test of Significance'.

Native Vegetation Conservation Act (1997)

The DEC wishes to stress that the proponents will need to consider the provisions of the *Native Vegetation Conservation Act (1997) (NVC Act)*. If the proposal involves the clearing of native vegetation it may require the consent of the Director General of Land and Water Conservation.

The *NVC Act* also allows for Regional Vegetation Committees to create Regional Vegetation Management Plans that will set guidelines for vegetation management in each region. Please contact the Department of Land and Water Conservation if the proposed development is in one of these Regions or if you have any other queries regarding the *NVC Act*.

FAUNA

Background

Evidence suggests that Western NSW has suffered the highest extinction rate for indigenous mammals of any region in the world. Many other vertebrate species are currently threatened. One of the major reasons for such a high level of extinction has been the destruction of habitat. Native vegetation including wetland, riparian and remnant environments, are very significant areas of fauna habitat. Therefore any development in such areas should fully consider the impact on fauna and its habitat.

Report Requirements

The EIA document should include a report on the fauna (including protected and threatened species), that includes the following:

- detailed location map and identification of the area surveyed (including the location of photographs, transects, areas of significance etc),
 - at least one of the following: a land satellite image, vegetation communities map, aerial photograph, or a remnant vegetation map,
 - a complete list of all **known** and **likely** terrestrial and aquatic species (eg birds, mammals, reptiles and amphibians including scientific names). It is suggested that invertebrates also be considered as they form part of the food chain for many fauna species,
 - those species which are protected, threatened or listed under any international agreements, as well as introduced species,
 - those species known or likely to breed in the area,
 - any species which have specific habitat requirements found within the project area,
 - those species or populations which may be near the limit of their geographic range or are a disjunct/isolated population,
 - assessment of the importance or otherwise of the location as a corridor, migratory route or drought refuge, in relation to other remnant vegetation, riparian and wetland areas or habitat in the region,
 - assessment of the impacts of the proposal on all fauna and its habitat, at both the site and at the regional scale,
-
- identification of any mitigation measures proposed to limit or ameliorate the impact of the proposal,

- detailed methodologies used and a list of the reference literature cited, and,
- any other issues that may be considered relevant.

SEPP No. 44 - Koala Habitat Protection

The Shire may be listed in Schedule 1 of SEPP No. 44 - Koala Habitat Protection. If so, the requirements of the SEPP regarding Koala habitat protection should be considered by the proponents.

THREATENED SPECIES OF FAUNA AND FLORA

Background

Apart from the need to consider the impact on protected species, the proponent will need to address the requirements of legislation that currently governs threatened species protection and impact assessment in NSW.

The *Threatened Species Conservation Act (1995) (TSC Act)* protects all threatened flora and fauna native to NSW (excluding fish and marine plants). The proponent will need to consider the provisions of this Act.

The *TSC Act* contains lists of threatened species, which are divided into 5 categories – those presumed extinct, endangered species, endangered populations, endangered ecological communities and vulnerable species. This Act also allows for the declaration of critical habitat, key threatening processes and the preparation of both Recovery Plans and Threat Abatement Plans. These listings and plans must be considered as part of the EIA process.

If an activity or development is proposed in a locality likely or known to be occupied by a threatened species, population, ecological community or critical habitat, any potential impact to that threatened species must be taken into account during the development assessment process. However under the *EP&A Act*, some types of development are not required to go through approval processes. Please note that a licence may still be required under the *TSC Act* if such a development/activity is likely to harm a threatened species, population or ecological community. An information circular (*'Threatened Species Conservation Act 1995'*) is available from the Western Directorate for detailed information about the *TSC Act*.

Eight Part Test & Species Impact Statements

If during the flora or fauna assessment or survey, threatened species are **found** or are **likely** to occur in the area, the proponents must undertake an 'Eight Part Test of Significance' as outlined in section 5A of the *EP&A Act* to determine whether or not the development would be likely to have a significant impact upon threatened species.

The '8 Part Test' is a statutory mechanism which allows decision makers to assess whether a proposed development or activity is likely to have a significant effect on threatened species, populations or ecological communities, or their habitats.

The '8 Part Test' is contained within section 5A of the *EP&A Act* and consists of eight factors which need to be addressed for informed decisions to be made regarding the effect of a proposed development or activity on threatened species, populations or ecological communities, or their habitats. An information circular ('Threatened Species Assessment under the EP&A Act: The 8 Part Test of Significance') is available from the Western Directorate for detailed information about the '8 Part Test'.

Following threatened species assessment via the '8 Part Test', it may be necessary to prepare a Species Impact Statement (SIS). The proponent will need to prepare a SIS in the following circumstances:

- If (after having addressed Section 5A) the flora/fauna assessment concludes that there is likely to be a significant impact to threatened species, or
- The proposed development is likely to affect critical habitat declared under the TSC Act.

If a SIS is required, the proponent (not the consultant) must write to the Director-General of DEC for any formal requirements for the SIS that he might deem appropriate. The SIS must then be prepared in accordance with these requirements and provided to the Director-General. In some instances the Minister for the Environment will also need to be consulted for approval. An information circular ('Species Impact Statements') is available from the Western Directorate for detailed information about this assessment.

Methods to reduce the impact on the protected and threatened species should be considered fully, and are considered an integral requirement within any SIS document.

The DEC advises that conducting an '8 Part Test' or a SIS according to the provisions of the *EP&A Act* and the *TSC Act* is a complex task and should be undertaken by suitably qualified person(s).

AVAILABLE DATA

The DEC can supply, at the standard cost, fauna prediction data and recorded fauna sightings data (Wildlife Atlas of NSW) to help in the investigation.

The following information on site recordings of Flora and Fauna is available from DEC:

- Atlas of NSW Wildlife (1995). A DEC database containing records of fauna and flora, including threatened species. Computer print-outs for all records on a 1:100,000 mapsheet are available (at cost) from the Data Exchange Officer on (02) 9585 6684.
- Threatened Species of Western NSW (Dec. 1996). Species profiles including likely distribution, habitat and threats. Ringbound folders are available at \$82.50 (incl. GST) (plus \$5.50 postage) from the Western Directorate Office, Dubbo (02) 6883 5330.

Other reference literature may be available for the subject locality/region. The proponent should explore this possibility thoroughly.

FURTHER INFORMATION

Should you wish to clarify any issues raised here or require further information please feel free to contact:

Conservation Assessment and Planning Unit

Western Directorate office

Department of Environment and Conservation

48 -52 Wingewarra St (PO Box 2111)

DUBBO NSW 2830

PH (02) 6883 5330

FAX (02) 6884 9382

ENVIRONMENTAL ASSESSMENT GUIDELINES CULTURAL HERITAGE

Aboriginal sites are widespread throughout New South Wales. There is considerable regional variation in the types of sites, their age, their contents and how they are situated on the landscape. It is important that these sites are conserved as fragile and irreplaceable Aboriginal heritage. In some cases there is Aboriginal oral tradition concerning specially significant sites or landscape features

The Department of Environment and Conservation (DEC) has a statutory role in the protection and preservation of Aboriginal sites. This includes reviewing and assessing the Aboriginal cultural and archaeological aspects of environmental studies, as well as a regulatory role in their impact or destruction.

The EIS or other environmental assessment should consider Aboriginal cultural heritage, even if the area is disturbed in some way. The EIS should consider:

- Accessing the DEC's Aboriginal Heritage Information Management System (AHIMS) in the initial planning stage. This is to determine if there are any already known sites which will require protection, or if there is a need for a Section 87 Permit or Section 90 Consent (see below). The AHIMS database is not a conclusive indicator that sites may exist in the development area. Information from the AHIMS database may be made available by the AHIMS Registrar. For contact details and general information about the Aboriginal Heritage Information Management System please refer to Attachment 1.
- The Aboriginal community (which may include Local Aboriginal Land Councils, Native Title Groups and Elders Groups) needs to be consulted so that they can be advised that there may be impact to sites relevant to their heritage. There also may be knowledge in the community about sites in the development area, particularly those related to oral tradition. This process of Aboriginal consultation should be maintained throughout the entire EIS procedure.
- An assessment of the need for an archaeological survey, and if so, to what level of detail. This should be defined by a study plan or research design. In most cases, an on-the-ground systematic archaeological investigation will be needed. If there is a likelihood of buried sites not visible on the surface, a Section 87 Permit from the DEC may be needed for sub-surface testing.
- The outcome of the survey is to determine what sites can be avoided, and what ones cannot. Another objective is to assess the significance of the sites. It may be that damage or destruction of some sites is unacceptable, or that special safe-guards are needed for others.

A broad overview of the Aboriginal Heritage Assessment process is

contained in Attachment 2.

If Aboriginal objects/places are known to be directly or indirectly adversely affected, the Proponents will need to apply for, and be issued, a Section 87 Permit or a Section 90 Consent by the Director-General of the DEC to comply with the National Parks and Wildlife Act (1974). A necessary part of this is a written statement detailing the concerns and opinion of the proposed impact from the Aboriginal community.

Normally, Special Conditions are attached. These may include provisions for impact minimisation and salvage. Salvage is a form of mitigation by documenting in detail what is to be lost by the impact. Frequently it involves archaeological excavation and analysis, or other types of recovery and study.

Alternatively the development might be redesigned by the Proponent to accommodate and protect the site(s). The archaeological survey, analysis and reporting, as well as the negotiation with the Aboriginal community, can be a lengthy process. If a Permit for salvage is needed, then this can add on more time. It is important to begin the study for Aboriginal site impacts in the very earliest stages to avoid delays in the developments' timeline.

The DEC has produced detailed guidelines for consultants and these are available from the Cultural Heritage Manager.

Further information should be sought from the Cultural Heritage Manager at the NPWS office at Dubbo.

Cultural Heritage Manager
Western Aboriginal Heritage Unit
Department of Environment and Conservation

52 Wingewarra St
PO Box 2111
DUBBO NSW 2830

PH (02) 6883 5345
FAX (02) 6834 9382

ATTACHMENT 1

THE ABORIGINAL SITES REGISTER OF NSW **GENERAL INFORMATION**

The National Parks and Wildlife Service maintains the Aboriginal Sites Register of NSW. The Register includes a computer database and site recording cards for all recorded Aboriginal sites in NSW, in addition to a database index of archaeological reports and a library of these reports. Information from the Register may be made available for a variety of uses.

What information is available?

Information relating to recorded Aboriginal sites in a particular area may be made available upon request. The information is generally available in the form of a standard report from the Register database. This report lists all recorded sites within and/or surrounding the area of interest, with each record including the site identifying number, site type, site location and Australian Map Grid co-ordinates, date of recording and the name of the recorder of the site.

If the area of interest is particularly large (e.g.. a river catchment), a Data Licence Agreement may be required. This agreement is a legal contract document between the Director-General of the National Parks and Wildlife Service and a named client, and is designed to ensure that any data supplied under the agreement is used appropriately.

In some cases, written support from the relevant Local Aboriginal Land Council may be required before information can be provided from the Register.

How is the data provided?

Site information will generally be provided as a standard computer print out, however, digital computer formats on disk may be available for specific purposes.

Is there a charge for data?

The cost for supply of a standard report is \$30 per search area. An urgent database search may be conducted for \$60. More complex reports may incur an additional charge.

In particular circumstances there may be no charge for a report (e.g.. for Aboriginal Land Councils, research purposes etc.). The waiving of any charge requires discussion with the Aboriginal Sites Registrar.

There is no charge imposed for a Data Licence Agreement, however, any data supplied under a Licence Agreement will generally be charged at the current "cost of transfer".

Are there any limitations in the data?

It is essential to note that a report from the Register does not represent a comprehensive list of all Aboriginal sites in a specified area. A report lists recorded sites only. In any given area there may be a number of undiscovered and/or unrecorded sites. As a result of this limitation, and the fact that all Aboriginal sites are protected under NSW legislation, the NPWS may recommend that a survey for Aboriginal sites is conducted where development is proposed.

Locational details are recorded as grid references. It is important to note that there *may* be errors in these recordings. If accurate site locations are required it may be necessary to confirm the locations on the ground.

If the information provided is to be used for ongoing purposes, it is recommended that regular updates are obtained as new records are continually being added to the database.

How to obtain Aboriginal sites data

To obtain information about recorded Aboriginal sites, a written request should be forwarded to the Aboriginal Sites Registrar (a request form is available if required). All requests must include;

- Company/organisation name (if applicable)
- Contact name, phone number and address details
- Purpose for which the information is required
- Copy of a topographic map with the area of interest clearly marked
- A cheque for \$30 per search area, made out to the NPWS (unless other arrangements have been made with the Registrar)

Applications should be forwarded to:

**The Aboriginal Sites Registrar
Cultural Heritage Division
NPWS
PO Box 1967
Hurstville, NSW 2220.**

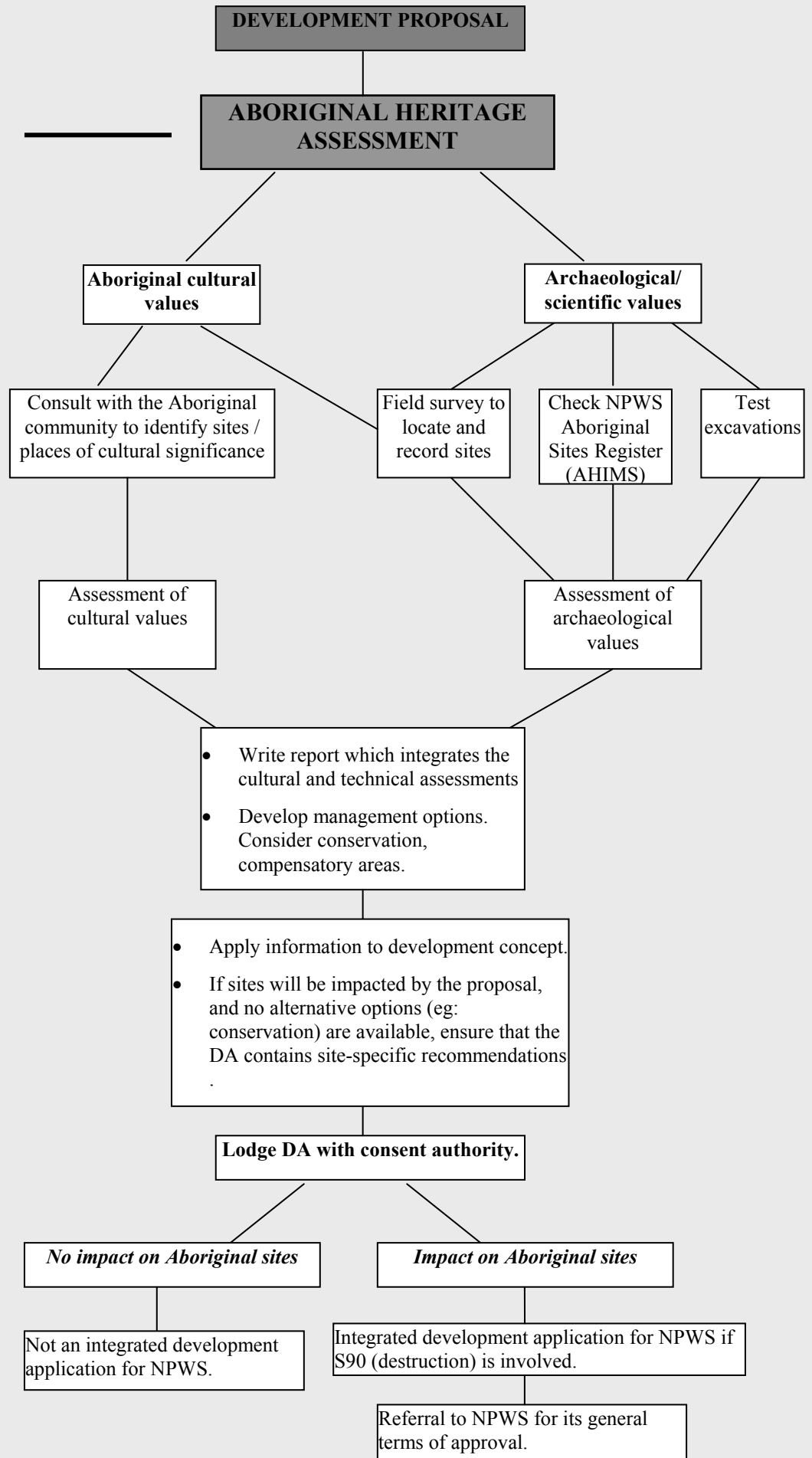
or fax (02) 9585 6466

Further information

For further information about the Aboriginal Sites Register, please contact the Aboriginal Sites Registrar (02 9585 6471, fax 02 9585 6466).

PROCESS

1. Development proposal.
2. Investigative studies and assessments. This could include: Aboriginal heritage, flora and fauna, hydrology, air, noise, social / economic etc.
3. For Aboriginal heritage, information is required about:
4. Information sources:
NB: Test excavations may be required. This requires a permit from NPWS, allow 8 weeks for processing.
5. Undertake assessment
6. Prepare report and recommend management options.
7. Apply this and information from other assessments to development concept and finalise development proposal. Avoiding impact on sites is the preferred strategy.
8. Lodgement of DA with consent authority
9. DA is an IDA if development will impact on Aboriginal sites in accordance with Section 90 of the NPW Act 1974.





Memorandum

To Ian Rufus

From Ann Sharrock

Date 17 February 2006 File no

Subject: Marrangaroo Land Use Study / Local Environmental Study

Ian,

Due to the lack of information about the subject site, these comments are very general.

Protection of Watercourses and Riparian Corridors

Department's Approval Role

The Department has an approval role under the *Rivers and Foreshores Improvement Act 1948* (R&FI Act) which relates to the management of rivers, estuaries and lakes on freehold land. A permit is required under Part 3A of the R&FI Act to:

- excavate or remove material from the bank, shore or bed of any stream, estuary or lake, or land that is not more than 40 metres from the top of the bank or shore of protected waters (measured horizontally).
- do anything which obstructs or detrimentally affects river flow, or is likely to do so.

"Excavations" can cover a range of activities and may be related to the construction of roads, drainage works, the provision of service utilities etc.

If future development of the land requires a Part 3A permit under the R&FI Act, the Department will attach conditions to the permit that will allow for the protection of the environment. Depending on the works involved, this may well include a condition for the establishment of vegetated riparian corridors along the watercourses on the site.

Protection of Watercourses and Riparian Corridors

The Department has developed a classification to identify minimum riparian corridor widths required along watercourses. The incorporation of riparian corridor outcomes into the LES and LEP is consistent with the State Government's approach to provide better up front planning and certainty.

The Department's stream mapping work was initially developed for the Riparian Corridor Management Study (RCMS) in the Wollongong LGA. The RCMS process has since been widely adopted and applied to other LGAs and land release sites. A form of the RCMS process has even been included in Landcom's Blue Book.

The RCMS identifies four key environmental objectives for riparian land and these are to:

- provide bed and bank stability
- protect water quality
- maintain viability of riparian vegetation
- provide continuity and connectivity

Based on the environmental objectives, the RCMS identifies three riparian categories to reflect the environmental significance of watercourses and the minimum widths to achieve the riparian categories are as follows:

- **Category 1 – an environmental corridor**
 - a minimum core riparian corridor width of **40 metres** along both sides of the watercourse (measured from top of bank), or to the extent of remnant native vegetation which ever is the widest to provide an environmental corridor, terrestrial and aquatic habitat, bank stability and protect water quality + a **10 metre** wide vegetated buffer.
- **Category 2 – terrestrial and aquatic habitat**
 - a minimum core riparian corridor width of **20 metres** along both sides of the watercourse (measured from top of bank), or to the extent of remnant native vegetation which ever is the widest to provide terrestrial and aquatic habitat, bank stability and water quality + a **10 metre** wide vegetated buffer.
- **Category 3 – bed and bank stability/water quality**
 - a minimum core riparian corridor width of **10 metres** along both sides of the watercourse (measured from top of bank) to provide bank stability and water quality - an additional buffer is generally not required.

At this stage the Department has not categorised any watercourse on the site. The Department recommends Council consult with Ann Sharrock (ph: 9895 7142) to finalise the stream categories for the site.

Specific objectives of each stream category are outlined in Attachment A. These objectives and the following principles are to be considered when developing the LUS/LES/LEP.

1. Watercourses/waterbodies of regional or national significance should be conserved and protected
2. Developments should not increase the number of lots that have direct frontage to watercourses/waterbodies.
3. Degraded (including piped) watercourses/waterbodies and their functions and habitats, should be rehabilitated towards a naturally functioning system, as far as practicable.
4. Natural watercourses/waterbodies and their functions and habitats should be conserved and protected.
5. Ecological linkages to nearby areas of Endangered Ecological Communities rated as “core” or “support to core” to watercourses/waterbodies should be established as far as practicable.
6. Natural watercourses/waterbodies and their functions and habitats should not be destroyed.
7. The construction of purpose-built watercourses/waterbodies on the site of viable natural ones should be discouraged.
8. Runoff entering watercourses/waterbodies from the development be of a quantity and of sufficient quality to demonstrate a net improvement of any receiving waters.
9. Existing uses that are non-sustainable within the watercourses/waterbodies and riparian areas should be discouraged.

Water Cycle Management

The Department encourages the incorporation of Water Sensitive Urban Design principles and methods.

Attachment A

Environmental Objectives for Riparian Land***Category 1 - Environmental Corridor***

Maximise the protection of terrestrial and aquatic habitat to:

- provide a continuous corridor for the movement of flora and fauna species through the catchment and beyond the catchment.
- provide extensive habitat (and connectivity between habitat nodes) for terrestrial and aquatic fauna
- maintain the viability of native riparian vegetation
- manage edge effects at the riparian/urban interface
- manage the impacts from saline affectation
- provide bank and bed stability
- protect water quality
- protect instream aquatic vegetation

This is achieved by:

- (i) providing a continuous riparian corridor that:
 - provides linkages to stands of remnant vegetation where applicable, and
 - a “core riparian zone” (CRZ) with a width greater than 40 m from the top of the bank, and
 - sufficient (additional) riparian corridor width based on geomorphological and environmental considerations
- (ii) providing a suitable environmental protection zoning to the riparian land that recognises its environmental significance
- (iii) restoring/rehabilitating the riparian zone with local provenance native vegetation
- (iv) ensuring vegetation in the CRZ is at a density that would occur naturally
- (v) locating services (power, water, sewerage, and water quality treatment ponds) outside of the CRZ. (Encroachment into the non core riparian area may be possible if the impact on riparian functions is minimal and integrity maintained)
- (vi) providing a suitable interface between the riparian area and urban development (roads, playing fields, open space) to minimise edge effects
- (vii) minimising the number of road crossings
- (viii) maintain riparian connectivity by using piered crossings in preference to pipes or culverts
- (ix) minimise the impact of walkways, cycleways and general access points by using ecologically informed design principles
- (x) locating flood compatible activities (playing fields) outside of the CRZ. (Encroachment into the riparian area may be possible if the impact on riparian functions is minimal and integrity maintained)
- (xi) managing urban development to avoid increasing the impact of salinity on the landscape and watercourse.
- (xii) providing lateral connectivity for instream function.

- (xiii) ensuring channel stability
- (xiv) protecting the natural values within the channel
- (xv) ensuring all stormwater discharge is treated outside of before it enters the CRZ.

Category 2 - Terrestrial and Aquatic Habitat

Maintain/restore the natural functions of a stream and its aquatic and terrestrial values to:

- maintain the viability of native riparian vegetation
- provide suitable habitat for terrestrial and aquatic fauna
- manage the impacts from saline affectation
- provide bank and bed stability
- protect water quality
- protect instream aquatic vegetation

This is achieved by:

- (i) providing a “core riparian zone” (CRZ) with a width greater than 20 m from the top of the bank
- (ii) providing, wherever possible, sufficient (additional) riparian corridor width based on geomorphological and environmental considerations
- (iii) restoring/rehabilitating the riparian area with local provenance native vegetation
- (iv) ensuring vegetation in the CRZ is at a density that would occur naturally
- (v) providing, whenever possible, appropriate zoning that recognises the environmental significance of the riparian land
- (vi) minimising the number of road crossings
- (vii) ensure road crossings are designed to maintain riparian connectivity
- (viii) providing a suitable interface between the riparian area and urban development (roads, playing fields, open space) to minimise edge affects
- (ix) minimising the extent of open parkland adjacent to a stream
- (x) locating services (power, water, and sewerage water quality treatment ponds) outside of the CRZ. Encroachment into the riparian area may be possible if the impact on riparian functions is minimised
- (xi) managing urban development to avoid increasing the impact of salinity on the landscape and watercourse.
- (xii) providing lateral connectivity for instream function.
- (xiii) ensuring channel stability
- (xiv) protecting the natural values within the channel
- (xv) ensuring all stormwater discharge is treated before it enters the stream

Category 3 -Bank Stability and Water Quality

Maintain/restore as much as possible the natural functions of a stream to:

- provide bank and bed stability
- protect water quality
- protect native vegetation
- protect instream aquatic vegetation

This is achieved by:

- (i) emulating wherever possible a naturally functioning stream
- (ii) ensuring channel stability
- (iii) protecting the natural values within the channel
- (iv) providing lateral connectivity for instream function.
- (v) using pipes or other engineering devices as a last resort
- (vi) ensuring all stormwater discharge is treated before it enters the stream



NSW GOVERNMENT

Department of Planning

General Manger
City of Lithgow Council
PO Box 19
LITHGOW NSW 2790

Contact: Terry Doran
Phone: 9895 7092
Fax: 9895 6270
Email: terry.doran@planning.nsw.gov.au

Our ref: SRW0000699-1

Your ref: SMH:MAJ

File:

Lithgow City CouncilScanned ☐

16 MAR 2006

Attention: Mr Ian Rufus

10th March 2006 Doc. No
GDA Ref.
Years

Subject: Marrangaroo Land Use Study/Local Environmental Study

Dear Ian

I refer to Council's letter of 18 January 2006 and our recent telephone conversation in the above.

As discussed, I understand that you are seeking the Department's views on the preparation of a local environmental study for the Marrangaroo site.

Council has held a stakeholders meeting during February and you have provided me with your notes of the meeting. As Councils are best placed to identify the local issues, the Department has previously taken the view that councils are in a position to prepare a schedule of proposed studies in consultation with stakeholders.

If you are agreeable to this process, the Department would be pleased to receive Council's schedule of proposed studies and provide you with its comments and advice on the need to prepare a formal local environmental study.

For your guidance, I have attached an extract from the Metropolitan Strategy that deals with the sustainability criteria for new land release. While some of the items may not concern the Marrangaroo site, the extract will offer some guidance for Council to finalise a list of studies.

As you are aware, owing to a restructure of the administrative responsibilities for this office, the Sydney West office will not be responsible for the Lithgow Local Government Area in the near future. Until these responsibilities are clarified and you receive further advice, you may care to direct any correspondence to me and I will redirect.

Yours sincerely

Terry Doran
Team Leader
Sydney West

Sydney West, 4/10 Valentine Avenue, Parramatta 2150 [Postal address: PO Box 404, Parramatta NSW 2124]
Phone 9895 7633 Fax 9895 6270 Website planning.nsw.gov.au

IMPLEMENTATION AND GOVERNANCE

TABLE G2 SUSTAINABILITY CRITERIA FOR NEW LAND RELEASE

DEVELOPMENTS MAY BE APPROVED IF THEY SUBSTANTIALLY MEET THE CRITERIA BELOW AFTER A MERITS ASSESSMENT

Threshold Sustainability Criteria for listing of site on MDP

Measurable Explanation of Criteria

1 Infrastructure Provision

Mechanisms in place to ensure utilities, transport, open space and communication are provided in a timely and efficient way.

- Development is consistent with any relevant residential development strategy, subregional strategy, regional infrastructure plan and Metropolitan Strategy.
- The provision of infrastructure (utilities, transport, open space, and communications) is costed and economically feasible based on Government methodology for determining infrastructure contribution.
- Preparedness to enter into development agreement.

2 Access

Accessible transport options for efficient and sustainable travel between homes, jobs, services and recreation to be existing or provide.

- Accessibility of the area by public transport and appropriate road access in terms of:
 - Location/land use; to existing networks and related activity centres.
 - Network: the areas potential to be serviced by economically efficient public transport services.
 - Catchment: the area's ability to contain, or form part of the larger urban area which contains adequate transport services. Capacity for land use/transport patterns to make a positive contribution to achievement of travel and vehicle use goals.
- No net negative impact on performance of existing subregional road, bus, rail, ferry and freight network.

3 Housing Diversity

Provide a range of housing choices to ensure a broad population can be housed.

- Contributes to the geographic market spread of housing supply, including any government targets established for aged, disabled or affordable housing.

4 Employment Lands

Provide regional/local employment opportunities to support Sydney's role in the global economy.

- Maintain or improve the existing level of subregional employment self containment.
- Meets subregional employment capacity targets:
 - Employment related land is provided in appropriately zoned areas.

5 Avoidance of Risk

Land use conflicts, and risk to human health and life, avoided.

- Available safe evacuation route (Flood and Bushfire).
- No residential development within 1:100 floodplain.
- Avoidance of physically constrained land: high slope; highly erodible.
- Avoidance of land use conflicts with adjacent, existing or future land use and rural activities as planned under regional strategy.

6 Natural Resources

Natural resource limits not exceeded/ environmental footprint minimised.

- Demand for water does not place unacceptable pressure on infrastructure capacity to supply water and on environmental flows.
- Demonstrates most efficient/suitable use of land.
 - Avoids identified significant agricultural land.
 - Avoids impacts on productive resource lands; extractive industries, coal, gas and other mining, and quarrying.
- Demand for energy does not place unacceptable pressure on infrastructure capacity to supply energy; requires demonstration of efficient and sustainable supply solution.

7 Environmental Protection

Protect and enhance biodiversity, air quality, heritage, and waterway health.

- Consistent with Government approved Regional Conservation Plan (if available).
- Maintains or improves areas of regionally significant terrestrial and aquatic biodiversity (as mapped and agreed by DEC and DPI). This includes regionally significant vegetation communities; critical habitat; threatened species; populations; ecological communities and their habitats.
- Maintain or improve existing environmental condition for air quality.
- Maintain or improve existing environmental condition for water quality and quantity.
 - Consistent with community water quality objectives for recreational water use and river health (DEC and CMA).
 - Consistent with catchment and stormwater management planning (CMA and local council).
- Protects areas of Aboriginal cultural heritage value (as agreed by DEC).

8 Quality and Equity in Services

Quality health, education, legal, recreational, cultural and community development and other government services are accessible.

- Available and accessible services.
 - Do adequate services exist?
 - Are they at capacity or is some available?
 - Has Government planned and budgeted to further service provision?
- Developer funding for required service upgrade/access is available.



DPI Fisheries Ref: LG6-10-3167

20 February 2006

General Manager
City of Lithgow Council
PO Box 19
Lithgow NSW 2790

Attn: Mr A Muir

Dear Mr Muir,

Re: MARRANGAROO LAND USE STUDY/LOCAL ENVIRONMENTAL STUDY

Thank you for your letter dated 18 January 2006 requesting the Department of Primary Industries' (DPI) comments in regards to the above matter. These comments also formalise those made at the Stakeholders meeting on 2 February 2006.

General Comments

It is noted that Lithgow City Council will undertake the Marrangaroo Land Use Study in tandem with the development of a Council wide Strategic Process and Plan that will guide the future uses of lands across the entire Council area. The Marrangaroo Land Use Study and any future planning decisions that arise from this should be consistent with both the proposed Council wide Strategic Plan and the NSW Government Planning reforms, including consideration of state policies.

The Department is very supportive of larger scale planning strategies being developed by Council and strongly encourages close consultation with DPI to ensure positive and sustainable outcomes for Primary Industries and aquatic habitats across the Lithgow Local Government Area.

Minerals

The area covered by the Marrangaroo LES contains the following mineral resources and associated issues:

- Coal: The western edge of the Sydney Basin runs through the centre of the area in a north-south orientation. As a consequence the only coal resources lie along the eastern edge of the Marrangaroo valley. Coal mining leases associated with the Fernbrook Colliery in this area were cancelled in 2002.

The land has subsequently been acquired by the Commonwealth government for use by the Defence Forces. As a result all mineral resources in this land belong to the Commonwealth.

There is a current mining lease just north of the correctional facility (outside the subject area) (ML 1303), which forms part of the Springvale Colliery.

- Quartzite: The Marangaroo Quartzite Quarry is located on the western edge of the study area and is currently operated by Metromix Pty Ltd. Although the main product of the quarry is coarse aggregate for the local region, the quartzite which is mined is of sufficiently high chemical purity and uniformity (96.6-98.1% SiO₂) that it is suitable for use in metallurgical applications such as steel making. Since quartzite is a mineral under the Mining Act 1992, the operation is covered by mining leases which extend until 2023 and resources exist on these leases to provide reserves for up to 50 years. This deposit is one of only two known sources of such silica in NSW. Accordingly DPI – Mineral Resources would object to any development proposals or zoning which restricted the current and future operations of the quarry.
- In particular the current buffer between the quarry and residential areas of Marrangaroo Fields must not be reduced due to the possible impacts of noise and dust on residences. Similarly no additional residential areas should be allowed in the Go Cart Track and Golf Course parcels as the most likely medium term extension to the quarry operation is on the ridge immediately northeast of the current pit.
- The haulage route from the quarry is via Oakey Forest Road to the Great Western Highway. Truck movements on this route are currently restricted due to the road quality and the proximity of residences. Any future development west of the highway must not increase traffic along Oakey Forest Road and the intersection with the highway would benefit from an upgrade or a reduction in the highway speed limit. There is also potential for loading of quarry product to rail at the Marangaroo railway siding if required.

Forests

There are currently no specific issues of concern to Forests NSW within the Marrangaroo locality. It is strongly recommended however that during the development of the Council wide Strategic Plan that issues surrounding land-use conflicts, fire risk, infrastructure important to primary industries (e.g. road networks) and the fragmentation of primary industries lands be addressed by Council.

Agriculture

The Marrangaroo locality is highly fragmented in terms of agricultural land use. This fragmentation has strongly impacted upon the agricultural viability within the locality. The potential of agriculture to remain as a landuse should be assessed by this study and strategies be developed to prevent future fragmentation and conflict with agricultural land uses.

In relation to other agricultural issues of concern, these include:

- The Land Use Study should address issues of animal pests and weeds. Any potential land use changes will need to consider weed management issues particularly for any noxious weeds.
- Future planning of the Marrangaroo locality should take into account the potential impacts of the saline groundwaters present within the site. Salinity management plans are recommended to address the potential impacts upon all lands within the locality.

Fisheries

The Department is concerned about any potential impacts that future planning decisions may have on Threatened Species and aquatic habitats within and connecting to the Marrangaroo locality. It is strongly recommended that issues relating to fish passage, water quality, water flow, aquatic habitat quality and riparian health be considered by Lithgow Council in the planning and assessment of any future land use or development.

In particular, the following should be considered in relation to the protection of aquatic habitats:

- The Marrangaroo locality is within the potential distribution of the Macquarie Perch and Adams Emerald Dragonfly, which are listed as Threatened Species under the *Fisheries Management Act 1994*. Any future planning decisions must not impact upon these species and their habitats. For further information please refer to the DPI website (www.fisheries.nsw.gov.au/threatened_species).
- Fish passage is to be maintained along the waterways within and adjacent to the area of the proposed subdivision. It is recommended that the future arrangement of lots and the supporting road network be planned to keep the number of waterway crossings to a minimum. Any plans to upgrade the road network to service these lots should be reviewed by DPI Fisheries if waterway crossings are proposed. The Departments' policies and guidelines for preferred waterway crossing designs are outlined in the following documents:
 - *"Why do fish need to cross the road? Fish Passage Requirements for Waterway Crossings"* (NSW Fisheries 2003).
 - *"Policy and Guidelines for Fish Friendly Waterway Crossings"* (NSW Fisheries 2003)

These publications are available on the DPI website (www.dpi.nsw.gov.au/fisheries). Navigate to 'Habitat Protection' then 'Developer and Council Information'.

- Poor planning within flood-prone lands has often resulted in the permanent modification or loss of natural watercourses to piping and channelisation in an attempt to protect properties from flood impacts. The Department does not support the piping or channelisation of watercourses and strongly recommends that flood prone lands be appropriately zoned and adequate flood buffers be put in place to prevent the need to modify watercourses for the purposes of flood protection.

- Any proposed subdivision and development of land may lead to an increase in runoff, nutrients and sediment levels within the waterways of the locality. It is noted that sediment has already begun to fill sections of Marragaroo Creek, altering aquatic habitats and potentially displacing aquatic species. All future developments and activities should have measures incorporated that achieve a no net increase in runoff and a nil reduction in water quality of receiving waters within the locality.

The Department recommends that all future development and water infrastructure planning should include measures consistent with *Water Sensitive Urban Design* so that water from regular rain events is managed and treated within the catchment well before reaching natural waterways. For example, impermeable surfaces should be kept to a minimum, gross pollutant traps and sediment detention ponds should be installed at source and off-line, adequate and intact riparian buffers should be included along all watercourses and adequate room should be provided throughout the locality for bioretention drainage swales or other similar water polishing features.

- An intact riparian zone is one of the primary mechanisms for protecting waterways from the adverse effects of development. The Department recommends appropriate vegetated buffers adjacent to all waterways to act as protection from these impacts.

It should also be noted that the “Degradation of Native Riparian Vegetation” is currently listed as a Key Threatening Process under the threatened species provisions of the *Fisheries Management Act 1994* and any works to rehabilitate riparian areas within the Marragaroo locality are strongly supported.

- The “Removal of Large Woody Debris” has also been listed as a Key Threatening Process under the threatened species provisions of the *Fisheries Management Act 1994*. It is a requirement under the DPI *Fish Habitat Protection Plan No. 1* that the Department be notified should any works require the removal or relocation of snags within any watercourse, particularly fallen trees or large rocks.

The following should also be considered in relation to aquaculture within the study area:

- NSW DPI is developing sustainable aquaculture strategies to outline a whole of government approach to aquaculture development. The strategies consider site selection, biological prerequisites and best management practices for sustainable aquaculture. At this time they have been completed for the North Coast and Hunter & Central Coast with these strategies to be utilised to produce a state-wide strategy during 2006. It should be noted that these strategies are an integral part of SEPP62 – “Sustainable Aquaculture”.
- Salmonid aquaculture is particularly sensitive to changes in water quality particularly, water temperature and flow rates. I draw your attention to Section 2.2 Water Supply Issues, Page 63 of the Hunter and Central Coast Sustainable Aquaculture Strategy which can be found at the following web address

www.fisheries.nsw.gov.au/aquaculture/general/hunter_sustainable_aquaculture_strategy . I also draw your attention to "Water Quality in Freshwater Aquaculture" Fishfacts 1, S.J. Rowland. Please find a copy of this document attached for your reference.

- Impacts on water quality and water flow need to be carefully considered in any study to avoid impacting an existing aquaculture facility within the catchment or any future aquaculture proposals. Reference is made to the ANZECC Water Quality Guidelines and the need to protect and enhance water quality in the catchment to ensure it meets all water quality parameters for aquaculture, other users and the environment.
- NSW Food Authority strictly monitors water quality parameters and the product produced from aquaculture facilities to ensure that the product is suitable for human consumption. Therefore, it is imperative to ensure water quality in the Marrangaroo land use study area is maintained or enhanced.
- Failure to account for water cumulative impacts may greatly impact on the ability for an aquaculturalist to sell their product.
- Any study should focus on the need to protect and where possible enhance the quality and quantity of water in the catchment.

The Department of Primary Industries has recently been formed by the merger of NSW Fisheries, Mineral Resources NSW, State Forests NSW and NSW Agriculture. This is a coordinated Department of Primary Industries response and reflects the views of all these former agencies.

Should you have any further queries on this matter please do not hesitate to contact me on (02) 9527 8553.

Yours sincerely,

Geoff Longhurst
Conservation Manager (Central)
Aquatic Habitat Protection Unit

Mr Ian Rufus
Planning and Development Manager
Lithgow Council
180 Mort Street
LITHGOW NSW 2790

Dear Mr Rufus

Marrangaroo Local Environmental Study and Masterplan

At this stage of the investigation into the future development of the Marrangaroo area the Department is unable to comment on the need for a future school site. Once the Local Environmental Study is completed and there is more detail on dwelling capacity the Department will comment further. Issues such as topography, connectivity to Lithgow town, land uses and other environmental constraints will impact on the demand for a new school in this area.

Attached is the Site Selection Criteria for school sites for Council's information.

Currently there is spare primary and secondary school accommodation available in Lithgow.

In light of the above information the Department will wait for the completion of studies on the Marrangaroo site before commenting further.

Please ensure that all official correspondence on properties related matters are sent to the General Manager, Asset Management Directorate, GPO Box 33 Sydney NSW 2001.

Should you require further information, please contact Sandra Patterson, Demographic Planner on (02) 9561 8544, sandra.patterson@det.nsw.edu.au

Yours sincerely

Doug White
for Beryl Jamieson
A/General Manager Asset Management

Please ensure that all official correspondence on properties related matters are sent to the General Manager, Asset Management Directorate, GPO Box 33 Sydney NSW 2001.

Should you require further information, please contact Sandra Patterson, Demographic Planner on (02) 9561 8544 or sandra.patterson@det.nsw.edu.au

Yours sincerely

Doug White
for Beryl Jamison
A/General Manager Asset Management

General Guidelines for New School Sites

These are broad guidelines which may vary with individual developments.

- 1 One primary school site per 2000+ new homes and one high school for 5000+ new homes (urban fringe release area).

Consideration must be made in respect of the following :

- a) possible existing facilities in nearby location
- b) non government share of the primary age population
- c) type of housing (urban fringe, rural residential , medium and high density infill, rural fringe)
- d) nature of the new population
- e) rate of proposed residential development

2 General Site Location Principles

- a) primary school drawing area should remain flexible over time
- b) School should be located on secondary distributor road school is ideally should have two frontages
- c) As far as possible the school should be located in the middle of its catchment within 1.6km of the bulk of its dwellings
- d) It is an advantage to locate near a playing field .
- e) High school should be located away from commercial centers and off license liquor shops
- f) Schools should be located well away from mobile phone towers and restricted premises.

3 Specific Site Selection

Generally the following attributes are desired:

- a) primary school sites should be around 3 hectares and high school sites 6 hectares
- b) slope not greater than 1 in 10
- c) Site above the 1 in 100 year flood line
- d) Shape of the site should be mainly regular
- e) Site should be fully serviced by water , sewerage, power, phone, kerb and guttering and a sealed road.
- f) Site should be free of easements, (road reservations, high voltage power lines) environmental constraints (flora, fauna, Aboriginal heritage, mine subsidence) or contamination that would restrict development of the site.

Individual sites should always be discussed with Asset Management (Sites Branch).

Contact: Stuart Read
Telephone: (02) 9873 8554
stuart.read@heritage.nsw.gov.au
File: S90/01535
Our Ref: HRL38892

Mr Ian Rufus
Planning and Development Manager
Lithgow City Council
PO Box 19
LITHGOW NSW 2790

Dear Mr Rufus

RE: Local Environmental /Land Use Study - Marrangaroo Valley

I refer to your email dated 15 February 2006 requesting information regarding the NSW Heritage Council's requirements for the preparation of the above mentioned study.

It is advised that the study should address the following issues:

- The heritage significance of the valley and any impacts the development may have upon this significance should be assessed. This assessment should include natural areas and places of Aboriginal, historic or archaeological significance. It should also include a consideration of wider heritage impacts in the area surrounding the site.
- The Heritage Council maintains the State Heritage Inventory which lists some items protected under the *Heritage Act, 1977* and other statutory instruments. This register can be accessed through the Heritage Office home page on the internet (<http://www.heritage.nsw.gov.au>).

It should be noted that the legal standing of items on the State Heritage Register can be provided by applying for a section 167 Certificate through the Office's website;

A late Victorian Cottage on Oakey Forest Road is listed on the Department of Housing's heritage and conservation register under section 170 of the Heritage Act. More information on this property can be obtained from the Department's Director General Mr Terry Barnes on telephone 8753 8100;

The Heritage Office has under consideration a number of potential heritage items relating to the Marrangaroo Shale Mine such as the Industrial Archaeological sites, gatehouse, chimney, and Anglican Church on the Great Western Highway. More information in this regard can be obtained from Cameron White on telephone 9873 8570, or Mr Bill Nethery on telephone 9873 8566;

In addition, you should consult lists maintained by the National Trust of Australia (NSW), Australian Heritage Council, any heritage listed under the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* and by Council in order to identify any identified items of heritage significance in the area

affected. Please be aware, however, that these lists are constantly evolving and that items with potential heritage significance may not yet be listed;

- Non-Aboriginal heritage items within the study area should be identified by field survey. This should include any buildings, works, relics (including relics underwater), gardens, landscapes, views, trees or places of non-Aboriginal heritage significance. A statement of significance and an assessment of the impact of the proposal on the heritage significance of these items should be undertaken. Any policies/measures to conserve their heritage significance should be identified. This assessment should be undertaken in accordance with the guidelines in the *NSW Heritage Manual*. The field survey and assessment should be undertaken by a qualified practitioner/consultant with historic sites experience. The NSW Heritage Office website can provide a list of suitable consultants (under 'publications' / H / heritage consultants');
- The study should have regard to any impacts on places, items or relics of significance to Aboriginal people. Where it is likely that the project will impact on Aboriginal heritage, adequate community consultation should take place regarding the assessment of significance, likely impacts and management/mitigation measures. For guidelines regarding assessment, please contact the National Parks and Wildlife Division of the Department of Environment and Conservation on (02) 9585 6444;
- The relics provisions in the Heritage Act require an excavation permit to be obtained from the Heritage Council, or an exception to be endorsed by the Heritage Council, prior to commencement of works if disturbance to a site with known or potential archaeological relics is proposed. Where possible refer to archaeological zoning plans or archaeological management plans held by Council. If any unexpected archaeological relics are uncovered during the course of work excavation should cease and an excavation permit, or an exception notification endorsement, obtained;
- If approval is required under the Heritage Act due to the listing of an item or place on the State Heritage Register (eg: the Marrangaroo Railway Viaduct), or being subject to an Interim Heritage Order, the Heritage Council's approval must be sought prior to an approval being issued by the consent authority under the *Environmental Planning and Assessment Act* (except where application relates to Integrated Development). In accordance with section 67 of the Heritage Act, an approval given by a consent authority in these cases before the Heritage Council's determination of the application has been notified to the consent authority, is void;

The requirements for the preparation of EIS heritage assessments prepared by Planning NSW may also be referred to and applied to the preparation of the study.

The Heritage Office would be happy to review any further documentation that may address any likely heritage impacts. If you have any further enquiries regarding this matter, please contact Stuart Read on (02) 9873 8554.

Yours sincerely

Vincent Sicari
Principal Heritage Officer
February 2006



NEW SOUTH WALES POLICE

Crime Prevention Officer Crime Management Unit

139 Rankin Street,
Bathurst NSW 2795
Tel: 02 6332 8699
Fax: 02 6332 8621

Attention: Ian RUFUS
Planning and Development
LITHGOW CITY COUNCIL

Ian,

Marrangaroo Land use Study/Local Environmental Study

In relation to our conversation on Thursday 9 March 2006 I have listed several areas which I feel require addressing.

- Police be involved in the initial structural development stage i.e. roads etc
- Police to be involved in continual consultation with the development based on the principles of the Crime Prevention Through Environmental Design (CPTED) mantra.
- Council *must* make representation to State Government for additional funding for Police as the development is intended to double the size of the town.
- Police would consider the development of a new police station at the new site depending upon negotiations conducted with key stakeholders at the appropriate/relevant time.
- Little or no Public Housing. If it is to be situated within the development then it is to be dispersed throughout the entire development.

The list could continue, at this time these are some of the issues to be addressed. A formal CPTED assessment can be completed on the initial infrastructure which would address a multitude of more complex issues.

Please feel free to contact me in relation to this assessment. I am available for continual consultation on this development.

Regards

Natalie McGill
Crime Prevention Officer
Chifley Local Area Command
Bathurst
9 March 2006

Emma Crago

From: Craig Ronan [Craig.Ronan@centralwest.ses.nsw.gov.au]
Sent: Tuesday, 28 February 2006 11:55 AM
To: Ian Rufus
Cc: cgoodwin@geolyse.com
Subject: Marrangaroo Masterplan - Workshop 2 March 2006
Attachments: Annex A - Lithgow Local Flood Plan.tif; 205177_FIG_Eco Constraints.jpg

Hi Ian,

Just a short note to advise that I will be unable to attend the above Workshop being held this coming Thursday as I have to attend a District Rescue Committee Meeting in Dubbo. I would therefore like to submit an apology.

I have carried out some basic research on the issues relating to Marrangaroo Creek and it appears that flooding is an issue. I have spoke to Collete Goodwin this morning and explained to her that I am currently waiting for a copy of the Flood Study carried out for or by the Department of Corrective Services (after speaking to the General Manager of the Lithgow Correctional Centre) before the construction of the Lithgow Correctional Centre. Collete indicated that the Department of Corrective Services has already given her a copy of a flood study so she may already have the required information.

It appears from verbal advice that I have received that the land that the current facility (Lithgow Correctional Centre) is built on what was originally part of the floodplain. To reduce the flood risk the land was raised approx 10 feet before construction of the Lithgow Correctional Centre as a direct result it seems of recommendations made in the Flood Study mentioned above.

For your information it appears that flooding occurs in Marrangaroo Creek mainly as a result of heavy rain during thunderstorms and as a result of east coast lows. Due to the nature of the catchment area of the creek the flooding it offers little or no warning with Marrangaroo Creek rising suddenly and falling just as fast. The map produced by Geolyse (attached) showing contours and drainage is very useful as it shows the drainage areas into Marrangaroo Creek, one of the issues is that the these drainage areas are likely to be dry most of the time until significant rain falls and run off occurs.

For your information please find attached a copy of Annex A of the Lithgow Local Flood Plan that details the flood threat in the Local Government Area of Lithgow. It is planned to review and rewrite this plan in the 2006/2007 Financial Year.

My research shows that in extreme rain events floodwater from Marrangaroo Creek has also covered the road (Great Western Highway) where the current bridge crosses the creek, the depth of this water however is not known. Research also indicates that water has been ankle deep in Reserve Road as a result of heavy rain.

Unfortunately records of flooding that has occurred over the years are few and far between. I am still conducting my research, including chasing up of GIS data and will advise when more information comes to hand. If anyone comes across any information in relation to flooding in the Marranagraoo area I would be very keen to speak to them.

Please please do not hesitate to contact me should you have any questions.

Regards,

Craig Ronan MAIES JP
Region Controller

Central West Region
NSW State Emergency Service
79 Corporation Avenue

5/04/2006

BATHURST NSW 2795

Phone: (02) 6332 3656

Fax: (02) 6332 2534

Mobile: 0418 476 254

E-mail: Craig.Ronan@centralwest.ses.nsw.gov.au

Web: www.ses.nsw.gov.au

ANNEX A TO THE GREATER LITHGOW CITY LOCAL FLOOD PLAN

THE FLOOD THREAT

GENERAL

Most of the territory of the Greater Lithgow City Council area is steep, mountainous and forested. There are some areas of undulating country but very little floodplain development. The drainage pattern is complex and includes the following rivers (see Map 1):

1. The upper reaches of the Cox's River and its tributaries (Farmers, Pipers Flat, Marrangaroo, Thompsons and Ganbenang creeks and River Lett) which drain the south-eastern portion of the council area. Important tributaries of Farmers Creek include Ida Falls, Vale of Clwydd and State Mine creeks. The Cox's River, part of the Nepean-Hawkesbury river system (Basin No 212), flows into Lake Burragorang.
2. The Capertee-Wolgan River system, including the tributaries Coco, Carne, Umbiella, Red Rock, Rocky, Tambo and Wollongambe Creeks) which drain the northern and eastern portions of the council area towards the Colo River (part of the Nepean-Hawkesbury river system) to the east.
3. The upper reaches of the Turon River and its principal tributaries, Palmers Oakey, Round Swamp and Coolamingal creeks. These streams drain the Airly, Turon and Sunny Corner State Forests and the Great Dividing Range and Ben Bullen Range in the north-west of the council area. They are part of the Macquarie River system (Basin No 421).
4. A short reach of the Fish River, and the tributary Solitary Creek, which drain the south-west of the council area west from the Great Dividing Range. These watercourses are also part of the Macquarie River system.

A defining characteristic of flooding within the council area is the speed with which floods rise and fall. Because the whole area is elevated and the streams are short and steep, flash and near-flash flooding are the norm and flood velocities are usually high. There is little warning apart from that provided by the rain which causes the floods.

WEATHER SYSTEMS AND FLOODING

Most parts of the Greater Lithgow City Council area have an average annual rainfall of between 700 and 800 mm. This rainfall is distributed in a fairly uniform manner across the seasons, but there are tendencies toward higher flood frequencies in the February-April and June-August periods than at other times of year. Almost all of the severe flood events recorded have been in these periods, but large amounts of rain can fall at any time of year.

In severe events, more than half the average annual rainfall could be recorded at some stations over a period of several days.

Flooding in the Greater Lithgow City Council area usually results from one of four mechanisms:

1. **Cyclonic depressions** forming troughs extending from northern Australia and directing northerly streams of moist, unstable air into northern and central western NSW. Such systems, which occur during the warmer months, frequently produce intense short-period rainfalls leading to flooding. Flooding from this mechanism is rare, however.
2. **Well-developed low-pressure troughs** associated with depressions well to the south and crossing the council areas from west to east. Sequences of such troughs can produce high rainfall totals over a period of weeks, usually in the winter months, with daily falls being less intense than those experienced as a result of the cyclonic depressions noted above.
3. **Low-pressure systems** situated off the coast of NSW and causing flows of moist air across the Great Dividing Range. This mechanism was responsible for the flood of August, 1986.
4. **High-intensity, short-duration convective thunderstorms** bringing very heavy rain and causing local runoff, flash flooding on minor tributaries and the surcharging of artificial drainage systems in built-up areas. Such storms are largely confined to the late spring, summer and early autumn months and do not create main-stream flooding.

Most flooding within the council area has followed periods of extended wet weather. A local rule of thumb in the valley of Farmers Creek is that rainfall of 100 mm in three days or less creates a significantly increased probability of flooding if further rain occurs. Heavy daily falls not occurring on already wet catchments can cause flooding but frequently do not.

Detailed records of flooding within the council area are few except for the urban centre of Lithgow. It is known, however, that flooding is irregular on all streams, with long virtually flood-free periods separated by shorter periods of frequent and sometimes severe flooding. The 1986 flood at Lyell Dam is estimated to have been a once-in-100 years (1% AEP) event; that is, a flood of the severity of this event would be expected to have only a 1% chance of occurring at the dam in any single year.

FLOODING ON FARMERS CREEK

Historically, the most damaging floods to occur in the council area have been those on Farmers Creek within the urban centre of Lithgow. This creek has a catchment of only 50 square kilometres at Lithgow and a valley floor less than 300 metres in width. The valley is subject to severe, short-duration thunderstorms which are often extremely localised. Damage resulting from these storms may occur in areas distant from Farmers Creek itself, including the Vale of Clwydd, Doctors Gap and the valley of State Mine Creek.

Built-up land along a 5.5 kilometre stretch of this creek is subject to inundation in events no more severe than those which occur, on average, about once in five years. Flood severity has

been worsened by human activity, large areas of the creek's floodplain having been filled to create ovals and reserves, and these act to constrict flood flows and raise flow velocities. Velocities of more than 3 metres per second have been recorded in the steeper, narrower sections and even in the lower parts of the valley flows can be at rates of over 2 metres per second. Heavy rain associated with flooding periodically creates landslides in the hills around the town.

FLOOD HISTORY

On Farmers Creek the record of major floods causing inundation of residential property is incomplete but the following events are known to have occurred:

Month, Year	Average Recurrence Interval (years)	Annual Exceedance Probability (%)	Impacts
Feb 1928	Not known		Very severe, widespread damage; water broke through colliery roof.
June 1963	Not known		Roads cut.
June 1964	Not known		Roads cut; water broke through colliery roof.
March 1978	14	7	Caused landslides, extensive damage to cars, houses and roads.
Feb 1981	Not known, but possibly similar to Feb 1990 event.		
Aug 1986*	5-10	10-20	Widespread damage.
Feb 1990	1-2	50-90	Houses inundated from Farmers Creek and local drainage problems.

* At this time there was also major flooding on most of the other streams of the council area, including the Fish, Turon and Cox's rivers.

Note: A flood of a particular **Annual Exceedance Probability** (AEP) has that % chance of occurring in any one year. The **Annual Recurrence Interval** (ARI) is the **average** length of time which is estimated to elapse between floods of a given magnitude or greater. A 14% flood is expected to occur, on average, about seven times in a 100-year period. In a **particular** 100-year period it may occur more or less often than this.

EXTREME FLOODING

The worst floods over recorded in the Greater Lithgow City Council area since European settlement should not be considered to be the most serious which will ever occur. Floods as severe as the 1978 event in the town of Lithgow or the 1986 event on the Cox's River will be equalled in the future and on occasions exceeded in their severity. When genuinely severe floods occur, they often reach **much** greater heights than was true of previous recorded floods.

Moreover, they are generally both faster to rise and more dangerous in terms of depth and velocity than previously known events. An extreme flood in Farmers Creek could produce flood heights more than two metres higher than were seen in Lithgow in 1978 along with a much greater extent of inundation.

All communications to be addressed to:

Head Office
NSW Rural Fire Service
Locked Mail Bag 17
Granville NSW 2142

Telephone: (02) 8741 5555

Head Office
NSW Rural Fire Service
15 Carter Street
Homebush Bay NSW 2127

Facsimile: (02) 8741 5550



The General Manager
Council of the City of Lithgow
PO Box 19
LITHGOW NSW 2790

Attention: Mr Ian Rufus

Your Ref: SMH: MAJ

Our Ref: LEP/0053
A06/0125 DM

14 February 2006
Lithgow City Council
Scanned ☐

Dear Sir,

20 FEB 2006

Re: Marrangaroo Land Use Study/Local Environmental Study.

Doc. No
GDA Ref.
Years

I refer to your letter dated 18 January 2006 seeking our advice in accordance with Section 62 of the *Environmental Planning & Assessment Act 1979* for the above Land Use Study/Local Environmental Study.

The RFS notes that the subject site is identified as Bush Fire Prone on the Lithgow Bush Fire Prone Land Map and incorporates both residential and Special Fire Protection Purpose developments.

Any development applications for residential and Special Fire Protection Purpose developments will be subject to the requirements of Section 100B of the *Rural Fires Act 1997* and/or Section 79BA of the *Environmental Planning and Assessment Act 1979*.

It is therefore suggested that a detailed bush fire assessment of the study area be undertaken to determine the suitability of the site for further residential and Special Fire Protection Purpose developments. In particular the bush fire assessment should address the following:

- (i) Controlling the type of developments permissible in bushfire prone areas
- (ii) Minimising the impact of radiant heat and direct flame contact by separating the development from the bushfire hazard by identifying the extent to which future development can provide for asset protection zones in accordance with Tables A2.2-A2.4 of *Planning for Bushfire Protection 2001*. Setbacks will depend on proximity to vegetation, vegetation type and slope.

- (iii) The ability to site and provide adequate water supplies for fire fighting,
- (iv) The ability to provide for egress/access as outlined within Section 4.3 of *Planning For Bushfire Protection* 2001. In particular perimeter roads should be incorporated into the design of any future subdivisions
- (v) Minimising the vulnerability of buildings to ignition from radiation and ember attack by addressing the construction of assets in accordance with *Australian Standard 3959 Building in Bush Fire Prone Areas*.
- (vi) The future management regimes for any areas of hazard remaining within the subject area. This should focus on the level of hazard posed to future development by the land or adjacent land and how the hazard may change as a result of development.

For any enquiries regarding this correspondence please contact Danielle Meggos.

Yours sincerely



Lew Short
Manager, Development Control Services

Ian Rufus

Planning and Development Manager

Lithgow City,

PO Box 19, LITHGOW NSW 2790.

Ian

In reference to the Marrangaroo study I would like to present the following thoughts for Council's consideration.

While the Department of State and Regional Development has no regulatory role in the current land use study it does have a strong interest in the availability of employment lands in Lithgow.

Anecdotal evidence would suggest that Lithgow is experiencing a shortage in employment land, especially industrial land. This appears to be occurring at the same time as demand for residential property is increasing.

While the growth being experienced by Lithgow is a positive occurrence it does raise the issue of the provision ongoing employment and wealth creation opportunities to support Lithgow's growth into the future.

16-FEB-2006 10:57 FROM SCA ENVIRONMENT& PLANNING

TO LITHGOW COUNCIL

P.01/01



PO Box 323 Parrish NSW 2751
Level 2, 311 High Street
Parrish NSW 2750
Tel 1300 722 468 Fax 02 4732 3666
Email info@sca.nsw.gov.au
Website www.sca.nsw.gov.au

Our Ref: D2006/00827
Your Ref: SMH:MAJ

The General Manager
The Council of the City of Lithgow
PO Box 19
LITHGOW NSW 2790

Lithgow City Council
Scanned ☐

16 FEB 2006

Attention: Andrew Muir/Ian Rufus

Dear Sir

Marrangaroo Land Use Study/Local Environmental Study

Doc. No
GDA Ref
Years

I refer to Council's letter of 18 January 2006 inviting the Sydney Catchment Authority (SCA) to attend a stakeholders meeting on 2 February 2006. The SCA was represented at the meeting.

The Marrangaroo locality proposed for a local environmental study (LES) is within the drinking water catchments of Sydney and adjacent regional centres. The SCA understands the LES will identify the capability of the land to support development. The key criteria from the SCA's perspective that should be used to assess capability is that development should be able to achieve a neutral or beneficial effect on water quality. This is consistent with the provisions of SEPP 68 - Protecting Sydney's Water Supply and the provisions proposed for the Regional Environmental Plan - Sustaining the Catchments. In the event that the whole or part of the study area is identified as possibly having potential for urban development the SCA strongly encourages application of water quality modelling.

As a general concept the SCA encourages appropriate riparian areas adjacent to significant watercourses. A minimum riparian area for both sides of Marrangaroo Creek is appropriate in this circumstance (for the length of the creek through the study area). The width of this riparian area should be determined through the LES process. The SCA also notes that the land adjacent to the creek and west of the Great Western Highway is steep and therefore has limited development opportunities.

The SCA requests Council to also consider the *Section 117 Direction - Water Catchment Protection - Sydney Catchment Authority* and the draft Section 117 Direction contained in the Regional Plan.

Representatives of the SCA are available to provide further guidance on the LES/LEP process as it progresses. If you wish to discuss any matter raised in this letter please do not hesitate to contact Malcolm Hughes on 4725-2139.

Yours sincerely


Lee Morgan
Manager Statutory Planning

16/2/06

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TOTAL P.01

Centre for Population HealthNepean Hospital Campus
Kingswood NSW 2747Phone: (02) 47342022
Fax: (02) 47343300PO BOX 63
PENRITH NSW 2751Mr Andrew Muir
City of Lithgow Council
PO Box 19
LITHGOW NSW 2790

16 February 2006

Dear Andrew,

Marrangaroo Land Use Study / Local Environmental Study

I refer to your letter to NSW Health, concerning the proposed land use study at Marrangaroo. Your letter has been forwarded to the Sydney West Centre for Population Health (CPH) for response. The Centre for Population Health provides health protection services, such as in infectious disease control and on environmental health, and provides disease prevention services in relation to tobacco control, childhood obesity prevention, falls prevention among older people, health impact assessment and healthy urban planning to the people of greater western Sydney including the City of Lithgow Council area.

The CPH would like to link local government and, through them, prospective developers and the general community, to the latest health evidence in order to support Council in their efforts to maintain sustainable environments that support health and well being. Changes in land use can pose complex threats to the health of the community, and can also offer great opportunities to improve health. Part of our program of work concerns addressing these links between the environment and human health. Our work is about preventing ill health and disease, in collaboration with our major partners such as local government, and we are always working towards improving the health of local populations. New evidence is constantly emerging linking urban environments to negative health impacts. Research also indicates that changes in how urban environments are planned can positively impact on health, after these plans are implemented. Hence we are keen to disseminate to local Councils information that will support planning for sustainable and healthy urban environments.

There are existing tools that may be applied by urban planners in local government, to strengthen the positive health and well being impacts of land use planning. These tools are mostly web-based resources, which have been developed to assist urban planners in developing healthier and sustainable communities. Perhaps Lithgow City Council is already aware of these tools, and may therefore consider including some of this material to support the work of relevant Council departments. However, I would like to recommend that Council consider, where feasible, adopting the recommendations provided in the following references:

- Healthy by design: a planners' guide to environments for active living (National Heart Foundation - Vic. branch)
http://www.planning.nsw.gov.au/programs/services/pdf/udas_yo.pdf

- Creating Active Communities: Physical Activity Guidelines for local Councils (NSW Dept. of Local Government)
<http://www.dlg.nsw.gov.au/Files/Information/physguid.pdf>
- Public Spaces for Young People (NSW Attorney General Depts.)
[http://www.ag.gov.au/agd/www/rwpattach.nsf/viewasattachmentPersonal/\(C99C9C662AE008709B6A1B06BCF8E5CF\)~ncp_PublicSaftey200802.pdf/\\$file/ncp_PublicSaftey200802.pdf](http://www.ag.gov.au/agd/www/rwpattach.nsf/viewasattachmentPersonal/(C99C9C662AE008709B6A1B06BCF8E5CF)~ncp_PublicSaftey200802.pdf/$file/ncp_PublicSaftey200802.pdf)
- Urban Design Guidelines with Young people in mind (DIPNR)
http://www.planning.nsw.gov.au/programs/services/pdf/udas_yo.pdf
- How to prepare a bike plan (RTA)
http://www.rta.nsw.gov.au/trafficinformation/downloads/bicycimpro_dl1.html
- How to prepare a pedestrian access and mobility plan (RTA)
http://www.rta.nsw.gov.au/trafficinformation/downloads/mobility-plan_how-to.pdf

Please address future correspondence to the Director, Sydney West Centre for Population Health, PO Box 63, Penrith 2751.

If you wish to discuss any of the above further please contact Helen Ptolemy at the Sydney West CPH Penrith Office on 02 4734 2022.

Yours sincerely

Dr Conrad Moreira
A/Regional Health Officer

Emma Crago

From: Bristol, Peter J [Peter.J.Bristol@team.telstra.com]
Sent: Wednesday, 1 February 2006 3:39 PM
To: Ian Rufus
Cc: Humphrey, Greg; Truman, Wendy; Bowen, Laures A
Subject: Lithgow Environment Meeting
Importance: High

Ian,

As discussed on the phone on Monday we will not be sending a representative to your meeting tomorrow.

We have had a preliminary review of the area disclosed in your maps and correspondence.

In the area under review we have Customer Access Network - servicing customers from the Lithgow Telephone Exchange via underground methods, Inter Exchange Optical Fibre cables - linking Telephone exchanges via underground optical fibre and dedicated services to places of interest such as the Correctional facilities as underground cabling.

The correspondence talks about your consideration to growth, changes in land use etc. Obviously we respond to those utility pressures as they arise and can outline typical scenarios in line with your expectations.

As required we maintain and work on our network and this would be no different in the area nominated. Where the activities require we nominate such activity to the City of Lithgow Council as per the current MOU.

As committed, we will confirm a date with yourself or Geolyse P/L to meet to discuss any requirements you may have for any specific detail, mapping etc.

If you require any other detail do not hesitate to call either Greg Humphrey, 02 42 512 608, or myself.

***Regards,
Peter Bristol***

Access Planning Manager NSW Country
Telstra Services

 02 62191282

 02 62575275

 0419497025

 peter.j.bristol@team.telstra.com

ACCESS PLANNING REGIONAL CORE SERVICES:

"Investing in the Access Network to deliver service availability, capability and products for the future"

Appendix D

AGENCY RESPONSE TO DRAFT LES

Emma Crago

From: Colette Goodwin [cgoodwin@geolyse.com]
Sent: Friday, 9 June 2006 12:45 PM
To: 'Emma Crago'
Subject: FW: MARRANGAROO DRAFT LOCAL ENVIRONMENTAL STUDY
Attachments: City of Lithgow Council - Land Use Study Local Environmental Study Marrangaroo Main West CRN 10 March 2006.pdf; City of Lithgow Council Pre exhibition comments Marrangaroo Land Use Study Local Environmental Study Marrangaroo CRN 26 May 2006.dat

Australian Rail Track Corporation Ltd ABN 75 081 455 754
 GPO Box 14 Sydney NSW 2001 Level 15 60 Carrington St Sydney NSW
 development@artc.com.au ph: 02 8259 0700 fax: 02 9279 4539

General Manager
 City of Lithgow Council
 180 Mort St
 Lithgow NSW 2790

Via email: ian.rufus@lithgow.nsw.gov.au

Attention: Mr Ian Rufus

RE: Marrangaroo Land Use Study/Local Environmental Study

Thank you for the opportunity to review the draft study.

Australian Rail Track Corporation Ltd's comments are as follows:

4.13.4 Noise Constraints and Management Issues – Railway line

Please delete the word “multi-unit” before residential – ARTC needs to ensure all residential development within 60 m of rail corridor is, if required, subject to acoustic assessment, not just multi-unit proposals.

Also final clause, please reword:

No limit applies to commercial or industrial developments although these developments may also require acoustic assessment if located within 60m of rail corridor.

5.1.4 Rail Network

Level Crossings – Government and ARTC Policy

Please add another italics subclause:

When a development is likely to increase traffic across an existing Level Crossing, ARTC highly recommends that Council consult with it in working towards a new under or overbridge and that some form of developer contributions to be made towards such an improvement.

Last paragraph: The rail siding to the Department of Defence land was removed in the 1980s. Please either remove all references to it or insert the amended paragraph:

In addition to the Main Western Railway, a branch rail siding at the northern end of the Study Area once provided a rail link to the Department of Defence land in the eastern section of the Study Area. However, this siding no longer exists having been removed in the 1980s.

We look forward to seeing the public exhibition.

Should you require further information, please don't hesitate to contact me.

Yours faithfully

Derek Rogers

Development Planning Officer, Sydney

29 May 2006

Your reference : ILR:MAJ
Our reference : 260261A17
Contact : Chris Marshall, 63327603

The General Manager
Lithgow City Council
PO Box 19
Lithgow NSW 2790

Attention: Ian Rufus

Dear Ian,

I refer to your letter dated 12 May 2006 requesting comments on **Marrangaroo Draft Local Environmental Study (LES)** in the context of its ongoing preparation for formal public exhibition. The current draft has been reviewed and the following comments offered for Council's assistance.

The DEC generally focuses its assistance to Council on planning matters at the landscape and whole of council level with particular attention to studies, strategies and local environmental plans (LEP). It has earlier assisted Council in these matters for both the Marrangaroo project and the wider, whole of Council area Land Use Strategy, with guidance on relevant issues to be addressed as well as providing direction on the relevant state policy and statutory frameworks to be applied. Assistance has been provided by way of letter and representation at Council facilitated planning meetings.

The DEC has advised Council that a major role for Council's Studies and Strategies is to recognise settlement and development as a significant pressure on many of the community values that are the core elements of sustainable development. The decisive strategic steps that Council should take to manage these pressures include:

- clearly direct subdivision and associated intensification of settlement pressures away from areas of biodiversity value and other environmental sensitivity,
- cluster compatible land uses and developments and provide effective buffering to manage neighbour conflict issues associated with noise, odour, dust and pesticide use, and
- set appropriate development conditions to protect community values on those areas that may be justified and identified as being both capable and suitable of supporting intensified settlement and development.

Council has also been advised that it is essential that the Strategies establish and demonstrate a clear case for settlement and development in terms of patterns and densities. Such a case should be based on the validity of the opportunities within the context of managing the values of the area to achieve a clearly established long-term vision for both settlement and development as well as environment protection and conservation.

While the Draft LES presents a case for the general capability of the Marrangaroo area to support land use change, it does not clearly articulate a strategic reason for increasing development here ahead of other areas in the Lithgow Council area. The draft LES could be substantially strengthened by establishing such a strategic case for the Marrangaroo site against other settlement and development opportunities that may exist. Particular attention needs to be given to establishing the relative merits of the Marrangaroo area against other areas, in the context of the significant suite of complex environmental protection issues and conservation values that exist there.

The Draft LES provides a substantial amount of site specific information that identifies a significant suite of complex environmental protection issues and conservation values relevant to Marrangaroo study area. It is noted that it also identifies opportunities to effectively address these by way of land use allocation and development control measures.

The DEC in particular notes and supports the approach of the LES to:

- identify both general biodiversity values as well as the specifics of significant species, populations and communities,
- protect and buffer existing remnant native vegetation,
- establish development control guidance to expand, link and manage pockets, clumps and fingers of native vegetation in the context of the stated aim of maintenance and improvement of these important assets,
- separating incompatible land uses to manage issues of noise, vibration and other matters,
- identify occurrences of Aboriginal cultural heritage via use of the AHIMS database, Aboriginal community consultation and field survey,
- highlight known occurrences of Aboriginal cultural heritage and the statutory implications of disturbing or destroying these assets,
- identify locations of likely land contamination for closer investigation, and
- guide development and settlement intensification to existing cleared lands.

The particular focus in the LES of highlighting the need for expansion, linkage and management of remnant native vegetation throughout areas proposed for development is supported as a means to address the remnant habitat of the Bathurst Copper-winged Butterfly that may exist outside the main areas of native vegetation protection. Council is advised to discuss with the Hawkesbury Nepean Catchment Management Authority (CMA) how these and the proposed larger linkages relate to their Regional Biodiversity Corridor Strategy.

In noting the specific referencing in the Draft LES of the Metromix Quarries Environment Protection Licence (EPL), the DEC alerts you to a recent application for an EPL by the Arch Vale Trout Farm and the need to explore the implications of this in the LES.

The DEC supports the effective separation of non compatible land uses and notes the proposed options for buffering residences from the impacts of noise and vibration from the Marrangaroo quarry. Council is advised that such a buffer does not release the EPL licensee from achieving it's specific licence requirements and to this end Council is encouraged to adopt a precautionary approach in selecting a generous buffer width to protect the industry and any potential sensitive receptors from conflict.

Your attention is also drawn to the EPL that applies to the NSW rail system covering the main western rail line that passes through the LES area. It is noted that the LES addresses the matter of noise in relation to this system.

The Draft could be greatly strengthened by directly referencing the current government endorsed Water Quality and River Flow Objectives that apply to the area, together with an assessment as to the extent that these are currently being achieved and the identification of current key pollutants and flow regimes. These endorsed objectives form the foundation for a transparent

process to manage the cumulative impact of developments by establishing development performance benchmarks to achieve either neutral or beneficial outcomes within the Sydney Drinking Water Catchment by way of development control provisions.

A similar approach using the State Groundwater Quality Policy framework needs to be used in relation to protecting groundwater uses from pollution.

I trust that Council finds this submission helpful in further refining the Draft LES prior to its eventual public exhibition. Please feel free to contact me at the Bathurst office of the DEC for further detail, discussion or assistance.

Yours sincerely

Chris Marshall
Senior Regional Programs Officer
Environment Protection & Regulation Division
Department of Environment and Conservation
25 May 2006

From: Craig Ronan [mailto:Craig.Ronan@centralwest.ses.nsw.gov.au]
Sent: Friday, 19 May 2006 3:24 PM
To: Ian Rufus
Subject: Re: MARRANGAROO DRAFT LOCAL ENVIRONMENTAL STUDY
Importance: High

Hi Ian,

In the absence of any formal Flood Studies for the Marangaroo area the NSW State Emergency Service is happy with Option 3.

We would like Council to however ensure that where residential and industrial areas are developed in the Marangaroo area in the future Council introduce a strategy in conjunction with the NSW State Emergency Service to educate property owners of the potential of flash flooding during extreme rain events.

Please call me should you have any questions or if you require additional information.

Regards,

Craig Ronan MAIES JP
 Region Controller

Central West Region
 NSW State Emergency Service
 79 Corporation Avenue
 BATHURST NSW 2795

Phone: (02) 6334 8555
 Fax: (02) 6334 8500
 Mobile: 0418 476 254
 E-mail: Craig.Ronan@centralwest.ses.nsw.gov.au

Web: www.ses.nsw.gov.au

----- Original Message -----

From: [Ian Rufus](mailto:Ian.Rufus@centralwest.ses.nsw.gov.au)
To: tom.shirt@rfs.nsw.gov.au ; [Ann Sharrock](#) ; [Anna Patton](#) ; [Derek Rogers](#) ; [Helen Ptolemy](#) ; [Malcolm Hughes](#) ; [Natalie McGill](#) ; [Patterson, Sandra](#) ; [Warwick Battye-Smith](#) ; [Cameron Dobson](#) ; [Cameron Ricketts](#) ; [Chris Marshall](#) ; [Conrad Moreira](#) ; [Craig Ronan](#) ; [Doug Moore](#) ; [Edward Frater](#) ; [Geoff Longhurst](#) ; [James Maldon](#) ; [Mary Kovac](#) ; [Pat Woodbury](#) ; [Ron Bouwman](#) ; [Trish Kidd](#) ; [Vince Sicari](#) ; [Warren Smith](#)
Sent: Monday, May 15, 2006 2:25 PM
Subject: MARRANGAROO DRAFT LOCAL ENVIRONMENTAL STUDY

The Study has now progressed to the draft stage. Public exhibition of the study is programmed to commence in early June 2006. A copy of the study on CD is in the post today. A copy of the preferred Option 3 is attached.

All comments and issues raised by stakeholders have been considered and addressed in the draft. However, I would appreciate your comments on the draft study and the concept plan in particular at this stage. As Council is keeping to a tight time line I will need any comments before close of business on 28 May, 2006. Emailed comments would be preferred due to speed and flexibility, followed by hard copy only if you require.

This is an internal document at this stage, until review and formal public exhibition. I would appreciate you keep it confidential at this stage, as it may change subject to Council, authorities and agencies review.

Please let me know if you do not receive your letter shortly. I realise the timeframe is short, so please phone me direct to discuss any aspect of the study on 63549913 or by return email..

Cheers,
Ian Rufus

Planning and Development Manager - Lithgow City, PO Box 19, LITHGOW NSW 2790.



Centre for Population Health

Nepean Hospital Campus
Kingswood NSW 2747

Phone: (02) 47342022
Fax: (02) 47343300

PO BOX 63
PENRITH NSW 2751

25 May 2006

Mr Paul Anderson
General Manager
City of Lithgow Council
PO Box 19
LITHGOW NSW 2790

Attn: Mr Ian Rufus

Dear Mr Rufus

Marrangaroo Draft Local Environmental Study

I refer to your letter dated 12 May 2006 requesting comments from Sydney West Area Health Service (SWAHS) on the Marrangaroo Draft Local Environmental Study (DLES). Additional information is provided below on issues outlined in the DLES with the potential to impact on the health and well being of the community. Considerations regarding community access to health services are also outlined.

1. Land Contamination

- Consultation with the NSW EPA (a division of the Department of Environment and Conservation) will be required based on the information provided in the LES. Many of the contaminants identified by the Contaminated Site Analysis constitute a Significant Risk of Harm and are therefore reportable to the NSW EPA. A health risk assessment may be required.

2. Surface Water

- As Geolyse will not be able to gather a sufficient quantity of data on the microbial quality to obtain a median level for comparison against the current ANZECC/ARMCANZ microbial values, it is recommended that Geolyse examine similar data from other reliable sources (e.g. Sydney Catchment Authority, Lithgow Council or others).
- Reference should be included to any existing State Emergency Services management plans for flooding in the area. The source of the reference for 'Wentworth Group of Scientists' (p. 4.25) should be identified.
- The statement that changes to surface water runoff will be avoided should be discussed more extensively in later proposals.

3. Air Quality

- SWAHS supports the need to ensure that existing air quality conditions within the study area are not degraded by any future development. Any planned industrial development in the proposed employment zones would need to have appropriate consent conditions to ensure that existing air quality conditions are maintained.

4. Noise

- As the residential area develops, consideration should be given to controlling blast over-pressure in association with prevailing meteorological conditions and topographic features which may influence noise impacts, and to ensure compliance with relevant noise standards.
- Investigations of noise mitigation measures should be undertaken. For example, quarry plant and equipment may need to be fitted with critical residential type silencers, earth bunding may need to be installed for reducing noise at the residential receptors, and a noise management/monitoring program should be established to manage noise impacts.
- In the Defence land, precinct noise complaints may arise due to operational training and ordnance blasting activities within the precinct. An adequate buffer zone for residential premises may need to be established to minimise noise complaints.

5. Access & Transport Networks

- Providing safe access to and from the Great Western Highway is a critical issue and needs to be addressed by the development proposal.
- SWAHS supports the Guiding Principle (Table 9.1, p. 9.2) derived from the community-identified need to provide “walking, cycle and public transport links back into Lithgow.” Providing safe, alternate road access to the town of Lithgow early in the life of the development will be particularly important as there is likely to be insufficient local economic activity to meet demand for basic goods and services.
- Opportunities and options for active transport should be maximised over the life of the development. SWAHS recognises that slow population growth is likely to militate against the provision of an economically viable public transport service in the early stages of the development. Options should be explored during later phases of planning for providing incentives to private operators to start up and maintain these services.
- In the medium- to longer-term, urban form should maximise the potential for walkability. It should at least be possible for most residents in the urban precincts of the development to walk to basic services and to a school. This outcome is best achieved by incorporating mixed land use (i.e. residential, commercial and office uses) wherever possible within the new development. It is not clear from the preferred Proposed Land Use Plan (Figure 28) or indeed any of the land use plans, that this will be realised.

6. Water Supply

- Appropriate infrastructure is required throughout the drinking water reticulation system to ensure that drinking water is adequately treated and appropriate barriers are in place to ensure a safe drinking water supply.
- Consideration and planning should be undertaken to ensure that there is sufficient water in times of drought. This could include planning for additional treatment infrastructure at water treatment plants if water from sources of questionable quality needs to be used.

7. Sewerage Infrastructure

- The flooding of sewerage infrastructure including pumping stations throughout the area should be considered as a possible risk/constraint.
- Possible water reuse options should be investigated, for example, for irrigation of open parkland spaces and/or industry use. However this should involve a full health risk assessment taking into consideration all potential implications for human health including direct exposure to, or aspiration of, sewage, or the use of effluent in any reclaimed water scheme.

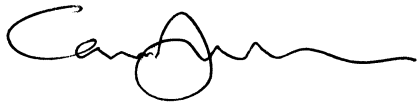
8. State Government & Infrastructure Providers – Health Services

- Reference to “Sydney West Area Health” is incorrect on pages 6.6 and 6.10. Should read “Sydney West Area Health Service”
- Lithgow Hospital and Lithgow Community Health Centre will be the main public sector health facilities for the Marrangaroo locality.
- The new Lithgow Hospital was opened in 1999 and there is capacity within the current services to accommodate some increase in the Lithgow LGA population.
- Health services planning is based on population projections endorsed by NSW Department of Planning, as part of its role in coordination of planning across government agencies. As the Lithgow LGA population is projected to decrease slightly and to age, there are no plans to significantly expand current public sector facilities.
- Subject to confirmation that the development will occur and its incorporation into Department of Planning estimates, further investigation would be done to assess the growth capacity of Hospital and Community Health facilities.
- Public transport options to access the Hospital and Community Health Centre should be incorporated into any development.
- Advice should be sought from the NSW Central West Division of General Practice regarding General Practitioner workforce issues relevant to this locality.

Additional discussion of the above issues and on how the planning of Marrangaroo can increase the opportunities to improve health within the community may be more relevant at a later stage of the development. The Area Health Service would be pleased to continue to assist Council to create and sustain environments that support the health and well being of the community.

Please contact Helen Ptolemy or Ron Bouwman on 4734 2022 if you wish to discuss any of the issues referred to in this letter.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Conrad Moreira', with a large circular flourish at the end.

Dr Conrad Moreira
A/Regional Health Officer