



Preliminary Flora and Fauna Assessment

Proposed Rezoning

Lots 1-4 Section 67 DP75863 and Lots 1-2 DP797732,
Jamberoo Road, Kiama

Prepared for
White Constructions

5 March 2013





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PREPARED FOR	White Constructions
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1 Introduction

Unicom Development Services Pty Ltd engaged Eco Logical Australia Pty Ltd (ELA) on behalf of White Constructions Pty Ltd to undertake a preliminary Flora and Fauna Assessment to accompany a planning proposal to rezone Lots 1-4 Section 67 DP 75863 and Lots 1-2 DP 797732 Jamberoo Road, Kiama (**Figure 1**), hereafter referred to as the subject land. This report is the result of initial field studies and consideration of a range of relevant reports, mapping, legislation, policies and plans.

The subject land has been predominantly cleared of native vegetation through a long history of agricultural use, and is currently zoned RU2 Rural landscape. The proposal involves rezoning the subject land to R2 Low Density Residential, to allow subdivision of the land for residential purposes.

While the subject land is predominantly cleared with few flora and fauna values, it is fringed by areas of native vegetation with high conservation values, including threatened plants and an endangered ecological community (EEC). Future residential development of the subject land needs to incorporate strategies to protect the conservation values on adjoining lands.

1.1 PROPOSAL DESCRIPTION

The proposal involves the rezoning of Lots 1-4 Section 67 DP 75863 and Lots 1-2 DP 797732 located to the south of Lilly Pilly Way, from RU2 Rural landscape to R2 Low Density Residential. The rezoning aims to enable the subdivision of the land into approximately 98 residential allotments, known as Cedar Grove Estate, Stage 2 (**Figure 2**). The subject land adjoins, and will extend from, the R2 zoned land to the north, and predominantly adjoins RU2 zoned lands to the west. To the east, the subject land adjoins E3 and E2 zoned lands, with a patch of E2 zoned land to the west of the subject land.

Access to the newly created subdivision is anticipated from the north, via Lilly Pilly Way and/or Banksia Drive. Asset Protection Zone (APZ) requirements will be achieved within the subject land. Water and sewer infrastructure is anticipated to connect to the east of the site, along the unformed Noorinan Street. Water and sewer connection is the only component of the proposed development that will involve direct removal of high conservation value vegetation, as part of the affected area comprises the Illawarra Subtropical Rainforest EEC. The affected vegetation is sparse in places due to a rocky gully, and heavily affected by weeds.

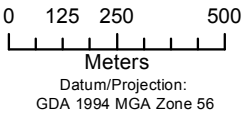
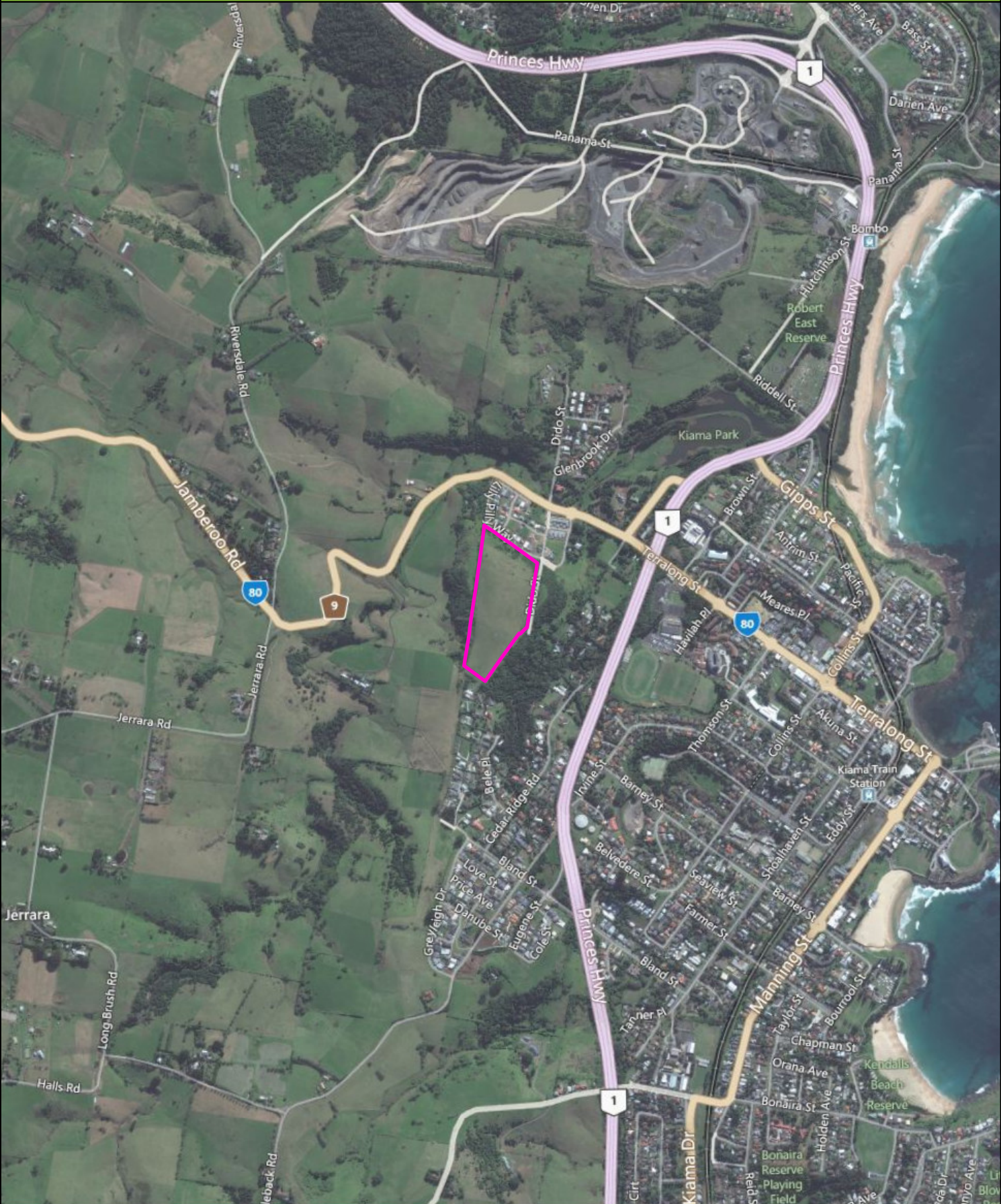
A linear path up to 10 m wide would need to be cleared for the connection of sewer and water pipelines along Noorinan Street. This would include the removal of up to approximately 0.03 ha of disturbed Illawarra Subtropical Rainforest. Within the site, approximately 1 ha of other vegetation dominated by exotic trees and shrubs would need to be cleared for the residential development. The remaining approximately 7 ha of the proposed development footprint comprises exotic grassland or pasture.

Two threatened flora species are known to occur on the eastern and western edges of the proposal, at the current interface between exotic grassland and disturbed rainforest vegetation or weeds. No threatened flora would be removed by the residential development resulting from the rezoning proposal. Similarly, the Illawarra Subtropical Rainforest EEC and important habitats for flora and fauna will not be directly affected by the resulting residential development.

The proposal has the potential for indirect impacts resulting from the residential development to adversely affect adjacent vegetation. Edge effects including weed invasion, erosion and sedimentation, increased lighting, increased noise, changes to hydrological and nutrient regimes, rubbish dumping, firewood collection and increased human disturbance can be associated with residential development near bushland. The potential for some of these impacts is increased due to the topography of the area, with the future development generally located above vegetation on moderate slopes. However, the level of existing disturbances and absence of any substantial native vegetation clearing, limits the overall impact of the proposal. Potential indirect impacts are able to be mitigated or prevented by appropriate and sensitive design at the subdivision planning stage, by environmental controls at the construction stage, and by ongoing management of the urban/bushland interface. Through these measures, the proposal also has the potential to improve the condition of habitat surrounding threatened species and communities.

The proposed rezoning for residential development utilises cleared land and together with appropriate site design, site controls and ongoing management, should adequately mitigate impacts upon endangered ecological communities, threatened species, habitats and connectivity.

Figure 1: Location of the Subject Land



 Subject Land

Data Sources:
Bing Aerials



Figure 2: Proposal, Study Area and Subject Site



- Subject Site
- Subject Land
- Study Area
- Site Layout
- Lots

0 20 40 80
Meters
Datum/Projection:
GDA 1994 MGA Zone 56

Data Sources:
Bing Aerials
DWG - SET Consultants

1.2 SUBJECT SITE, STUDY AREA AND LOCALITY

The subject land is located in Kiama, approximately 1.1 km to the west north-west of the CBD. It lies immediately to south of Lilly Pilly Way, near the current interface of the Kiama residential area and the rural lands to the west.

Subject Site

For the purposes of this assessment the subject site is considered to be those areas currently zoned RU2 and proposed to be zoned R2 Low Density Residential (Lots 1 & 2 DP 797732 and Lots 1-4 DP 758563) and parts of the unformed Noorinan Street, which lies between these Lots and will be affected by water and sewer pipeline construction (**Figure 2**). The subject site is approximately 8 ha in size.

Study Area

The study area includes the subject site and adjacent areas of native and/or exotic vegetation which could be indirectly affected by the later stages of the proposal to subdivide the land (**Figure 2**). The study area generally includes land up to 40 m beyond the subject site, although the focus of surveys for this preliminary assessment was land within and immediately adjacent to the subject site. Areas up to 100 m beyond the subject site were also traversed to gain an understanding of adjacent habitat attributes.

Locality

The locality for the purposes of this report is land within a 5 km radius from the centre of the study area.

1.3 TOPOGRAPHY AND GEOLOGY

The subject site is located in the coastal area below the Illawarra Escarpment and occupies a gently undulating ridge at approximately 40-70 m AHD. Steeper gradients to the north, east and west of the site characterise the surrounding landform. The site occurs within the Bumbo soil landscape unit, described as low rolling hills with benched slopes and long convex slopes, with friable sandy clay loams or hardsetting sandy loams over Bumbo Latite (Hazelton 1992). The site ultimately drains to the north east via Spring Creek and Willow Gully (category 2 watercourses), and drains to the ocean between Kiama and Bombo. Some exposed latite rock and boulders are evident on the site, and these become much more prevalent on the steeper slopes to the east and west.

1.4 DISTURBANCES

The entire subject site has been cleared and used for agricultural purposes for probably more than a century. The area is currently used for grazing and almost entirely supports grazing pasture composed of exotic grasses. Much of the surrounding properties that are included in the study area have also been cleared, although substantial regrowth of native and exotic vegetation has occurred, along with planting of exotic trees (Coral Trees). Apart from some core areas of subtropical rainforest in relatively good condition, much of the vegetation in the study area is characterised by a dominance of exotic species. Parts of the study area containing denser vegetation are accessed and disturbed by cattle. Stone or wire fencing and vehicle tracks are also apparent within the study area.

While some native vegetation extends a short distance from the southeast of the study area (Willow Gully), vegetation surrounding the study area is largely isolated, fragmented and disturbed due to clearing, residential development and farming activities. The occurrence of native vegetation patches with poor habitat connectivity is typical of the locality.

2 Relevant Legislation, Policies and Plans

2.1 COMMONWEALTH

2.1.1 Environmental Protection and Biodiversity Conservation Act 1999

The Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) provides a national scheme for protecting the environment and conserving biodiversity values.

Approval from the Commonwealth Environment Minister is required under the EPBC Act if the action (which can include a project, development, undertaking or activity) will, or is likely to, have a significant impact on matters considered to be of national environmental significance (NES matters). NES matters relevant to the proposal include species and ecological communities that are listed under the Act. The EPBC Act does not define significant impact but identifies matters that are necessary to take into consideration.

This report undertakes a preliminary assessment of EPBC NES matters and advises if a referral to the federal Department of Sustainability, Environment, Water, Population and Communities (DSEWPC – formerly Department of Environment, Water, Heritage and Arts) is likely to be required.

2.2 STATE

2.2.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) is the principal planning legislation for NSW, providing a framework for the overall environmental planning and assessment of development proposals.

The EP&A Act places a duty on the determining authority to adequately address a range of environmental matters including maintenance of biodiversity and the likely impact to threatened species, populations or ecological communities (under the TSC Act – refer below).

2.2.2 Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) aims to protect and encourage the recovery of threatened species, populations and ecological communities listed under the Act. Obligations on Councils include consideration of threatened species, populations, ecological communities and recovery plans in fulfilling their statutory responsibilities under the EP&A Act.

2.2.3 Native Vegetation Act 2003

The *Native Vegetation Act 2003* (NV Act) aims to conserve and manage native vegetation through regulation of native vegetation clearing. It provides for the encouragement and promotion of the management of native vegetation on a regional basis in the social, economic and environmental interests of the state. Management of native vegetation must have regard to its contribution to water quality, biodiversity and land degradation. It also provides a mechanism to improve the condition of existing native vegetation.

The NV Act does not directly apply to rezoning applications and will not apply to the subsequent residential land zoning. However, the Act may apply to proposed clearing for the pipeline construction to the east of the subject land or other clearing within land zoned as E2 or E3. Advice on the application of the NV Act should be sought from the Southern Rivers Catchment Management Authority.

2.3 LOCAL

2.3.1 Kiama Local Environmental Plan 2011

Under the Kiama Local Environmental Plan 2011 (LEP), the subject land is zoned RU2 Rural Landscape, with adjoining land zoned as R2, E2 and E3. The project proposes to rezone the subject site to R2 Low Density Residential, the same zoning as the adjoining Cedar Grove Estate Stage 1 to the north. Under the LEP, the proposal is permissible with relevant approvals.

3 Methods

3.1 DATABASE AND LITERATURE REVIEW

A review of relevant information was undertaken prior to the commencement of field studies and referred to for the preparation of this report. Databases and other sources were interrogated to generate a list of threatened and migratory species that have been recorded or are likely to occur within 10 km of the study area (Appendix A). Relevant datasets and information included:

- The Atlas of NSW Wildlife – searched on 18 October 2012;
- The EPBC Protected Matters Search Tool – searched on the 18 October 2012;
- Existing vegetation and biodiversity mapping from Kiama Council; and
- Previous flora and/or fauna studies relevant to the area, including Kevin Mills & Associates (2006a & 2006b), Illawarra Bushland Database.

Data gathered during all field studies and the literature review was analysed and interpreted in accordance with the provisions of legislation and planning controls pertaining to flora and fauna. Threatened and migratory species, threatened populations and EECs that have been recorded, or have the potential to occur within the locality have been assessed for their likelihood to occur within the study area and the significance of any potential impacts associated with the proposal (Appendix A).

3.2 FLORA SURVEYS

General botanical surveys were conducted in the study area by ELA between 28 April and 14 September 2012.

Community Identification, Mapping and Floristic Audit

The Random Meander technique documented by Cropper (1993) was used across the study area, to document the flora species present and the approximate location and extent of vegetation communities. Particular attention was given to identifying the presence of threatened flora species and endangered ecological communities (EECs), especially within or immediately adjacent to the subject site.

Targeted species primarily included *Zieria granulata*, *Cynanchum elegans*, *Daphnandra* sp. C 'Illawarra' and *Solanum celatum* but also *Irenepharsus trypherus*, *Lespedeza juncea* subsp. *sericea* and *Chorizema parviflorum*. Additional targeted surveys to ascertain the size of the *Zieria granulata* population to the west of the subject site were undertaken on 14 September 2012 to ascertain the extent of the population. Where found, *Zieria* specimens were marked with flagging tape and the location of plant clusters were recorded with handheld GPS.

Limitations

The floristic surveys undertaken recorded as many species as possible and provide a comprehensive but not definitive species list. More species would be recorded during a longer survey over various seasons.

The mapped boundaries of vegetation communities, including EECs, are indicative due to the limited survey effort employed on land adjacent to the subject site. Additional threatened flora may be present within the study area beyond the boundaries of the subject site.

Nevertheless, the techniques used in this investigation are considered adequate to gather the data necessary to assess the impacts of the proposal on the flora species and vegetation communities found in the study area.

Flora Survey Effort

The ELA flora survey effort employed a total of 26 person-hours as documented in **Table 1**.

Table 1: Flora survey effort employed over the study area by ELA for this assessment.

DATE	METHOD	EFFORT	TARGET SPECIES
28 April 2012	Random meander, community identification and targeted search	10 person-hours	All species
11 May 2012	Random meander, community identification and targeted search	6 person-hours	All species
14 September 2012	Targeted search	10 person hours	<i>Zieria granulata</i>
TOTAL FLORA SURVEY EFFORT		26 PERSON HOURS	

3.3 FAUNA SURVEYS

Field investigations for fauna and fauna habitats were conducted by ELA in conjunction with vegetation surveys in the study area between 28 April and 14 September 2012 for a total of 26 hours. Fauna surveys were limited to opportunistic methods given the lack of substantial habitats to be directly or indirectly affected by the proposal and the preliminary level of the assessment.

Surveys involved direct visual and aural recording of species and indirect evidence of fauna, such as scats, tracks, burrows, diggings, scratchings, nests and roosts.

Specific searches were conducted for habitats or resources of relevance for those threatened fauna species known from the general region, or species, which might be anticipated to occur given the vegetation communities and habitats present. These resources included potential feed trees, hollow-bearing trees, understorey shelter, burrows, caves, boulder piles and water habitats.

Limitations

The results of fauna surveys can be optimised by conducting investigations over a long period to compensate for the effect of unfavourable weather, seasonal changes and climatic variation. In general, the longer the survey the more species will be detected. Results can also be improved by using a wide range of techniques, since some species are more likely to be detected by a particular method or during a more favourable time in the breeding cycle.

However, surveys are subject to constraints that determine the amount of time allocated, the methods used and the timing of the work. Thus, the results should be viewed in the light of these limitations. The fauna detected in current survey work are a guide to the native fauna present, but are by no means a definitive list of the species occurring within the area. Nevertheless, the techniques used in this investigation are considered adequate to gather the data necessary for this preliminary assessment.

Survey Conditions

Opportunistic fauna survey conditions throughout the survey period were fine, warm, with no rain and little or no wind.

4 Results

4.1 DATABASE AND LITERATURE REVIEW

Appendix A provides a list of threatened and migratory species that have been recorded, or for which suitable habitat occurs, within a 10 km radius of the study area. In Appendix A, the habitat characteristics of these species have been evaluated to determine their likelihood to occur within the study area. Species known only from marine or estuarine habitats have been excluded.

The potential impacts of the proposal on those threatened species or endangered communities known from the study area have been assessed further in Appendix C.

4.1.1 Previous Records of Conservation Significance

The review of existing information revealed no threatened species records within the predominantly cleared subject site. Records of two threatened flora species, *Cynanchum elegans* and *Daphnandra johnsonii*, occur close to the eastern edge of the subject site. Areas of Illawarra Subtropical Rainforest were also mapped as occurring close to the east and west of the subject site (KMA 2006a).

4.2 FLORA

4.2.1 Vegetation Communities

The vegetation in the study area is highly disturbed, predominantly consisting of Introduced Grassland/Pasture with a surrounding fringe of Weeds/exotics and Regrowth, Disturbed Rainforest and Subtropical Rainforest (**Figure 3**). Two areas of Subtropical Rainforest occur, in the east and west of the study area, as shown in **Figure 3**. Introduced Grassland / Pasture

This area covers the majority of the site with the characteristic plant species being Kikuyu *Pennisetum clandestinum*, occurring along with other minor introduced pasture species and occasional occurrences of Lantana *Lantana camara*. Other species occurring in this community include: Cobblers Pegs *Bidens pilosa*, Fireweed *Senecio madagascariensis*, Fleabane *Conyza bonariensis*, Cotton Bush *Gomphocarpus fruticosus* and Paddy's Lucerne *Sida rhombifolia*.

4.2.2 Weeds / Exotics / Regrowth

This community consists predominantly of introduced tree species (approximately 85%) with scattered occurrences of native species (such as Wattles) typical of heavily disturbed areas. The community often consists of a low canopy of 3 – 5 metres and a variable foliage cover of up to approximately 80% where the dominant species are African Olive *Olea europea* subsp. *cuspidata* and Broad-leaved Privet *Ligustrum lucidum*. Planted lines of mature Coral Trees *Erythrina x sykesii* are a characteristic feature of this community, often with a dense understorey of Lantana *Lantana camara*, occurring predominantly on the fringes.

Patches of this community are dominated by native species that characterise regrowth of heavily disturbed areas such as Sydney Golden Wattle *Acacia longifolia* var. *longifolia*, Maiden's Wattle *Acacia maidenii* and Green Cascarilla *Croton verreauxii*.

Minor canopy or understorey species include Cockspur Thorn *Maclura cochinchinensis*, Lillypilly *Acmena smithii*, Small-leaved Privet *Ligustrum sinense*, Camphor Laurel *Cinnamomum camphora*, Guioa *Guioa semiglauca*, Koda *Ehretia acuminata* var. *acuminata*, Hibiscus *Hibiscus heterophyllus*, and Sweet Pittosporum *Pittosporum undulatum*.

Shrub and groundcover is minimal, occurring only in small patches in canopy openings and on the fringes, and consists of introduced grasses with occasional rainforest groundcover species.

4.2.3 Disturbed Rainforest

This community consists of a mixture of introduced tree species (approximately 50%), native rainforest trees and native understorey species. The community generally consists of a low canopy of 4 – 8 metres and a foliage cover of approximately 80%. The variable canopy primarily comprises African Olive *Olea*, Camphor Laurel, Broad-leaved Privet, Sweet Pittosporum, Coral Tree, Maiden's Wattle and Green Cascarilla.

Shrub and groundcover is minimal due to rock cover, and consists predominantly of native rainforest groundcover species. The threatened species Illawarra Socketwood *Daphnandra* sp. C 'Illawarra' and Illawarra Zieria *Zieria granulata* occur on the fringe of this vegetation community.

Minor canopy species include Cabbage Palm *Livistona australis*, Cockspur Thorn *Maclura cochinchinensis*, Lillypilly *Acmena smithii*, Small-leaved Privet, Camphor Laurel, Flintwood *Scolopia braunii*, Guioa *Guioa semiglauca*, Sassafras *Doryphora sassafras*, Koda *Ehretia acuminata* var. *acuminata*, Hibiscus *Hibiscus heterophyllus*, Whalebone *Streblus brunonianus* and Native Holly *Alchornea ilicifolia*.

Shrub and groundcover species include Kidney Weed *Dichondra repens*, Scurvy Weed *Commelina cyanea*, Basket Grass *Oplismenus aemulus*, Speedwells *Veronica plebeia*, Jointed Fern *Arthropteris tenella*, Stinging Nettle *Urtica incisa*, Tussock Sedge *Carex appressa*, Weeping Grass *Microlaena stipoides* var. *stipoides*, Asparagus sp., Golden Guinea Flower *Hibbertia scandens*, Scrambling Lily *Geitonoplesium cymosum*, Mist Flower *Ageratina riparia*, Northern Cranesbill *Geranium homeanum*, and Pennywort *Hydrocotyle tripartita*.

This community merges with the Subtropical Rainforest community below and the boundaries between these communities have not been defined precisely, but it differs as the dominant species are exotic or native but not characteristic of Subtropical Rainforest.

4.2.4 Subtropical Rainforest

This community has a canopy cover of approximately 80-90%, consisting predominantly of canopy species and climbers, with an intermittent cover throughout of low groundcover species. The Disturbed Rainforest described above fringes this community. There is a generally a low occurrence of introduced species in this community, occurring predominantly on the fringes.

Characteristic canopy species include Guioa *Guioa semiglauca*, Red Cedar *Toona ciliata*, Koda *Ehretia acuminata* var. *acuminata*, Green Native Cascarilla *Croton verreauxii*, Figs *Ficus* sp., Whalebone *Streblus brunonianus*, Myrtle Ebony *Diospyros pentamera*, Native Quince *Alectryon subcinereus*, Cockspur Thorn *Maclura cochinchinensis*, Brush Bloodwood *Baloghia inophylla*,

Cabbage Palm *Livistona australis*, Flintwood *Scolopia braunii*, Stinging Tree *Dendrocnide excelsa*, Veiny Wilkiea *Wilkiea huegeliana* and Red-fruited Olive Plum *Elaeodendrum australe*.

Climbers occurring in this community include Giant Pepper Vine *Piper novae-hollandiae*, Burney Vine *Trophis scandens* subsp. *scandens*, Common Milk Vine *Marsdenia rostrata*, Monkey Rope *Parsonsia straminea*, Native Grape *Cayratia clematidea* and Round-leaf Vine *Legnephora moorei*.

The sparse understorey has scattered patches of Jointed Fern *Arthropteris tenella*, Water Fern *Blechnum camfieldii*, Scurvy Weed *Commelina cyanea*, Basket Grass *Oplismenus aemulus*, Pastel Flower *Pseuderanthemum variabile*, Jungle Brake *Pteris umbrosa*, Giant Maidenhair *Adiantum formosum*, Rasp Fern *Doodia aspera*, Settlers Flax *Gymnostachys anceps*, Harsh Ground Fern *Hypolepis muelleri* and Swamp Lily *Crinum pedunculatum*.

4.2.5 Endangered Ecological Communities

The Subtropical Rainforest community is consistent with the final determination of Illawarra Subtropical Rainforest, which is listed as an EEC under the TSC Act. Twenty plant species listed in the final determination as characteristic of the community were recorded during surveys. The extent of the Illawarra Subtropical Rainforest in the study area has been reduced in the past by clearing and continues to be adversely affected by weed invasion, particularly by African Olive.

The Disturbed Rainforest community has some similarities with Illawarra Subtropical Rainforest, and these areas are likely to have previously supported Illawarra Subtropical Rainforest. However, the Disturbed Rainforest community is dominated by native or exotic species that are not consistent with the final determination of Illawarra Subtropical Rainforest.

4.2.6 Flora Species

A total of 88 native and 47 introduced flora species were recorded in the study area during the flora survey, and these are listed in Appendix B.

Two threatened flora species were recorded during the survey period. A small stand of Illawarra Socketwood *Daphnandra* sp. C 'Illawarra' (listed as *Daphnandra johnsonii* under the EPBC Act), was recorded near the eastern edge of the subject site (**Figure 3**). Illawarra Zieria *Zieria granulata* was recorded in the western side of the study area (**Figure 3**). Targeted surveys for this species recorded 50 mature plants and 27 seedlings on the western side of the study area. The majority of plants occur beyond the subject site, although two mature plants occur on the western boundary of the subject site.

A previous record of the threatened White-flowered Wax-plant *Cynanchum elegans* occurs close to the eastern edge of the subject site (**Figure 3**), although this species was not recorded during the survey period. The similar Common Milk Vine *Marsdenia rostrata* was recorded at this location but for the purposes of this assessment, *C. elegans* is assumed to be present.

Surveys for threatened flora species focused within and on the edges of the subject site, although targeted searches for *Z. granulata* were extended to the entire western portion of the study area. Therefore, it is possible that these and other threatened flora species occur elsewhere within the study area, but beyond the subject site and immediately adjoining areas and not likely to be directly affected by the proposal.

4.3 FAUNA

4.3.1 Fauna Habitats

Fauna habitats within the subject site are generally very limited, as most of the area contains exotic pasture grasses, with fringing regrowth *Acacias*, and weeds such as African Olive, Lantana and Coral Trees. These habitats are utilised for foraging and sheltering by a relatively small number of common birds and probably reptiles and amphibians. Low stone walls near some of the boundaries of the subject site may provide additional shelter sites for reptiles and amphibians. No important habitats for fauna occur in the subject site.

Beyond the subject site fauna habitats are significantly more diverse, with dense rainforest habitats providing shelter and foraging resources for a large range of birds, mammals, reptiles and amphibians. Small ephemeral drainage lines and rocky slopes are also characteristic of habitats in the wider study area, particularly in the east. The more substantial riparian habitats of Spring Creek to the west and Willow Gully to the east are at least 100m from the subject site and beyond the study area for this assessment.

No hollow-bearing trees were observed in the study area, although a low number of larger rainforest trees (for example Fig Trees) may contain small cavities. No caves or naturally occurring rock crevices were observed in the study area, although rock piles along boundary lines and elsewhere in the study area provide very small crevice sheltering habitats.

4.3.2 Habitat Connectivity

Habitat connectivity is generally poor due to the extent of previous clearing in the area and the current configuration of farming areas, residential areas and road corridors (see **Figure 1**).

In the southeast of the study area, subtropical rainforest habitat connectivity extends further to the east through Willow Gully and immediately surrounding areas. However, the extent of nearby habitats is very limited by development and much of this habitat is fragmented and degraded.

Natural or important fauna habitats are essentially absent from the subject site, so connectivity through the area to be developed is of low value. Some animals may cross the subject site to move between denser vegetation on the east and west of the study area, although fauna movement through the surrounding landscape would be primarily limited to highly mobile species, especially birds and bats.

4.3.3 Fauna Species

Observations during the survey period resulted in the detection of 34 native and four introduced fauna species within the study area. These species are listed in **Table 2** below. No threatened or listed migratory fauna species were recorded during the survey period.

Fauna investigations focused mainly on identifying the values of surrounding fauna habitats rather than generating a comprehensive fauna inventory from targeted surveys, given the highly disturbed nature of the subject site. While the subject site has very limited fauna habitat values, it is expected that many more fauna species would utilise the broader study area, including several threatened or migratory birds and bats.

Table 2: Fauna species recorded during the survey

CATEGORY	COMMON NAME	SCIENTIFIC NAME	DETECTION METHOD
Mammals	European Red Fox*	<i>Vulpes vulpes</i> *	Observed
	Rabbit*	<i>Oryctolagus cuniculus</i> *	Observed
	Swamp Wallaby	<i>Wallabia bicolor</i>	Observed
	Wombat	<i>Vombatus ursinus</i>	Scats
Birds	Australian Magpie	<i>Gymnorhina tibicen</i>	Observed
	Australian Raven	<i>Corvus coronoides</i>	Call recognition
	Brown Cuckoo Dove	<i>Macropygia amboinensis</i>	Call recognition
	Brown Gerygone	<i>Gerygone mouki</i>	Observed
	Brown Goshawk	<i>Accipiter fasciatus</i>	Observed
	Brown Thornbill	<i>Acanthiza pusilla</i>	Observed
	Crimson Rosella	<i>Platycercus elegans</i>	Observed
	Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	Observed
	Eastern Yellow Robin	<i>Eopsaltria australis</i>	Observed
	European Blackbird*	<i>Turdus merula</i>	Observed
	Galah	<i>Cacatua roseicapillus</i>	Observed
	Green Catbird	<i>Ailuroedus crassirostris</i>	Call recognition
	Grey Butcherbird	<i>Cracticus torquatus</i>	Call recognition
	Grey Fantail	<i>Rhipidura fuliginosa</i>	Observed
	Grey Shrike-thrush	<i>Colluricincla harmonica</i>	Call recognition
	Laughing Kookaburra	<i>Dacelo novaeguineae</i>	Call recognition
	Lewin's Honeyeater	<i>Meliphaga lewinii</i>	Observed
	Masked Lapwing	<i>Vanellus miles</i>	Observed
	Nankeen Kestrel	<i>Falco cenchroides</i>	Observed
	Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	Observed
	Red-browed Finch	<i>Neochmia temporalis</i>	Observed
	Red-whiskered Bulbul*	<i>Pycnonotus jocosus</i>	Observed
	Red Wattlebird	<i>Anthochaera carunculata</i>	Observed
	Restless Flycatcher	<i>Myiagra inquieta</i>	Observed
	Satin Bowerbird	<i>Ptilonorhynchus violaceus</i>	Observed
	Silvereye	<i>Zosterops lateralis</i>	Observed
	Sulphur Crested Cockatoo	<i>Cacatua pastinator</i>	Observed
	Superb Fairy-wren	<i>Malurus cyaneus</i>	Observed
	Welcome Swallow	<i>Hirundo neoxena</i>	Observed
	White-browed Scrubwren	<i>Sericornis frontalis</i>	Observed
	White-faced Heron	<i>Egretta novaehollandiae</i>	Observed
	Willie Wagtail	<i>Rhipidura leucophrys</i>	Observed
	Wonga Pigeon	<i>Leucosarcia melanoleuca</i>	Call recognition
Amphibians	Common Eastern Froglet	<i>Crinia signifera</i>	Call recognition

* Introduced species

Figure 3: Vegetation Communities and Threatened Species



- | | | | |
|--|--|---|------------------------------|
|  | Subject Land |  | Cadastre |
|  | <i>Daphnandra</i> sp. Illawarra |  | Introduced Grassland |
|  | <i>Zieria</i> granulata |  | Weeds/Exotics/Regrowth |
|  | <i>Cynanchum</i> elegans (previous record) |  | Disturbed Rainforest |
| | |  | Subtropical Rainforest (EEC) |

Note: Vegetation Community boundaries are indicative only.

Data Sources:
Bing Aerials

0 20 40 80
Meters

Datum/Projection:
GDA 1994 MGA Zone 56

Figure 4: Ecological Constraints



Subject Land

Cadastre

E2 Zoning

High

Moderate - High

Low

Ecological Constraint Categories

0 20 40 80

Meters

Datum/Projection:
GDA 1994 MGA Zone 56

Note: Indicative Boundaries Only

Data Sources:
Bing Aerials

N

eco
logical

AUSTRALIA

www.ecoaus.com.au

5 Biodiversity Values

5.1 SUMMARY OF BIODIVERSITY VALUES

Generally, the subject site has very low biodiversity values, as it is essentially cleared. However, parts of the study area, contain vegetation and habitats of high biodiversity value, with two threatened plant species (*Zieria granulata* and *Daphnandra* sp C 'Illawarra') and one endangered ecological community (Illawarra Subtropical Rainforest) occurring at or close to the edge of the subject site. Within the study area habitats a further 24 species of conservation significance have the potential to occur based on database searches from the locality (Appendix A). These species and communities are summarised in **Table 3**.

Table 3: EECs, threatened species and listed migratory species known or with the potential to occur in the study area

Species or EEC	TSC Act	EPBC Act	Likelihood
Illawarra Subtropical Rainforest	EEC	—	Recorded
White-flowered Wax Plant (<i>Cynanchum elegans</i>)	E	E	Previous record
Illawarra Socketwood (<i>Daphnandra</i> sp. C 'Illawarra')	E	E	Recorded
Illawarra Zieria (<i>Zieria granulata</i>)	E	E	Recorded
Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>)	V	—	Potential
Flame Robin (<i>Petroica phoenicea</i>)	E	E	Potential
Pink Robin (<i>Petroica rodinogaster</i>)	V	—	Potential
Scarlet Robin (<i>Petroica boodang</i>)	V	—	Potential
Rose-crowned Fruit Dove (<i>Ptilinopus regina</i>)	V	—	Potential
Superb Fruit Dove (<i>Ptilinopus superbus</i>)	V	—	Potential
Square-tailed Kite (<i>Lophoictinia isura</i>)	V	—	Potential
Powerful Owl (<i>Ninox strenua</i>)	V	—	Potential
Masked Owl (<i>Tyto novaehollandiae</i>)	V	—	Potential
Sooty Owl (<i>Tyto tenebricosa</i>)	V	—	Potential
Spotted-tailed Quoll (<i>Dasyurus maculatus</i>)	V	E	Potential
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	V	V	Potential
Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)	V	—	Potential
Little Bentwing Bat (<i>Miniopterus australis</i>)	V	—	Potential
Eastern Bentwing Bat (<i>Miniopterus schreibersii oceanensis</i>)	V	—	Potential
East Coast Freetail Bat (<i>Mormopterus norfolkensis</i>)	V	—	Potential
Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)	V	V	Potential
Yellow-bellied Sheathtail Bat (<i>Saccolaimus flaviventris</i>)	V	—	Potential
Southern Myotis (<i>Myotis macropus</i>)	V	—	Potential

Grey-headed Flying-Fox (<i>Pteropus poliocephalus</i>)	V	V	Likely
Rufous Fantail (<i>Rhipidura rufifrons</i>)	—	M	Potential
Satin Flycatcher (<i>Myiagra cyanoleuca</i>)	—	M	Potential
Black-faced Monarch (<i>Monarcha melanopsis</i>)	—	M	Likely
Cattle Egret (<i>Ardea ibis</i>)	—	M	Potential

The primary conservation values of the site are highlighted in **Table 3** and these entities are the focus of the impact assessment in Section 6 and Appendix C.

5.2 ECOLOGICAL CONSTRAINTS RATIONALE

The ecological constraints assessment considers threatened biodiversity and significant habitat characteristics within the study area as a rationale for assigning areas as high, medium-high or low ecological constraint. These constraint areas are presented in **Figure 4** and described further below.

5.2.1 High Constraint Areas

Areas have been mapped as high constraint as they support:

- Illawarra Subtropical Rainforest; and
- Threatened flora records (buffered by 10m).

These areas are the highest priority for vegetation retention and conservation and are generally beyond the proposed development footprint apart from a small area impacted by pipeline construction to the east of the site and *Zieria granulata* buffers on the western edge of the site.

5.2.2 Moderate-High Constraint Areas

Areas have been mapped as moderate-high constraint as they support:

- Disturbed native and exotic vegetation that does not constitute Illawarra Subtropical Rainforest, but acts as a buffer to this community; and
- Disturbed native and exotic vegetation that has good potential to be rehabilitated and provides known and potential habitat for threatened plant species.

These areas are a slightly lower priority for retention and conservation, although are generally beyond the development footprint apart from small areas impacted by pipeline construction to the east of the site.

5.2.3 Low Constraint Areas

Areas have been mapped as low constraint as they support:

- Highly modified or exotic vegetation which generally has negligible recovery potential and habitat values.

The vast majority of the proposed development is located within areas of low constraint.

Other ecological constraint considerations relating to the Kiama LEP are shown separately in **Figure 4**. This shows the differences in the extent of high conservation value habitats (Illawarra Subtropical Rainforest EEC and associated vegetation) found during the current study compared to the E2

Environmental Protection zoning on either side of the study area. While the E2 zoning in the study area is still a statutory constraint to development, it does not correlate with the extent of high conservation value vegetation in the north east of the study area.

6 Impact Assessment

6.1 VEGETATION COMMUNITIES

The preliminary subdivision proposal will result in direct impacts (residential development footprint, APZs and infrastructure) to approximately 7 ha of introduced Grassland/Pasture, approximately 1 ha of Weeds/Exotics/Regrowth, and approximately 0.03 ha of disturbed Illawarra Subtropical Rainforest (ISR).

The vast majority of direct impact to vegetation is to predominantly exotic communities with low conservation values. A small area of disturbed ISR will be removed for water and sewer connection to the site. Despite being degraded by weeds, the rainforest vegetation has high conservation value as it constitutes an EEC.

The proposal avoids direct impacts to ISR as much as possible, and those direct impacts (0.03ha) are small relative to the likely extent of the community in the immediate area (>5 ha). The areas of ISR affected by pipeline construction will require robust controls to minimise clearing and indirect impacts and will be rehabilitated following construction works. A range of control measures and ongoing management will also be required along the eastern and western sides of the subdivision to minimise potential edge effects on adjacent ISR. The proposal has the potential to both control edge effects of the development and improve the condition of habitat surrounding ISR.

An assessment of significance of the potential impacts of the proposal on ISR is presented in Appendix C.

6.2 THREATENED FLORA

Two threatened flora species, Illawarra Socketwood *Daphnandra* sp. C 'Illawarra' and Illawarra Zieria *Zieria granulata*, are known to occur immediately adjacent to the subject site, and an unconfirmed record of a third flora species, White-flowered Wax Plant *Cynanchum elegans*, also occurs adjacent to the subject site. All three species are listed as endangered under both NSW and Commonwealth legislation. Additional locations for these or other threatened flora species may exist elsewhere in the study area, but such sites are unlikely to be exposed to the potential edge effects of the development.

No individuals of any threatened flora species are likely to be removed by the proposal, nor will any typical or important habitat for these species be removed. However, a range of edge effects often associated with residential development have the potential to adversely affect these species given their proximity to the proposed development. While adverse edge effects could lead to degraded habitat quality and loss of individuals, the types of indirect impacts likely to be associated with the proposal are considered manageable, if control and mitigation measures are considered at the detailed site design stage and continue throughout the construction stage and post construction in the form of ongoing management and monitoring.

All known habitats containing threatened plants in the study area are currently degraded by weeds. The proposal has the potential to both control edge effects of the development and improve the condition of habitat surrounding threatened plants.

Assessments of significance of the potential impacts of the proposal on threatened flora species have been undertaken in Appendix C.

6.3 THREATENED FAUNA AND FAUNA HABITATS

The proposal will not remove any important fauna habitats, nor were any potentially sensitive habitats, such as tree hollows, recorded close to the subject site. The most notable fauna habitats are associated with rainforest habitats in the outer parts of the study area. These habitats are generally buffered from the development by vegetation dominated or modified by exotic species.

No threatened fauna species are likely to utilise the subject site on a regular basis due to the lack of any important habitats occurring there. There is the potential for a range of threatened fauna to occur in other parts of the study area (**Table 4**). All of these species are relatively mobile, being migratory or occupying extensive home ranges, and their occurrence in the study area is likely to be occasional or seasonal rather than permanent. Potential impacts to threatened fauna or their habitats from the proposal are largely limited to indirect edge effects as no specific habitat for threatened fauna is likely to be removed or modified. Controls on edge effects of the development required for threatened flora and ISR will reduce any potential impacts on threatened fauna habitats.

6.4 CONNECTIVITY VALUES

While the subject site itself has negligible habitat connectivity values, construction of the residential subdivision will reduce the potential for some species to move (or transfer genetic material) between rainforest patches to the east and west of the site. While impacts to connectivity values are relatively minor and limited by the extent of clearing in the locality, consideration should be given to retaining some form of connectivity across the site. For birds this could involve strategic landscaping with native trees to provide 'stepping stone' connectivity. For terrestrial fauna, such as Swamp Wallabies, areas of relatively unobstructed access through the subdivision may enhance connectivity. While limited opportunities exist for such passage, this may be possible along the northern or southern boundaries of the site.

6.5 CONCLUSION OF IMPACT ASSESSMENT

An assessment of the potential impacts of the proposal on key biodiversity values (those threatened species and EEC's that are known to occur within the study area) has been undertaken (Appendix C). The outcome of this assessment was that the proposal is unlikely to significantly impact on those threatened species and EEC's assessed, provided that a range of measures are implemented to reduce the occurrence and impact of edge effects. A small loss of degraded ISR is likely to be required for the subdivision stage, although the proposal also has the potential to substantially improve habitat condition for ISR and threatened plants by removing or alleviating current impacts from invasive weeds and grazing.

7 Recommendations

To further ameliorate the potential impacts of the proposal (including subdivision stage) and to facilitate improved environmental outcomes, the following recommendations for impact mitigation and amelioration are suggested.

- The subdivision stage of the development needs to incorporate a range of measures to mitigate and control potential indirect impacts to areas of high conservation value to the east and west of the site. These measures need to commence at the detailed design stage and need to include ongoing management of the eastern and western boundaries of the site.
- The two mature *Zieria granulata* plants on the western edge of the site should be retained if possible and appropriately protected and managed.
- Minimum buffer distances of 10 m should be applied between flora species and communities of conservation significance and construction works where possible, although establishing broader environmental protection measures for the site and surrounds are also integral to conservation outcomes.
- The rehabilitation and appropriate management of adjacent lands to the east and west of the site should be investigated as part of the proposal, to control potential edge effects and improve the condition of currently degraded habitats.
- The subdivision stage of the development is to include a vegetation management plan or similar to guide the management of the interface between residential areas and land containing high conservation values to the east and west of the site. The plan is to consider a range of issues including management of APZs, signage, access restrictions, control of pets, landscaping, weed control, rehabilitation, public education and monitoring.
- Landscape planting within the subdivision is to prohibit the use of recognised weeds, exotic or invasive species that may be detrimental to surrounding habitats of conservation significance.
- Landscaping proposed along the northern side of the subdivision, and elsewhere if possible, should attempt to provide some 'stepping stone' habitat connectivity from east to west, through the planting of appropriate, locally occurring native trees and shrubs.
- The final subdivision and landscape design should consider facilitating terrestrial fauna movement from east to west, through the provision of unobstructed movement routes, at least in the north and south of the site.
- The specific location and construction methods for water and sewer pipelines that bisect Illawarra Subtropical Rainforest will be undertaken in consultation with an ecologist to minimise impacts.
- Strict erosion and sediment control measures must accompany the subdivision stage to avoid adverse impacts to adjacent habitats. Such measures should be incorporated into an Erosion and Sediment Control Plan.
- An induction program should be developed for workers involved in the construction of any future development within the study area, so that the high conservation value vegetation and

habitats within the study area and surrounds are not inadvertently impacted during construction or during the operation and maintenance phase of the development.

8 Conclusion

This preliminary flora and fauna report has given consideration to the key ecological constraints identified from field surveys of the study area, relevant Commonwealth, state and local government legislation, policies and plans.

The land subject to the rezoning proposal is generally of low conservation value due to a long history of clearing, grazing and establishment of exotic plants. The site is predominately comprised of exotic pasture grasses, with fringing exotic trees, weeds and a low number of native regrowth species.

However, high conservation value vegetation occurs close to the western and eastern edges of the site. The threatened plants *Zieria granulata* and *Daphnandra* sp *Illawarra* occur close to the edges of the site, along with the Illawarra Subtropical Rainforest endangered ecological community. A record for the threatened plant *Cynanchum elegans* also exists close to the edge of the site.

While the rezoning will not require the removal of any species or habitats of conservation significance, the subsequent residential subdivision will require removal of a small and disturbed section of Illawarra Subtropical Rainforest for construction of water and sewer pipelines. Given the close proximity and upslope position of the proposal to threatened plants and Illawarra Subtropical Rainforest, the residential subdivision also has the potential to degrade these adjacent habitats through edge effects and other indirect impacts.

A preliminary assessment of the potential impacts of the proposal on key biodiversity values of the site (threatened plants and communities) listed under the TSC Act and EPBC Act was undertaken (Appendix C). This assessment concluded that the proposal is unlikely to result in significant impacts to these species and communities provided that appropriate control measures and management strategies are implemented before, during and after the development, as indicated in Section 7.

To compensate for the small but unavoidable impacts to the Illawarra Subtropical Rainforest and to assist in controlling indirect impacts of the subdivision, the rehabilitation and management of adjacent lands should be investigated. This should become part of a strategy to ensure that indirect impacts of the subdivision are managed and that the overall development will at least maintain the integrity of local conservation values. As the adjacent areas of high conservation value are currently degraded and impacted by weeds and/or grazing, the final proposal also has the potential to substantially improve the condition of these areas.

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Appendix A: Likelihood of Occurrence Table

Summary of initial assessment to determine the likelihood of occurrence of threatened species, populations and ecological communities in the proposal site.

An assessment of likelihood of occurrence was made for threatened and migratory species identified from the database search. Five terms for the likelihood of occurrence of species are used in this report. This assessment was based on database or other records, presence or absence of suitable habitat, features of the proposal site, results of the field survey and professional judgement. The terms for likelihood of occurrence are defined below:

- “yes” = the species was or has been observed on the site
- “likely” = a medium to high probability that a species uses the site
- “potential” = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
- “unlikely” = a very low to low probability that a species uses the site
- “no” = habitat on site and in the vicinity is unsuitable for the species.

Shorebirds have been excluded from the analysis below as they would not occur within the study area.

Plant species that are only associated with the habitats above the escarpment have been excluded from the analysis below as they would not occur within the study area.

THREATENED FLORA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
<i>Acacia baueri</i> subsp. <i>exalata</i> Square Raspwort	V		<i>Acacia baueri</i> subsp. <i>aspera</i> is restricted to the Sydney region, occurring on the Kings Tableland in the central Blue Mountains and with sporadic occurrences on the Woronora Plateau in the Royal National Park, Mt. Keira district and at Wedderburn. It occurs in low, damp heathlands, often on exposed rocky outcrops (DEC 2005).	No
<i>Arthropteris palisotii</i> Lesser Creeping Fern	E		<i>Arthropteris palisotii</i> occurs in rainforest, mainly on tree trunks in north-eastern NSW and also in Queensland, however may now be extinct in NSW (DEC 2005).	Unlikely
<i>Boronia deanei</i> <i>Deane's Boronia</i>	V	V	<i>Boronia deanei</i> occurs as scattered populations between the far south-east of NSW and the Blue Mountains (including the upper Kangaroo River near Carrington Falls, the Endrick River near Nerriga and Nalbaugh Plateau). It grows in wet heath, often at the margins of open forest adjoining swamps or along streams (DEC 2005).	No
<i>Callistemon linearifolius</i> Netted Bottle Brush	V		<i>Callistemon linearifolius</i> has been recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW, growing in dry sclerophyll forest (DEC 2005).	No
<i>Calomnion complanatum</i> A moss	E		In NSW, <i>Calomnion complanatum</i> has been recorded from only three locations: Cambewarra Mountain (near Nowra), Rocky Creek Canyon (Newnes Plateau), and two sites at Mount Wilson (Waterfall Reserve and Zircon Creek). Each record is of only a few plants. It grows on the trunks of tree ferns, and occasionally on sandstone rock (DEC 2005).	Unlikely
<i>Chamaesyce psammogeton</i> Sand Spurge	E		<i>Chamaesyce psammogeton</i> is known from coastal sites north from near Jervis Bay as well as on Lord Howe Island. It is a prostrate perennial herb, which grows on foredunes and exposed sites on headlands often with <i>Spinifex</i> (DEC 2005).	No
<i>Chorizema parviflorum</i> in the Wollongong and Shellharbour	E2		This endangered population of <i>Chorizema parviflorum</i> occurs between Austinmer and Albion Park in the Wollongong and Shellharbour LGAs. It mainly occurs in woodland or open forest, with one location on a	No

THREATENED FLORA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
Local Government Areas			coastal headland (DEC 2005).	
<i>Cryptostylis hunteriana</i> Leafless Tongue-orchid	V	V	This terrestrial orchid is known from swamp-heath and open forest on sandy soils in coastal districts. <i>Cryptostylis hunteriana</i> is known from a range of vegetation communities including swamp-heath and woodland (DEC 2005). The larger populations typically occur in woodland dominated by Scribbly Gum (<i>Eucalyptus sclerophylla</i>), Silvertop Ash (<i>E. sieberi</i>), Red Bloodwood (<i>Corymbia gummifera</i>) and Black Sheoak (<i>Allocasuarina littoralis</i>); where it appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (<i>C. subulata</i>) and the Tartan Tongue Orchid (<i>C. erecta</i>) (DEC 2005).	No
<i>Cynanchum elegans</i> White-flowered Wax Plant	E	E	This climber occurs mainly at the ecotone between dry subtropical rainforest and sclerophyll forest/woodland communities. The known southern limit of this species is at Gerroa. <i>Cynanchum elegans</i> is a climber or twiner with a variable form, and flowers between August and May, peaking in November (DEC 2005). It occurs in dry rainforest gullies, scrub and scree slopes, and prefers the ecotone between dry subtropical rainforest and sclerophyll woodland/forest (NPWS 1997). The species has also been found in littoral rainforest; <i>Leptospermum laevigatum</i> – <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> coastal scrub; <i>Eucalyptus tereticornis</i> open forest/ woodland; <i>Corymbia maculata</i> open forest/woodland; and <i>Melaleuca armillaris</i> scrub to open scrub (DEC 2005).	Potential (previous record, unconfirmed)
<i>Daphnandra</i> sp. C Illawarra Illawarra Socketwood	E	E	<i>Daphnandra</i> sp. C Illawarra is restricted to the Illawarra region in NSW. It grows in subtropical rainforest on laterite usually on rocky hillsides and gullies (Floyd 2008). Listed on EPBC Act as <i>Daphnandra johnsonii</i> .	Yes
<i>Distichlis distichophylla</i> Australian Saltgrass	E		<i>Distichlis distichophylla</i> grows only in coastal situations, with records from Jervis Bay, Bermagui, Wonboyn, Narooma, Bodalla and Nadgee Nature Reserve, except for one existing population at Lake Cargelligo (DEC 2005). It is a coloniser of damp saline soils, found at the edges of salt marshes and on low dunes (DEC 2005).	No

THREATENED FLORA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
<i>Eucalyptus langleyi</i> Albatross Mallee	V	V	<i>Eucalyptus langleyi</i> grows on poor sandy sites primarily west and south west of Nowra, in mallee shrubland on poorly drained shallow sand on sandstone (DEC 2005). Also endangered population north of Nowra.	No
<i>Genoplesium baueri</i> Bauer's Midge Orchid	E		Known from coastal areas from northern Sydney south to the Nowra district. Previous records from the Hunter Valley and Nelson Bay are now thought to be erroneous. Grows in shrubby woodland in open forest on shallow sandy soils.	No
<i>Haloragis exalata</i> subsp. <i>exalata</i> Square Raspwort		V	<i>Haloragis exalata</i> has been recorded in 4 widely scattered localities in eastern NSW; the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW; where it appears to require protected and shaded damp situations in riparian habitats (DEC 2005).	Unlikely
<i>Irenepharsus trypherus</i> Illawarra Irene	E	E	This species has been recorded at the base of cliffs near waterfalls amongst rainforest or subtropical rainforest vegetation and is also associated with rocky and unstable upper-slopes of ridge systems extending south and east from the Illawarra Escarpment. The primary range of the species extends from Marshall Mount to Lake Yarrunga.	Unlikely
<i>Lastreopsis hispida</i> Bristly Shield Fern	E		The only recent NSW record of <i>Lastreopsis hispida</i> is from Mt Wilson in the Blue Mountains, but also occurs in southern Victoria and Tasmania, and is common in New Zealand (DEC 2005). It grows in moist humus-rich soils in wet forest and rainforest gullies, and at Mt Wilson, associated species include <i>Ceratopetalum apetalum</i> , <i>Elaeocarpus holopetalus</i> , <i>Fieldia australis</i> , <i>Cyathea australis</i> , <i>Blechnum nudum</i> , <i>B. patersonii</i> and <i>Leptopteris fraseri</i> (DEC 2005).	Unlikely
<i>Melaleuca biconvexa</i> Biconvex Paperbark	V	V	<i>Melaleuca biconvexa</i> occurs in coastal districts and adjacent tablelands from Jervis Bay north to the Port Macquarie district. It grows in damp places often near streams (PlantNet 2011).	No
<i>Pelargonium</i> sp.	E	E	In NSW, <i>Pelargonium</i> sp. (G.W. Carr 10345) is known from the Southern Tablelands (PlantNet 2011). Otherwise, only known from the shores of Lake Omeo near Benambra in Victoria where it grows in cracking	No

THREATENED FLORA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
Omeo Stork's-bill			clay soil that is probably occasionally flooded (Walsh & Entwisle 1999).	
<i>Pimelea curviflora</i> var. <i>curviflora</i>	V	V	<i>Pimelea curviflora</i> var. <i>curviflora</i> is confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. It grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands (DEC 2005). Associated with the Duffys Forest Community, shale lenses on ridges in Hawkesbury sandstone geology (Pittwater Council 2000).	No
<i>Pimelea spicata</i> Spiked Rice-flower	E	E	In western Sydney, <i>Pimelea spicata</i> occurs on an undulating topography of well structured clay soils, derived from Wianamatta shale (DEC 2004). It is associated with Cumberland Plains Woodland (CPW), in open woodland and grassland often in moist depressions or near creek lines (Ibid.). Has been located in disturbed areas that would have previously supported CPW (Ibid.).	No
<i>Pomaderris adnata</i> Sublime Point Pomaderris	E		<i>Pomaderris adnata</i> is only known from Sublime Point, north of Wollongong on the Central Coast. It occurs on the edge of the escarpment in heathy open forest or woodland (DEC 2005; PlantNet 2011).	No
<i>Pterostylis gibbosa</i> Illawarra Greenhood	E	E	Known from a small number of populations in the upper Hunter Valley (Milbrodale), the Illawarra region (Albion Park and Yallah) and near Nowra (DEC 2005). Plants grow in a variety of woodland and open forest communities with shallow rocky soils.	No
<i>Pterostylis pulchella</i> Waterfall Greenhood	V	V	Known only from a small number of populations along the Illawarra Escarpment e.g. Fitzroy, Belmore and Minnamurra Falls. Plants grow in shallow, moist soils close to sandstone ledges and cliffs.	No
<i>Pultenaea aristata</i> Prickly Bush-pea	V	V	<i>Pultenaea aristata</i> is restricted to the Woronora Plateau, in a small area between Helensburgh, south of Sydney, and Mt Keira above Wollongong (DEC 2005). It is associated with scrub and heath on sandstone ridge tops and upper slopes of large upland swamps on shallow sandy loams (Keith 1994).	No

THREATENED FLORA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
<i>Senna acclinis</i> Rainforest Cassia	E		In NSW, <i>Senna acclinis</i> occurs in coastal districts and adjacent tablelands north from the Illawarra. It grows in or on the edges of subtropical, littoral and dry rainforest and in open eucalypt forest (DEC 2005).	Unlikely
<i>Solanum celatum</i>	E		<i>Solanum celatum</i> is restricted to an area from Wollongong to just south of Nowra and west to Bungonia, on the Central Coast and South Coast. Majority of records are prior to 1960. It grows on hills and slopes in eucalypt woodland, rainforest clearings and wet sclerophyll forest. It is commonly found after fire or disturbance (DEC 2005; PlantNet 2011).	Unlikely
<i>Streblus pendulinus</i> Siah's Backbone		E	Siah's Backbone is a tree or large shrub that grows to 6 m in height and occurs from Cape York Peninsula to Milton, south-east New South Wales. Siah's Backbone is found in warmer rainforests, chiefly along watercourses. The altitudinal range is from near sea level to 800 m above sea level. The species grows in well developed rainforest, gallery forest and drier, more seasonal rainforest.	No (Listing intended for Norfolk Island)
<i>Syzygium paniculatum</i> Magenta Lilly Pilly	E	V	This species occupies a narrow coastal area between Bulahdelah and Conjola State Forests in NSW. On the Central Coast, it occurs on Quaternary gravels, sands, silts and clays, in riparian gallery rainforests and remnant littoral rainforest communities (Payne 1997). In the Ourimbah Creek valley, <i>S. paniculatum</i> occurs within gallery rainforest with <i>Alphitonia excelsa</i> , <i>Acmena smithii</i> , <i>Cryptocarya glaucescens</i> , <i>Toona ciliata</i> , <i>Syzygium oleosum</i> with emergent <i>Eucalyptus saligna</i> . At Wyrabalong NP, <i>S. paniculatum</i> occurs in littoral rainforest as a co-dominant with <i>Ficus fraseri</i> , <i>Syzygium oleosum</i> , <i>Acmena smithii</i> , <i>Cassine australe</i> , and <i>Endiandra sieberi</i> . Payne (1991) reports that the species appears absent from Terrigal formation shales, on which the gully rainforests occur. <i>S. paniculatum</i> is summer flowering (November-February), with the fruits maturing in May (DEC 2005).	Unlikely
<i>Thelymitra</i> sp. Kangaloon Kangaloon Sun-orchid	CE	CE	<i>Thelymitra</i> sp. Kangaloon is only known to occur on the southern tablelands of NSW in the Moss Vale / Kangaloon / Fitzroy Falls area at 550-700 m above sea level. It is thought to be a short-lived perennial, flowering in late October and early November. It is found in swamps in sedgeland over grey silty grey loam soils (DEWHA 2010). It is known to occur at three swamps that are above the Kangaloon Aquifer, and that	No

THREATENED FLORA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
			are a part of the ecological community “Temperate Highland Peat Swamps on Sandstone” which is listed under the Environment Protection and Biodiversity Conservation Act 1999.	
<i>Triplarina nowraensis</i> Nowra Heath Myrtle	E	E	<i>Tripladenia nowraensis</i> is confined to the Nowra district on the Central and South Coasts of NSW. It grows in moist heath close to stream channels or swampy slopes (PlantNet 2011).	No
<i>Wilsonia backhousei</i> Narrow-leafed Wilsonia	V		In NSW, <i>Wilsonia backhousei</i> is found on the coast between Mimosa Rocks National Park and Wamberal north of Sydney (Nelson's Lake, Potato Point, Sussex Inlet, Wowly Gully, Parramatta River at Ermington, Clovelly, Voyager Point, Wollongong and Royal National Park). It grows on the margins of salt marshes and lakes (DEC 2005).	No
<i>Wilsonia rotundifolia</i> Round-leafed Wilsonia	E		In NSW, <i>Wilsonia rotundifolia</i> is known from several sites in the Jervis Bay area, Royal National Park, near Deniliquin and on the lakebeds of Lake George and Lake Bathurst when these are exposed. Grows in mud in coastal saltmarsh and inland saline or brackish lake beds (DEC 2005).	No
<i>Zieria baeuerlenii</i> Bomaderry Zieria	E	E	<i>Zieria baeuerlenii</i> occurs in only one location north-west of Nowra on the NSW South Coast. It grows in skeletal sandy loam overlaying sandstone, on a rocky plateau amongst sandstone boulders in either shrubby open forest, shrubby woodland or closed scrub (DEC 2005).	No
<i>Zieria granulata</i> Illawarra Zieria	E	E	<i>Zieria granulata</i> is known from a number of sites in the Illawarra region of the Central Coast, mainly between Oak Flats and Toolijooa. It usually grows in shrubland on rocky outcrops with shallow volcanic soils. Less frequently found on moist slopes of the escarpment and in low-lying areas on Quaternary sediments in sclerophyll forest and on rainforest margins (DEC 2005; PlantNet 2011).	Yes
<i>Zieria tuberculata</i> Warty Zieria	V	V	<i>Zieria tuberculata</i> is known from a number of sites in the Mt Dromedary and Tilba Tilba area on the NSW far South Coast. It grows in heath amongst rocky outcrops on rain forest edges and in tall forest and shrubland (DEC 2005).	No

THREATENED FAUNA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
Mammals				
Brush-tailed Rock-wallaby <i>Petrogale penicillata</i>	E	V	This species inhabits rock piles and often north-facing cliffs with numerous crevices and ledges. No records in the locality and no suitable habitat in the study area.	No
Eastern Bentwing-bat <i>Miniopterus schreibersii</i>	V	-	Associated with a range of habitats such as rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland. It forages above and below the tree canopy on small insects. Will utilise caves, old mines, and stormwater channels, under bridges and occasionally buildings for shelter. May occur in and around the study area to forage. Suitable vegetated habitats will not be affected by the proposal.	Potential (general foraging habitat only)
East Coast Freetail-bat <i>Mormopterus norfolkensis</i>	V	-	Most records of this species are from dry eucalypt forest and woodland east of the Great Dividing Range (Churchill 1998). Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges (Environment Australia 2000; Allison & Hoye 1998). Primarily roosts in hollows or behind loose bark in mature eucalypts, but have been observed roosting in the roof of a hut (Environment Australia 2000; Allison & Hoye 1998). May occur in and around the study area to forage. Suitable vegetated habitats will not be affected by the proposal.	Potential (general foraging habitat only)
Eastern False Pipistrelle <i>Falistrellus tasmaniensis</i>	V	-	The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings (DECC 2007). May occur in and around the study area to forage. Suitable vegetated habitats will not be affected by the proposal.	Potential (general foraging habitat only)

THREATENED FAUNA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
Eastern Pygmy-possum <i>Cercartetus nanus</i>	V		Found in wet and dry eucalypt forest, subalpine woodland, coastal banksia woodland and wet heath (Menkhorst & Knight 2004). Pygmy-Possums feed mostly on the pollen and nectar from banksias, eucalypts and understorey plants and will also eat insects, seeds and fruit (Turner & Ward 1995). The presence of Banksia sp. and Leptospermum sp. are an important habitat feature (DECC 2007). Small tree hollows are favoured as day nesting sites, but nests have also been found under bark, in old birds nests and in the branch forks of tea-trees (Turner & Ward 1995).	Unlikely
Grey-headed Flying-fox <i>Pteropus poliocephalus</i>	V	V	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 1998, Eby 1998). Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 1998). The species forages on a range of nectar and soft fruit resources in trees. There are no known camps in the study area or immediate surrounds. No foraging habitat would be removed by the proposal.	Likely (general foraging habitat only)
Golden-tipped Bat <i>Falsistrellus tasmaniensis</i>	V		The most favoured habitat for this species is moist closed forests often with a rainforest influence, however, some captures have been made in dry forests some distance from any rainforest (Lunney et. al. 1986; Parnaby and Mills, 1994). It has been suggested that the amount of vines and complex tree layers allows for increased numbers of spiders and webs and such areas are sought by the Golden-tipped Bat (Schulz & Eyre 2000). This species is often caught over streams within rainforest are known to frequently roost within the pendulous nests of Yellow-throated and Large-billed Scrub Wrens and Brown Gerygone in such areas (Schulz & Eyre 2000). No records in the locality.	Unlikely
Greater Broad-nosed Bay <i>Scoteanax rueppellii</i>	V		Associated with moist gullies in mature coastal forest, or rainforest, east of the Great Dividing Range (Churchill, 1998), tending to be more frequently located in more productive forests (Hoye & Richards 1998). Within denser vegetation types use is made of natural and constructed openings such as roads, creeks and small rivers, where it hawks backwards and forwards for prey (Hoye & Richards 1998). May occur in and around the study area to forage. Suitable vegetated habitats will not be affected by the proposal.	Potential (general foraging habitat only)
Koala <i>Phascolarctos</i>	V	V	Koalas inhabit eucalypt woodland and forests and feed on around 70 eucalypt and 30 non-eucalypt tree species. Habitat in the study area is generally unsuitable for the species.	No

THREATENED FAUNA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
<i>cinereus</i>				
Large-eared Pied Bat <i>Chalinolobus dwyeri</i>	V	V	The Large-eared Pied Bat has been recorded in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests. This species roosts in caves, rock overhangs and disused mine shafts and as such is usually associated with rock outcrops and cliff faces. May occur in and around the study area to forage. Suitable vegetated habitats will not be affected by the proposal.	Potential (general foraging habitat only)
Little Bentwing- bat <i>Miniopterus australis</i>	V		Prefers well-timbered areas including rainforest, wet and dry sclerophyll forests, Melaleuca swamps and coastal forests (Churchill 1998). This species shelter in a range of structures including culverts, drains, mines and caves (Environment Australia 2000). Relatively large areas of dense vegetation, of either wet sclerophyll forest, rainforest or dense coastal banksia scrub, are usually present adjacent to caves in which this species is found (DECC 2007). Breeding occurs in caves, usually in association with <i>M. schreibersii</i> (Environment Australia 2000, DECC 2007). May occur in and around the study area to forage. Suitable vegetated habitats will not be affected by the proposal.	Potential (general foraging habitat only)
New Holland Mouse <i>Pseudomys novaehollandiae</i>		V	A small burrowing native rodent with a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. Inhabits open heathlands, open woodlands with a heathland understorey and vegetated sand dunes. A social animal, living predominantly in burrows shared with other individuals. The home range of the New Holland Mouse ranges from 0.44 ha to 1.4 ha and the species peaks in abundance during early to mid stages of vegetation succession typically induced by fire (DSEWPC 2010).	No
Southern Myotis <i>Myotis macropus</i>	V	-	The Large-footed Myotis is associated with a range of habitat types as long as they are close to water for foraging. Roosting has been recorded in a range of environments including caves, structures, tree hollows and dense vegetation. Potential to utilise habitats on the outskirts of the study area, although no suitable habitat will be affected by the proposal.	Potential
Large-eared Pied Bat	V	V	The Large-eared Pied Bat has been recorded in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests (Churchill 1998; DECC 2007). This species roosts in caves, rock overhangs and disused	Potential

THREATENED FAUNA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
<i>Chalinolobus dwyeri</i>			mine shafts and as such is usually associated with rock outcrops and cliff faces (Churchill 1998; DECC 2007). May occur in and around the study area to forage. Suitable vegetated habitats will not be affected by the proposal.	
Long-nosed Potoroo <i>Potorous tridactylus</i>	V	V	This species prefers thick contiguous undergrowth where the soil is light and sandy. No suitable habitat exists in the study area and the species is unlikely to occur there.	Unlikely
Smoky Mouse <i>Pseudomys fumeus</i>	CE	E	This species are found in far south eastern NSW. There are less than 2500 individuals left in the wild and all extant populations appear to be in decline. Vegetation changes, as well as feral cats, foxes and dogs appear to be the main causes	No
Southern Brown Bandicoot <i>Isodon obesulus</i>	E	E	This species is associated with heath, coastal scrub, heathy forests (Menkhorst & Knight 2004), shrubland and woodland on well drained soils. This species is thought to display a preference for newly regenerating heathland and other areas prone to fire (Menkhorst & Seebeck 1990). This species prefers thick contiguous undergrowth where the soil is light and sandy. There is no suitable habitat for the species within the study area and it would not occur there.	No
Spotted-tailed Quoll <i>Dasyurus maculatus</i>	V	E	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests (Mansergh 1984), more frequently recorded near the ecotones of closed and open forest. This species requires habitat features such as maternal den sites, an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage in. Maternal den sites are logs with cryptic entrances; rock outcrops; windrows; burrows (Environment Australia 2000). The species is known mainly from the Illawarra Escarpment, although records exist in the vicinity of the study area. Suitable, although fragmented and degraded habitat, occurs in parts of the study area and surrounds. The species could potentially occur in the study area. No suitable habitats would be directly affected by the proposal.	Potential
Squirrel Glider <i>Petaurus norfolcensis</i>	V	-	Associated with dry hardwood forest and woodlands (Menkhorst et al. 1988; Quin 1995). Foraging resources include sap, insects and nectar from high nectar producing species, including winter flower species (Menkhorst et al. 1988). The presence of hollow bearing eucalypts is a critical habitat value (Quin 1995). Suitable habitat does not occur in the study area.	No

THREATENED FAUNA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
Yellow-bellied Glider <i>Petaurus australis</i>	V	-	The species dens in tree hollows and forages in open forests on insects and tree exudates. No suitable habitat or records exist in the vicinity of the study area.	No
Yellow-bellied Sheathtail-bat <i>Saccolaimus flaviventris</i>	V		Found in almost all habitats, from wet and dry sclerophyll forest, open woodland (Churchill 1998), open country, mallee, rainforests, heathland and waterbodies (SFNSW 1995). Roosts in tree hollows; may also use caves; has also been recorded in a tree hollow in a paddock (Environment Australia 2000) and in abandoned sugar glider nests (Churchill 1998). The Yellow-bellied Sheathtail-bat is dependent on suitable hollow-bearing trees to provide roost sites, which may be a limiting factor on populations in cleared or fragmented habitats (Environment Australia 2000).	Potential
White-footed Dunnart <i>Sminthopsis leucopus</i>	V		The White-footed Dunnart occurs in Tasmania and along the Victorian and southern NSW coast. The Shoalhaven area is the species' northern-most limit. The White-footed Dunnart is found in a range of different habitats across its distribution, including coastal dune vegetation, coastal forest, tussock grassland and sedgeland, heathland, woodland and forest. In NSW, the species seems to favour vegetation communities with an open understorey structure.	No
Birds				
Australasian Bittern <i>Botaurus poiciloptilus</i>	V	E	Terrestrial wetlands with tall dense vegetation, occasionally estuarine habitats (Marchant & Higgins 1993). Reedbeds, swamps, streams, estuaries (Simpson & Day 1999). No suitable habitat occurs in the study area.	No

THREATENED FAUNA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
Australian Painted Snipe <i>Rostratula australis</i>	E	V	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (DECC 2007). Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds (ibid.). Breeding is often in response to local conditions; generally occurs from September to December (DECC 2007). Roosts during the day in dense vegetation (NSW Scientific Committee 2004). Forages nocturnally on mud-flats and in shallow water (DECC 2007). Feeds on worms, molluscs, insects and some plant-matter (ibid.).	No
Barking Owl <i>Ninox connivens</i>	V		Associated with a variety of habitats such as savanna woodland, open eucalypt forests, wetland and riverine forest. The habitat is typically dominated by Eucalypts (often Redgum species), however often dominated by Melaleuca species in the tropics (DECC 2007). It usually roosts in dense foliage in large trees such as River She-oak (<i>Allocasuarina cunninghamiana</i>), other Casuarina and Allocasuarina, eucalypts, Angophora, Acacia and rainforest species from streamside gallery forests (NPWS 2003). It usually nests near watercourses or wetlands (NPWS 2003) in large tree hollows with entrances averaging 2-29 metres above ground, depending on the forest or woodland structure and the canopy height (Debus 1997).	Unlikely
Black Bittern <i>Ixobrychus flavicollis</i>	V		Occurs in both terrestrial and estuarine wetlands generally in areas of permanent water and dense vegetation (DECC 2007). In areas with permanent water it may occur in flooded grassland, forest, woodland, rainforest and mangroves (DECC 2007).	No
Blue-billed Duck <i>Oxyura australis</i>	V		The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation (DECC 2007). The species is completely aquatic, swimming low in the water along the edge of dense cover (DECC 2007). It will fly if disturbed, but prefers to dive if approached (DECC 2007). Blue-billed Ducks are partly migratory, with short-distance movements between breeding swamps and over-wintering lakes with some long-distance dispersal to breed during spring and early summer (DECC 2007). Young birds disperse in April-May from their breeding swamps in inland NSW to non-breeding areas on the Murray River system and coastal lakes (DECC 2007).	No
Bush Stone- curlew <i>Burhinus</i>	E		Associated with dry open woodland with grassy areas, dune scrubs, in savanna areas, the fringes of mangroves, golf courses and open forest / farmland (Pittwater Council 2000; Marchant & Higgins 1993). Forages in areas with fallen timber, leaf litter, little undergrowth and where the grass is short and patchy (Environment Australia 2000; Marchant & Higgins 1993). Is thought to require large tracts of habitat to support breeding, in which there is a preference for relatively undisturbed in lightly disturbed.	No

THREATENED FAUNA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
<i>grallarius</i>				
Diamond Firetail <i>Stagonopleura guttata</i>	V	-	This species occurs in grassy eucalypt woodlands, open forest, mallee, natural Temperate Grassland and in secondary grassland derived from other communities. No suitable habitat occurs in the study area.	No
Eastern Bristlebird <i>Dasyornis brachypterus</i>	E	E	This species is usually associated with heathland vegetation and areas of dense understorey and groundcover. Habitat is characterised by dense, low vegetation including heath and open woodland with a heathy understorey; in northern NSW occurs in open forest with tussocky grass understorey; all of these vegetation types are fire prone.	No
Eastern Ground Parrot <i>Pezoporus wallicus wallicus</i>	V		Predominantly restricted to coastal heath and sedgelands that provide a high density of cover and food foraging resources (Blakers et al. 1984; Simpson & Day 1999).	No
Eastern Osprey <i>Pandion cristatus</i>	V		Associated with waterbodies including coastal waters, inlets, lakes, estuaries, beaches, offshore islands and sometimes along inland rivers (Schodde and Tidemann 1986; Clancy 1991; Olsen 1995). Osprey may nest on the ground, on sea cliffs or in trees (Olsen 1995). Osprey generally prefer emergent trees, often dead or partly dead with a broken off crown (Olsen 1995).	Unlikely
Flame Robin <i>Petroica phoenicea</i>	V		Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes, often on ridges and slopes, in NSW. Prefers clearings or areas with open understoreys, and grassy groundlayer for breeding habitat. Will often occur in recently burnt areas. Shrub density does not appear to be an important habitat factor. Many birds move to the inland slopes and plains in winter, or to drier more open habitats in the lowlands.	Potential
Freckled Duck	V		Associated with a variety of plankton-rich wetlands, such as heavily vegetated, large open lakes and their shores, creeks, farm dams, sewerage ponds and floodwaters (DECC 2007).	No

THREATENED FAUNA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
<i>Stictonetta naevosa</i>				
Gang-gang Cockatoo <i>Callocephalon fimbriatum</i>	V	-	The Gang-gang Cockatoo occurs in forests and woodlands of south-eastern Australia. The species is dependant upon tree hollows for nesting and feeds on a range of seeds from species such as eucalypts and acacias. During summer in dense, tall, wet forests of mountains and gullies, alpine woodlands (Morcombe 2004). In winter they occur at lower altitudes in drier more open forests and woodlands, particularly box-ironbark assemblages (Shields & Chrome 1992). They sometimes inhabit woodland, farms and suburbs in autumn/winter (Simpson & Day 2004).	Potential
Glossy Black-cockatoo <i>Calyptrorhynchus lathamii</i>	V	-	This species occurs in forests and woodlands where She-oak feeding resources are prevalent and large tree hollows exist for breeding. Evidence of this species was found. Associated with a variety of forest types containing Allocasuarina species, usually reflecting the poor nutrient status of underlying soils (Environment Australia 2000; NPWS 1997; DECC 2007). Intact drier forest types with less rugged landscapes are preferred (DECC 2007). Nests in large trees with large hollows (Environment Australia 2000).	Unlikely
Little Eagle <i>Hieraaetus morphnoides</i>	V		Utilises open eucalypt, sheoak and acacia forest, woodland or open woodland. Uses tall trees for nesting, with a large stick nest being built. Lays eggs in spring, and young fledge in early summer. Preys on birds, reptiles and mammals, and occasionally feeds on large insects or carrion.	Unlikely
Little Lorikeet <i>Glossopsitta pusilla</i>	V		In New South Wales Little Lorikeets are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Little Lorikeets mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. They feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes.	Potential
Masked Owl <i>Tyto novaehollandiae</i>	V		Associated with forest with sparse, open, understorey, typically dry sclerophyll forest and woodland (DECC 2007) and especially the ecotone between wet and dry forest, and non forest habitat (Environment Australia 2000). Known to utilise forest margins and isolated stands of trees within agricultural land (Hyem 1979) and heavily disturbed forest where its prey of small and medium sized mammals can	Potential

THREATENED FAUNA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
			be readily obtained (Kavanagh & Peake 1993).	
Olive Whistler <i>Pachycephala olivacea</i>	V	-	This species inhabits wet forests on the ranges of the east coast of NSW, generally above 500m. It forages in trees and shrubs and on the ground for berries and insects. Elevated (>500 MASL), cool temperate rainforest and moist eucalypt forest in the northern part of their range. This species appears to favour large tracts of undisturbed and densely vegetated forest (SFNSW 1995).	Unlikely
Orange-bellied Parrot <i>Neophema chrysogaster</i>		CE	Breeds only in coastal south-west Tasmania and spends the winter in coastal Victoria and South Australia. It nests in hollows in eucalypt trees which grow adjacent to its feeding plains. In early October the birds arrive in the south west and depart after the breeding season usually in March and April. It feeds on the seeds of several sedges and heath plants, including buttongrass. Its main food preferences are found in sedgeland which have not been burned for between 3-15 years. Also included in the diet are seeds of three Boronia species and the everlasting daisy Helichrysum pumilum. After breeding, migrating birds move gradually northwards up the west coast, through the Hunter Group and King Island in Bass Strait and on to the mainland. On the journey the birds usually feed on beach-front vegetation including salt tolerant species such as sea rocket Cakile maritima. They also eat various coastal native and introduced grasses.	Unlikely
Pink Robin <i>Petroica rodinogaster</i>	V		The Pink Robin prefers densely vegetated gullies in eucalypt forest and rainforest. Occurs in Tasmania, Victoria and south east NSW to the central coast.	Potential
Powerful Owl <i>Ninox strenua</i>	V		Powerful Owls are associated with a wide range of wet and dry forest types with a high density of prey, such as arboreal mammals, large birds and flying foxes (Environment Australia 2000, Debus & Chafer 1994). Large trees with hollows at least 0.5m deep are required for shelter and breeding (Environment Australia 2000).	Potential
Red Goshawk <i>Erythrorhynchus radiatus</i>		V	Associated with forests and woodlands with a mosaic of vegetation types, an abundance of birds and permanent water. In NSW, this species is thought to favour mixed subtropical rainforest, Melaleuca Swamp Forest, and open eucalypt forest along rivers, often in rugged terrain (Marchant & Higgins 1993; DECC 2005). Across northern Australian south through eastern Queensland to far north-east NSW. The species is very rare in NSW. Most records are from the Clarence River Catchment, with a few about the lower Richmond and Tweed Rivers.	No
Regent Honeyeater <i>Anthochaera</i>	E	E	This migrant to the region forages for nectar in winter-flowering trees such as Spotted Gum and Swamp Mahogany. The study area is dominated by spring and summer-flowering tree species, such as Scribbly Gum, Bloodwood and Grey Gum, which are not favoured by the Regent Honeyeater. T Associated with temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban	No

THREATENED FAUNA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
<i>Phrygia</i>			areas with mature eucalypts, and riparian forests of River Oak (<i>Casuarina cunninghamiana</i>) (Garnett 1993). Areas containing Swamp Mahogany (<i>Eucalyptus robusta</i>) in coastal areas have been observed to be utilised (NPWS 1997). The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes (NPWS 1995). As such it is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar (Environment Australia 2000).	
Rose-crowned Fruit-Dove <i>Ptilinopus regina</i>	V		Tall tropical and subtropical, evergreen or semi-deciduous rainforests, especially with a dense growth of vines trees (Marchant and Higgins 1999). Also located in closed wet sclerophyll forest, gallery forests or sclerophyll woodlands with abundant fruiting trees, near or next to rainforest (DECC 2007). Is thought to prefer large areas of vegetation, but has been located in patches and occasionally in parks and gardens with fruiting trees (Marchant and Higgins 1999).	Potential
Scarlet Robin <i>Petroica boodang</i>	V		Occurs from the coast to the inland slopes in NSW. After breeding (July-Jan), some disperse to the lower valleys and plains of the tablelands and slopes, and may appear as far west as the eastern edges of the inland plains in autumn and winter. Primarily resides in dry eucalypt forests and woodlands, with usually open and grassy understorey, with scattered shrubs. Abundant logs and fallen timber are important habitat components. In autumn and winter many Scarlet Robins live in open grassy woodlands, and grasslands or grazed paddocks with scattered trees, and may join mixed flocks of other small insectivorous birds.	Potential
Sooty Owl <i>Tyto tenebricosa</i>	V		Sooty Owls are associated with tall wet old growth forest on fertile soil with a dense understorey and emergent tall Eucalyptus species (Environment Australia 2000, Debus 1994). Pairs roost in the daytime amongst dense vegetation, in tree hollows and sometimes in caves. The Sooty Owl is typically associated with an abundant and diverse supply of prey items and a selection of large tree hollows (Debus 1994, Garnett 1993, Hyem 1979).	Potential
Spotted Harrier <i>Circus assimilis</i>	V		Occurs mostly commonly in native grassland, but also in grassy open woodland including acacia and mallee remnants, inland riparian woodland, and foraging at the edges of inland wetlands, Can also forage over agricultural land for prey such as rabbits, but most native prey require ground cover. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn).	No
Square-tailed Kite	V	-	This summer migrant to the Shoalhaven hunts for passerines in coastal open forests and breeds in mature trees that are often near waterways. This species may forage in the study area from time to time but this habitat would form a very small amount of the species' vast home range. In coastal areas associated tropical and temperate forests and woodlands on fertile soils with an abundance of passerine birds (Marchant & Higgins 1993, DECC 2007). May be recorded inland along timbered watercourses (DECC 2007). In NSW it is commonly	Potential

THREATENED FAUNA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
<i>Lophoictinia isura</i>			associated with ridge or gully forests dominated by Woollybutt (<i>Eucalyptus longiflora</i>), Spotted Gum (<i>E. maculata</i>), or Peppermint Gum (<i>E. elata</i> , <i>E. smithii</i>) (DECC 2007).	
Superb Fruit-Dove <i>Ptilinopus superb</i>	V		Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms (DECC 2007). It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees (ibid.). Part of the population is migratory or nomadic (ibid.). At least some of the population, particularly young birds, moves south through Sydney, especially in autumn (ibid.). Breeding takes place from September to January (ibid.). Will feed in adjacent mangroves or eucalypt forests (Blakers et al. 1984).	Potential
Swift Parrot <i>Lathamus discolor</i>	E	E	This migrant to the region predominantly forages in winter-flowering trees such as Spotted Gum and Swamp Mahogany. Breeds in Tasmania between September and January. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts (Blakers et al. 1984; Schodde and Tidemann 1986; Forshaw and Cooper 1981). Hence, in this region, autumn and winter flowering eucalypts are important for this species. Favoured feed trees include winter flowering species such as Swamp Mahogany (<i>Eucalyptus robusta</i>), Spotted Gum (<i>Corymbia maculata</i>), Red Bloodwood (<i>C. gummifera</i>), Mugga Ironbark (<i>E. sideroxylon</i>), and White Box (<i>E. albens</i>) (DECC 2007).	Unlikely
Turquoise Parrot <i>Neophema pulchella</i>	V		Steep rocky ridges and gullies, rolling hills, valleys and river flats and the plains of the Great Dividing Range compromise the topography inhabited by this species (Marchant & Higgins 1993). Spends much of the time on the ground foraging on seed and grasses (DECC 2007). It is associated with coastal scrubland, open forest and timbered grassland, especially low shrub ecotones between dry hardwood forests and grasslands with high proportion of native grasses and forbs (Environment Australia 2000).	Unlikely
Varied Sittella <i>Daphoenositta chrysoptera</i>	V		Distribution includes most of mainland Australia except deserts and open grasslands. Prefers eucalypt forests and woodlands with rough-barked species, or mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods from bark, dead branches, or small branches and twigs.	No
White-fronted Chat <i>Epthianura</i>	V		Regularly observed in the saltmarsh of Newington Nature Reserve (with occasional sightings from other parts of Sydney Olympic Park and in grassland on the northern bank of the Parramatta River). Current estimates suggest this population consists of 8 individuals. Regularly observed in the saltmarsh and on the sandy shoreline of a small island of Towra Point Nature Reserve. This population is estimated to comprise 19-50 individuals. Have been observed breeding from late July through to early March, with 'open-cup' nests built in low	No

THREATENED FAUNA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
<i>albifrons</i>			vegetation. Nests in the Sydney region have also been seen in low isolated mangroves. Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feeding mainly on flies and beetles caught from or close to the ground (DECC 2005).	
Reptiles				
Broad-headed Snake <i>Hoplocephalus bungaroides</i>	E	V	This nocturnal species occurs on north-facing sandstone cliffs with loose rock sitting on the cliff substrate. It shelters in tree hollows during the summer months, emerging at night to hunt for small lizards. Typical sites consist of exposed sandstone outcrops and benching where the vegetation is predominantly woodland, open woodland and/or heath on Triassic sandstone of the Sydney Basin (DECC 2007). They utilise rock crevices and exfoliating sheets of weathered sandstone during the cooler months and tree hollows during summer (Webb & Shine 1998b). Some of the canopy tree species found to regularly co-occur at known sites include <i>Corymbia eximia</i> , <i>C. gummifera</i> , <i>Eucalyptus sieberi</i> , <i>E. punctata</i> and <i>E. piperita</i> (DECC 2007).	No
Rosenberg's Goanna <i>Varanus rosenbergi</i>	V		Associated with Sydney sandstone woodland and heath land. Rocks, hollow logs and burrows are utilised for shelter (Environment Australia 2000). Terrestrial termitaria are required for reproduction (King and Green 1999).	No
Amphibians				
Giant Barred Frog <i>Mixophyes iteratus</i>	E	E	Found on forested slopes of the escarpment and adjacent ranges in riparian vegetation, subtropical and dry rainforest, wet sclerophyll forests and swamp sclerophyll forest (DECC 2007; Ehmann 1997). This species is associated with flowing streams with high water quality, though habitats may contain weed species (Ehmann 1997). This species is not known from riparian vegetation disturbed by humans (NSW Scientific Committee 1999). During breeding eggs are kicked up onto an overhanging bank or the streams edge (DECC 2007).	No

THREATENED FAUNA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
Giant Burrowing Frog <i>Heleioporus australiacus</i>	V	V	In the Shoalhaven this species is usually recorded in close proximity to watercourses often associated with sandstone. Forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). Associated with semi-permanent to ephemeral sand or rock based streams (Ehmann 1997), where the soil is soft and sandy so that burrows can be constructed (Environment Australia 2000).	No
Green and Golden Bell Frog <i>Litoria aurea</i>	E	V	This species prefers permanent, unshaded water bodies containing emergent vegetation such as Cumbungi. This species has been observed utilising a variety of natural and man-made waterbodies (Pyke & White 1996) such as coastal swamps, marshes, dune swales, lagoons, lakes, other estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas, drains, ditches and any other structure capable of storing water (DECC 2007). Fast flowing streams are not utilised for breeding purposes by this species (Mahony 1999). Preferable habitat for this species includes attributes such as shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy shading (DECC 2007). Large permanent swamps and ponds exhibiting well-established fringing vegetation (especially bulrushes– <i>Typha</i> sp. and spikerushes– <i>Eleocharis</i> sp.) adjacent to open grassland areas for foraging are preferable (Ehmann 1997; Robinson 1993). Ponds that are typically inhabited tend to be free from predatory fish such as Mosquito Fish (<i>Gambusia holbrooki</i>) (DECC 2007).	No
Littlejohn's Tree Frog <i>Litoria littlejohni</i>	V	V	This species appears to be restricted to sandstone woodland and heath communities containing creeks with dense riparian vegetation at mid to high altitudes. Littlejohn's Tree Frog has a distribution that includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria (DECC 2007). It occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops. It appears to be restricted to sandstone woodland and heath communities at mid to high altitude (NSW Scientific Committee 2000). It forages both in the tree canopy and on the ground, and it has been observed sheltering under rocks on high exposed ridges during summer (NSW Scientific Committee 2000). It hunts either in shrubs or on the ground. Breeding is triggered by heavy rain and can occur from late winter to autumn, but is most likely to occur in spring when conditions are favourable. Males call from low vegetation close to slow flowing pools. Eggs and tadpoles are mostly found in slow flowing pools that receive extended exposure to sunlight, but will also use temporary isolated pools (DECC 2007).	No

THREATENED FAUNA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
Red-crowned Toadlet <i>Pseudophryne australis</i>	V		Red-crowned Toadlets are found in steep escarpment areas and plateaus, as well as low undulating ranges with benched outcroppings on Triassic sandstones of the Sydney Basin (DECC 2007). Within these geological formations, this species mainly occupies the upper parts of ridges, usually being restricted to within about 100 metres of the ridgetop. However they may also occur on plateaus or more level rock platforms along the ridgetop (DECC 2007). Associated with open forest to coastal heath (Ehmann 1997). Utilises small ephemeral drainage lines which feed water from the top of the ridge to the perennial creeks below for breeding, and are not usually found in the vicinity of permanent water (Ehmann 1997). Breeding sites are often characterised by clay-derived soils and generally found below the first sandstone escarpment in the talus slope (NPWS 1997).	No
Stuttering Frog <i>Mixophyes balbus</i>	E	V	This frog is generally associated with permanent streams in rainforest at altitudes above 300 m AHD. A variety of forest habitats from rainforest through wet and moist sclerophyll forest to riparian habitat in dry sclerophyll forest (DECC 2007) that are generally characterised by deep leaf litter or thick cover from understorey vegetation (Ehmann 1997). Breeding habitats are streams and occasionally springs. Not known from streams disturbed by humans (Ehmann 1997) or still water environments (NSW Scientific Committee 2002).	No
Terrestrial Migratory Species				
Black-faced Monarch <i>Monarcha melanopsis</i>		M	Rainforest and eucalypt forests, feeding in tangled understorey (Blakers et al. 1984). Breeds in damp, dense forest types and foraging extends to adjacent eucalypt forest.	Likely
Rainbow Bee- eater <i>Merops ornatus</i>		M	Resident in coastal and subcoastal northern Australia; regular breeding migrant in southern Australia, arriving September to October, departing February to March, some occasionally present April to May (Pizzey and Doyle 1988). Occurs in open country, chiefly at suitable breeding places in areas of sandy or loamy soil: sand-ridges, riverbanks, road-cuttings, sand-pits, occasionally coastal cliffs (ibid). Nest is a chamber at the end of a burrow, up to 1.6 m long, tunnelled in flat or sloping ground, sandy back or cutting (ibid).	No
Satin Flycatcher		M	Wetter, denser forest, often at high elevations (Simpson & Day 2004). Heavily vegetated gullies in forests, and taller woodlands of coastal	Potential

THREATENED FAUNA SPECIES	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
	TSC Act	EPBC Act		
<i>Myiagra cyanoleuca</i>			south-east Australia.	
Rufous Fantail <i>Rhipidura rufifrons</i>		M	The Rufous Fantail is a summer breeding migrant to southeastern Australia (Morcombe, 2004). The Rufous Fantail is found in rainforest, dense wet eucalypt and monsoon forests, paperbark and mangrove swamps and riverside vegetation (Morcombe, 2004). Open country may be used by the Rufous Fantail during migration (Morcombe, 2004).	Potential
White-bellied Sea-Eagle <i>Haliaeetus leucogaster</i>		M	Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas (Marchant & Higgins 1993, Simpson & Day 1999). Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away (Marchant & Higgins 1993).	Unlikely

Appendix B: Flora Species List

SCIENTIFIC NAME	COMMON NAME
<i>Acacia longifolia</i> var. <i>longifolia</i>	Sydney Golden Wattle
<i>Acacia maidenii</i>	Maiden's Wattle
<i>Acacia mearnsii</i>	Black Wattle
<i>Acmena smithii</i>	Lillypilly
<i>Acronychia oblongifolia</i>	White Aspen
<i>Adiantum formosum</i>	Giant Maidenhair
* <i>Ageratina riparia</i>	*Mist Flower
<i>Alchornea ilicifolia</i>	Native Holly
<i>Alectryon subcinereus</i>	Native Quince
<i>Alphitonia exelsa</i>	Red Ash
* <i>Andropogon virginicus</i>	*Whisky Grass
* <i>Araujia sericifera</i>	*Moth Vine
* <i>Asparagus aethiopicus</i>	*Asparagus Fern
* <i>Asparagus asparagoides</i>	*Bridal Creeper
* <i>Asparagus plumosus</i>	*Climbing Asparagus
<i>Arthropteris tenella</i>	Jointed Fern
<i>Asplenium flabellifolium</i>	Necklace Fern
* <i>Avena fatua</i>	*Wild Oat
* <i>Axonopus fissifolius</i>	*Carpet Grass
<i>Backhousia myrtifolia</i>	Grey Myrtle
<i>Baloghia inophylla</i>	Brush Bloodwood
* <i>Bidens pilosa</i>	*Cobbler's Pegs
<i>Blechnum camfieldii</i>	Water Fern
<i>Brachychiton acerifolius</i>	Illawarra Flame Tree
<i>Breynia oblongifolia</i>	Coffee Bush
* <i>Briza subaristata</i>	*Quaking Grass
<i>Calochlaena dubia</i>	False Bracken Fern
<i>Carex appressa</i>	Tussock Sedge
<i>Cayratia clematidea</i>	Native Grape
<i>Centella asiatica</i>	Indian Pennywort

SCIENTIFIC NAME	COMMON NAME
<i>*Cerastium glomeratum</i>	*Mouse-ear Chickweed
<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	Mulga Fern
<i>*Chloris gayana</i>	*Rhodes Grass
<i>*Cinnamomum camphora</i>	*Camphor Laurel
<i>*Cirsium vulgare</i>	*Spear Thistle
<i>*Citrus x taitensis</i>	*Wild Lemon
<i>Clerodendrum tomentosum</i>	Hairy Clerodendrum
<i>Commelina cyanea</i>	Scurvy Weed
<i>*Conyza bonariensis</i>	*Fleabane
<i>Crinum pedunculatum</i>	Swamp Lily
<i>Croton verreauxii</i>	Green Native Cascarilla
<i>Cryptocarya glaucescens</i>	Jackwood
<i>*Cyclospermum leptophyllum</i>	*Slender Celery
<i>Cynodon dactylon</i>	Common Couch
<i>Daphnandra</i> sp. C 'Illawarra' (<i>D. johnsonii</i>)	Illawarra Socketwood
<i>*Datura stramonium</i>	*Common Thornapple
<i>Deeringia amaranthoides</i>	Deeringia
<i>*Delairea odorata</i>	*Cape Ivy
<i>Dendrocnide exelsa</i>	Giant Stinging Tree
<i>Dichondra repens</i>	Kidney Weed
<i>Diospyros pentamera</i>	Myrtle Ebony
<i>Doodia aspera</i>	Rasp Fern
<i>Doryphora sassafras</i>	Sassafras
<i>Ehretia acuminata</i> var. <i>acuminata</i>	Koda
<i>*Ehrhardta erecta</i>	*Panc Veldt Grass
<i>Einadia hastata</i>	Berry Saltbush
<i>Einadia trigonos</i> subsp. <i>trigonos</i>	Fishweed
<i>Elaeodendrum australe</i>	Red-fruited Olive Plum
<i>*Eriobotrya japonica</i>	*Loquat
<i>*Erythrina x sykesii</i>	*Coral Tree
<i>Eustrephus latifolius</i>	Wombat Berry
<i>Ficus coronata</i>	Sandpaper Fig
<i>Ficus macrophylla</i>	Moreton Bay Fig
<i>Ficus rubiginosa</i>	Rusty Fig
<i>Geitonoplesium cymosum</i>	Scrambling Lily

SCIENTIFIC NAME	COMMON NAME
<i>Geranium homeanum</i>	Northern Cranesbill
<i>Glycine clandestina</i>	Love Creeper
* <i>Gomphocarpus fruticosus</i>	*Cotton Bush
<i>Guioa semiglauc</i>	Guioa
<i>Gymnostachys anceps</i>	Settlers Flax
<i>Hibbertia scandens</i>	Golden Guinea Flower
<i>Hibiscus heterophyllus</i> subsp. <i>heterophyllus</i>	Native Rosella
<i>Histiopteris incisa</i>	Bats Wing Fern
<i>Hydrocotyle tripartita</i>	Pennywort
* <i>Hypochaeris radicata</i>	*Flatweed
<i>Hypolepis muelleri</i>	Harsh Ground Fern
<i>Juncus usitatus</i>	Common Rush
* <i>Lantana camara</i>	*Lantana
<i>Legnephora moorei</i>	Round-leaf Vine
* <i>Ligustrum lucidum</i>	*Broad-leaf Privet
* <i>Ligustrum sinense</i>	*Small-leaf Privet
<i>Livistona australis</i>	Cabbage Palm
<i>Maclura cochinchinensis</i>	Cockspur Thorn
<i>Marsdenia rostrata</i>	Common Milk Vine
<i>Melia azederach</i>	White Cedar
<i>Melicope micrococca</i>	Hairy-leaved Doughwood
<i>Microlaena stipioides</i> var. <i>stipoides</i>	Weeping Grass
<i>Morinda jasminoides</i>	Jasmine Morinda
<i>Notelaea longifolia</i>	Mock Olive
* <i>Ochna serrulata</i>	*Mickey Mouse Bush
* <i>Olea europea</i> subsp. <i>cuspidata</i>	*African Olive
<i>Oplismenus aemulus</i>	Basket Grass
<i>Pandorea pandorana</i> subsp. <i>pandorana</i>	Wonga-wonga Vine
<i>Pararchidendron pruinosum</i> var. <i>pruinsum</i>	Snowwood
<i>Parsonsia straminea</i>	Monkey Rope
* <i>Paspalum dilatatum</i>	*Paspalum
* <i>Passiflora subpeltata</i>	*White Passion Flower
* <i>Pennisetum clandestinum</i>	*Kikuyu
* <i>Phytolacca octandra</i>	*Inkweed
<i>Piper novae-hollandiae</i>	Giant Pepper Vine

SCIENTIFIC NAME	COMMON NAME
<i>Pittosporum multiflorum</i>	Orange Thorn
<i>Pittosporum undulatum</i>	Sweet Pittosporum
<i>Plectranthus parviflorus</i>	Cockspur Flowers
<i>Podocarpus elatus</i>	Plum Pine
* <i>Prunella vulgaris</i>	*Self-heal
<i>Pseuderanthemum variabile</i>	Pastel Flower
<i>Pteridium esculentum</i>	Bracken
<i>Pteris umbrosa</i>	Jungle Brake
* <i>Rubus anglocandicans</i>	*Blackberry
<i>Rubus rosifolius</i> var. <i>rosifolius</i>	Rose-leaf Bramble
<i>Rumex brownii</i>	Swamp Dock
<i>Scolopia braunii</i>	Flintwood
* <i>Senecio madagascariensis</i>	*Fireweed
* <i>Senna pendula</i> var. <i>glabrata</i>	*Cassia
* <i>Sida rhombifolia</i>	*Paddy's Lucerne
* <i>Silybum marianum</i>	*Variegated Thistle
<i>Smilax australis</i>	Lawyer Vine
* <i>Solanum americanum</i>	*Blackberry Nightshade
* <i>Solanum mauritanum</i>	*Wild Tobacco Bush
* <i>Solanum pseudocapsicum</i>	*Jerusalem Cherry
<i>Stellaria flaccida</i>	Forest Starwort
<i>Stephania japonica</i> var. <i>discolor</i>	Snake Vine
<i>Streblus brunonianus</i>	Whalebone
<i>Syzygium australe</i>	Brush Cherry
* <i>Tagetes minuta</i>	*Stinking Roger
<i>Toona ciliata</i>	Red Cedar
* <i>Tradescantia fluminensis</i>	*Wandering Jew
* <i>Trifolium repens</i>	*White Clover
<i>Trophis scandens</i> subsp. <i>scandens</i>	Burney Vine
<i>Urtica incisa</i>	Stinging Nettle
* <i>Verbena bonariensis</i>	*Purple-top Verbena
<i>Veronica plebeia</i>	Speedwells
* <i>Vicia sativa</i> subsp. <i>nigra</i>	*Common Vetch
<i>Wilkiea huegeliana</i>	Veiny Wilkiea
<i>Zieria granulata</i>	Illawarra Zieria

Appendix C: Assessment of Significance

EP&A ACT ASSESSMENT OF SIGNIFICANCE (7-PART TEST)

The Assessment of Significance (7-part test) is applied to species, populations and ecological communities listed on Schedules 1, 1A and 2 of the TSC Act and Schedules 4, 4A and 5 of the Fisheries Management Act. The assessment sets out 7 factors, which when considered, allow proponents to undertake a qualitative analysis of the likely impacts of an action and to determine whether further assessment is required via a Species Impact Statement (SIS). All factors must be considered and an overall conclusion made based on all factors in combination. An SIS is required if, through application of the 7-part test, an action is considered likely to have a significant impact on a threatened species, population or ecological community.

Whilst, given the proposal comprises a proposed rezoning under Part 3 of the EP&A Act, there is no statutory obligation to undertake an Assessment of Significance, the 7-part test is a useful and relevant tool for assessing the potential impacts of the proposal on individual threatened entities.

Threatened species, populations and ecological communities which may be directly or indirectly affected by the proposal include:

- Illawarra Subtropical Rainforest (ISR)
- *Cynanchum elegans*
- *Daphnandra* sp. C 'Illawarra'
- *Zieria granulata*

ILLAWARRA SUBTROPICAL RAINFOREST

Illawarra Subtropical Rainforest is located on high nutrient soils in the Illawarra region. Characteristic tree species include *Baloghia inophylla* (Brush Bloodwood), *Brachychiton acerifolius* (Flame Tree), *Dendrocnide excelsa* (Giant Stinging Tree), *Diploglottis australis* (Native Tamarind), *Ficus* spp., *Pennantia cunninghamii* (Brown Beech) and *Toona ciliata* (Red Cedar). Species of *Eucalyptus*, *Syncarpia* and *Acacia* may also be present as emergents or incorporated into the dense canopy.

Illawarra Subtropical Rainforest occurs predominately in the eastern parts of the study area and beyond, with a smaller occurrence in the west, as shown in Figure 3.

a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Illawarra Subtropical Rainforest is not a threatened species.

b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

Illawarra Subtropical Rainforest is not an endangered population.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

The proposed rezoning area does not contain any ISR. The subsequent residential subdivision construction is likely to directly affect a small area of ISR for water and sewer pipeline connection, and has the potential to indirectly affect areas of ISR through a range of edge effects.

The impacts to ISR from water and sewer connection to the east will affect a small, linear and weed affected periphery of the ISR. No substantial trees appear likely to be affected. Rehabilitation of areas disturbed by pipeline works will be undertaken as part of the subdivision proposal.

The subdivision has the potential to further degrade the composition of nearby ISR through poor design and inadequate environmental controls, which could result in a range of edge effects associated with residential development, such as polluted runoff, invasive weed spread, and dumping of rubbish or garden waste.

However, ISR in the study area is already heavily degraded by invasive weeds. Potentially adverse edge effects can be adequately controlled and mitigated by strategies including sensitive site design at the detailed design stage of the subdivision, stringent construction stage controls and safeguards, and by ongoing management of the residential/bushland interface. Appropriate control measures are outlined in Section 7, and need to be integrated into the subdivision proposal.

The extent of the local occurrence of ISR to the east of the site appears to be approximately 5 ha. Given that direct impacts to ISR limited to a small area (approximately 0.03ha or around 0.6% of the local occurrence) that will be rehabilitated, and provided that the development include appropriate planning and long term strategies to manage edge effects, adverse impacts to the ISR would be minimised or eliminated. There is also potential for the proposal to improve the condition of weed affected vegetation surrounding the ISR by rehabilitation efforts on surrounding lands.

Under these circumstances, it is considered unlikely that the proposal would adversely affect the extent or modify the composition of the ISR such that its local occurrence is placed at risk of extinction.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

- i) Only a relatively small area (up to approximately 0.03 ha) of degraded ISR is likely to be directly removed by the construction of pipelines to the east. Minor indirect impacts such

as edge effects may occur, but these are not likely to pose any substantial risk to the ISR provided that adequate control measures are employed.

- ii) The subdivision stage will partially fragment a degraded portion of ISR through the construction of water and sewer pipelines. This impact will be narrow (up to 10m wide) and linear, through an area with a high proportion of rock and weeds, so effects on connectivity would be minimal. The subdivision will also further restrict connectivity between areas of ISR in the west and east of the study area, although this habitat has already been removed.
- iii) The habitat to be adversely affected by the proposal is not important to the long term survival of ISR in the locality. The local occurrence of ISR appears to be at least 5 ha in size.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No critical habitat has been declared for ISR.

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

No recovery plan exists for the ISR. No relevant threat abatement plans have been prepared for this community.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

A key threatening process is defined under the TSC Act as “a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities”.

Three key threatening process listed under Schedule 3 of the TSC Act are considered relevant to ISR and the current proposal, ‘Clearing of Native Vegetation’, ‘Invasion and establishment of exotic vines and scramblers’ and ‘Invasion of native plant communities by exotic perennial grasses’.

The proposal involves a small amount (approximately 0.03 ha) of native vegetation clearing for pipeline construction. The affected vegetation is a small area of relatively degraded ISR, which will be rehabilitated as much as possible following construction.

The proposal involves works upslope of the habitat for the ISR which has the potential to lead to habitat modification. However, these potential effects can be appropriately mitigated by sensitive design at the detailed design stage of any residential development, robust construction controls and by ongoing management actions to control edge effects. Furthermore, exotic vines, scramblers and perennial grasses are already widespread and abundant within the study area so any increase in these KTPs in association with the proposal is likely to be negligible. The proposal has the potential, through ongoing management of the bushland interface, to result in a substantial reduction of these KTPs within the study area.

Conclusion

Provided that effective mitigation and control measures are integrated into the residential subdivision proposal and implemented before, during and after construction, as outlined in Section 7, it is considered unlikely that the proposal will result in a significant impact on the Illawarra Subtropical Rainforest.

CYNANCHUM ELEGANS

Cynanchum elegans (White-flowered Wax Plant) is listed as an endangered species in NSW under schedule 1 of the TSC Act and nationally under the EPBC Act. *Cynanchum elegans* is a climber or twiner with stems to approximately 1 m long (Harden 1994). Leaves are generally broad-ovate, 1.5–5.5 cm long and 15–25 mm wide with a short-acuminate apex. Few white-flowered inflorescences are produced in clusters or umbels on branched stalks between August and May.

This species is distributed from the Gloucester district to the Wollongong area and inland to Mt Dangar (Harden 1994) where it occurs in rainforests and their margins, particularly dry rainforest and vine thicket, although it is also known from coastal scrubs and open woodland and forest (Harden 1994; Fairley 2004). It is known from at least 28 sites in the Illawarra region.

A record of the species exists near the eastern edge of the subject site, at the interface of grazing land and dense vegetation (predominantly weeds), as shown in Figure 3. Surveys were not able to verify this record, as only the similar Common Milk Vine *Marsdenia rostrata* was found at this location. *Cynanchum elegans* was not recorded from other vegetation edges around or within the subject site. The species may exist elsewhere in the study area as suitable habitat is present. Such areas of potential habitat have not been subject to targeted survey for the species, but are generally further from the subject site and not likely to be affected by the proposal. *Cynanchum elegans* is included in this assessment on a conservative basis due to the previous record and presence of suitable habitat.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

The presence of *Cynanchum elegans* in the study area was not confirmed, although a record for the species and suitable habitat is present. Targeted surveys within and around the edges of the subject site did not record the species. The proposed action does not involve the direct removal of any known habitat for this species.

The proposal does involve works within approximately 20m of the previous record, and has the potential to introduce indirect impacts or edge effects that could, if uncontrolled, pose a risk to the species. The previous record appears to occur in habitat that is predominantly exotic vegetation and has been subject to disturbances from grazing and associated edge effects from clearing. The species may occur elsewhere on surrounding lands, which are at less risk from the proposal.

The potential edge effects on the species can be appropriately mitigated by sensitive site design of future residential development, robust construction controls on the eastern edge of the site, and by ongoing management of the eastern and western sides of the site, which would contain asset protection zones on the bushland interface. Any weed control and other bush regeneration activities need to be aware of the species to avoid accidental removal.

The controls above should be components of any development proposal on the site, due to the presence of other threatened plants and endangered communities. Under these circumstances, the proposal is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

Not applicable, *Cynanchum elegans* is not an endangered population.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable, *Cynanchum elegans* is not an endangered ecological community.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

The proposal will not remove, fragment or isolate any known habitat for this species. The residential development could introduce edge effects that are detrimental to the species, if present. Habitat for the species around the previous record, although degraded by weeds, would be important to the survival of the species in the area, as no other records are known from the site.

However, the potential indirect impacts to the species posed by the residential development are likely to be mitigated appropriately through a range of control measures that need to be implemented for other ecological constraints in the study area. The species record is situated close to an area of Illawarra Subtropical Rainforest and other threatened plants are known to occur on the edge of the site. The range of protective actions and ongoing management required for these constraints adjacent to the site should encompass the area of the *Cynanchum elegans* record and potential habitat near the eastern edge of the development.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No critical habitat has been declared for *Cynanchum elegans*.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

No recovery plan or threat abatement plan has been prepared for *Cynanchum elegans*.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

A key threatening process is defined under the TSC Act as “a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities”.

Three key threatening processes listed under Schedule 3 of the TSC Act are considered relevant to *Cynanchum elegans* and the current proposal: ‘Clearing of Native Vegetation’; ‘Invasion and establishment of exotic vines and scramblers’; and ‘Invasion of native plant communities by exotic perennial grasses’.

The proposal involves a small amount (approximately 0.03 ha) of native vegetation clearing for pipeline construction. The affected vegetation is a small area of relatively degraded ISR, which will be rehabilitated as much as possible following construction.

Furthermore, exotic vines, scramblers and perennial grasses are already widespread within the study area so any increase in these KTPs in association with the proposal is likely to be negligible. The proposal has the potential, through ongoing management of the bushland interface, to result in a substantial reduction of these KTPs within the study area.

NPWS (2002) does recognise that other threatening processes associated with residential development can adversely impact on the species, including nearby road construction, weed invasion, dumping of rubbish and fill material, poorly supervised bush regeneration activities and other habitat modification resulting from upslope developments. These processes are relevant to the proposal, although these and other indirect impacts are expected to be effectively controlled through sensitive design at the detailed design stage of any residential development, robust construction controls and by ongoing management actions to control edge effects as outlined in Section 7.

Conclusions

Provided that effective mitigation and control measures are integrated into the residential subdivision proposal and implemented before, during and after construction, as outlined in Section 7, it is considered unlikely that the proposal will result in a significant impact on *Cynanchum elegans*.

DAPHNANDRA SP. ‘ILLAWARRA’

Daphnandra sp. C ‘Illawarra’ (also known as *Daphnandra johnsonii* under the EPBC Act) is listed as an endangered species in NSW under Schedule 1 of the TSC Act and nationally under the EPBC Act. The species is restricted to the Illawarra region where it has been recorded from the local government areas of Shoalhaven, Kiama, Shellharbour and Wollongong.

Daphnandra sp. C ‘Illawarra’ is a tree that grows to approximately 20 meters. The leaves are opposite, coarsely toothed, roughly oval in shape, with a raised mid-vein on the upper surface. *Daphnandra* sp.

C 'Illawarra' has small, pale greenish white flowers (rarely with a pink margin), borne in a many-flowered panicle from the leaf base. The flowering period is usually briefly in September and early October (DEC 2005a).

Daphnandra sp. C 'Illawarra' is usually associated with vegetation types that include rainforest and moist eucalypt forest. It usually occupies rocky hillsides and gullies of the Illawarra lowlands, occasionally extending onto the upper escarpment slopes (DEC 2005a).

Threats to *Daphnandra* sp. C 'Illawarra' include further loss and fragmentation of habitat, particularly through clearing for agriculture, quarries and residential development, and habitat degradation resulting from weed invasion, grazing, rubbish dumping, landfill, urban run-off, track construction/widening, and inappropriate fire management (DEC 2005a).

This species was recorded at one location in the study area, on the eastern edge of the cleared grazing land. Another record of the species occurs approximately 150m to the east, in Willow Gully, and it is possible that the species occurs elsewhere in the study area. All known individuals will be retained by the proposal.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

The species occurs as a small patch of trees at the interface of grazing pasture and disturbed rainforest to the east of the subject site. The proposed action does not involve the removal of any individuals or suitable habitat for this species. No construction works would need to be undertaken within 10-15m of the *Daphnandra* patch. However, the proposal will ultimately involve development upslope from the species, with potential impacts from runoff, erosion, increased nutrients or pollutants, and a range of other edge effects typical of residential areas.

The species (and possibly much of the local population) is susceptible to these potential impacts because it appears only to occur in a relatively small patch, without a substantial vegetated buffer and is downslope of the proposed subdivision. However, these potential impacts can be appropriately managed and mitigated by sensitive site design, robust construction control methods and ongoing management of the bushland interface.

Under these circumstances, the proposal potentially could have an adverse effect on the life cycle of the species unless the controls above are implemented for any residential subdivision on the site, and employed before, during and after any development.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

Not applicable, *Daphnandra* sp. C 'Illawarra' is not an endangered population.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable, *Daphnandra* sp. C 'Illawarra' is not an endangered ecological community.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

The proposed action does not involve the direct removal or fragmentation of any known habitat for this species. The proposal does involve the risk of edge effects degrading the known habitat of the species, although these indirect impacts can be effectively mitigated and controlled by sensitive site design, robust construction control methods and ongoing management of the bushland interface.

While no habitat is likely to be significantly modified by the proposal with control measures in place, the potentially affected habitat is important for the long-term survival of the species on the site, as it is the only location in the study area where the species is known from, and may represent a discrete population or sub-population.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No critical habitat has been declared for *Daphnandra* sp. C 'Illawarra'.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

A recovery plan currently exists for *Daphnandra* sp. C 'Illawarra'. The overall objective of this plan is to provide for the continued and long-term survival of this species in the wild by preventing the loss of populations of the species (DEC 2005a). Two objectives of the plan are relevant to the proposal.

Objective 1 of the recovery plan aims to prevent the loss of sites from impacts due to land-use change through effective impact assessment under the EP&A Act (DEC 2005a).

Objective 2 relates to the identification of threats that include weed invasion, rubbish dumping and grazing by livestock and feral deer (DEC 2005a).

The proposed action has been considered with respect to both objectives 1 and 2. This report has been prepared to initially assess the impacts and identify threats to the habitat for this species, associated with the proposed landuse change. While no individuals or habitat for the species will be directly affected by the proposal, this assessment has identified potential indirect threats to the species due to the proximity and exposure to the proposed residential development. The species is currently exposed to impacts from cattle grazing and weed invasion, which would be improved by the proposal, although it would also introduce the potential for other edge effects associated with

residential development. To ensure that the proposal is not likely to adversely affect the species, a range of management actions and control measures need to be implemented, as outlined in Section 7.

No relevant threat abatement plans have been prepared for this species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

A key threatening process is defined under the TSC Act as “a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities”.

Three key threatening processes listed under Schedule 3 of the TSC Act are considered relevant to *Daphnandra* sp. C ‘Illawarra’ and the current proposal: ‘Clearing of Native Vegetation’; ‘Invasion and establishment of exotic vines and scramblers’; and ‘Invasion of native plant communities by exotic perennial grasses’.

The proposal involves a small amount (approximately 0.03 ha) of native vegetation clearing for pipeline construction. The affected vegetation is a small area of relatively degraded ISR, which will be rehabilitated as much as possible following construction.

Furthermore, exotic vines, scramblers and perennial grasses are already widespread within the study area so any increase in these KTPs in association with the proposal is likely to be negligible. The proposal has the potential, through ongoing management of the bushland interface, to result in a substantial reduction of these KTPs within the study area.

These processes are expected to be effectively controlled through sensitive design at the detailed design stage of any residential development, robust construction controls and by ongoing management actions to control edge effects, as outlined in Section 7.

Conclusions

Provided that effective mitigation and control measures are integrated into the residential subdivision proposal and implemented before, during and after construction, as outlined in Section 7, it is considered unlikely that the proposal will result in a significant impact on *Daphnandra* sp. C ‘Illawarra’.

ZIERIA GRANULATA

Zieria granulata is listed as an endangered species in NSW under Schedule 1 of the TSC Act and nationally under the EPBC Act. The species is restricted to the Illawarra region where it occurs predominantly in the local government areas of Kiama and Shellharbour.

Zieria granulata is a tall shrub or small tree that grows to approximately 6 meters. The leaves are opposite and palmately trifoliate and the entire plant is covered with glandular tubercles. Flowers are white with four petals to 5mm in diameter. Flowering occurs during spring to summer (DEC 2005b).

Zieria granulata is usually associated with dry ridge tops and rocky outcrops with shallow, volcanic soils. The species has been recorded within a range of vegetation types, but predominantly in association with *Melaleuca armillaris* scrub or shrubland; Subtropical Rainforest; and *Eucalyptus tereticornis* woodland or forest (DEC 2005b).

Seventy seven individuals were recorded in the western section of the study area. Additional plants may occur in the east of the study area. All known individuals will be retained by the proposal.

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Zieria granulata was recorded in the west of the study area, with 50 mature plants and 27 seedlings located during targeted surveys. The majority of plants occur beyond the subject site, although two mature plants occur on the western boundary of the subject site. These two plants are separated from the remainder of the population by a dry stone wall up to approximately 1m in height, which generally forms the western side of the development. The two *Zieria granulata* plants in the subject site can be retained within the western asset protection zone. Surrounding vegetation within the subject site is almost entirely exotic and will be removed, and no natural habitat for *Zieria granulata* needs to be removed for the proposal.

While the proposal will have no direct impact on *Zieria granulata* individuals or intact habitat, it will involve development upslope from the species, with potential impacts from runoff, erosion, increased nutrients or pollutants, and a range of other edge effects typical of residential areas. However, these potential impacts can be appropriately managed and mitigated by sensitive site design, robust construction control methods and ongoing management of the bushland interface. These controls need to be components of any development proposal on the site, employed before, during and after any development.

Currently, all of the *Zieria granulata* individuals known from the site are adversely affected by weeds and/or grazing activities. The proposal has the potential to remove these impacts and through ongoing bush regeneration actions, substantially improve the condition of habitat for this species.

Under these circumstances, the proposal is not likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

Not applicable, *Zieria granulata* is not an endangered population.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable, *Zieria granulata* is not an endangered ecological community.

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

The proposed action does not involve the direct removal or fragmentation of any natural habitat for this species. The proposal does involve the risk of edge effects degrading the known habitat of a large proportion of the population, which is located close to the site boundary and thus susceptible to edge effects. However, these indirect impacts can be effectively mitigated and controlled by sensitive site design, robust construction control methods and ongoing management of the bushland interface. The proposal also has the opportunity to substantially improve the habitat condition of this population of *Zieria granulata* by the removal of current threats (grazing and invasive weeds).

While no habitat is likely to be significantly modified by the proposal with control measures in place, the potentially affected habitat is important, but not essential, for the long-term survival of the species in the locality. While the majority of plants are located close to the site boundary and thus susceptible to edge effects, there are other *Zieria granulata* individuals known from the study area that will not be affected by the proposal, and several other records of the species in surrounding areas. The individuals in the study area would form part of the West Kiama population, which contains approximately 12 sites and more than 1,500 plants (DEC 2005b).

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No critical habitat has been declared for *Zieria granulata*.

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

A recovery plan currently exists for *Zieria granulata*. The overall objective of this plan is to provide for the continued and long-term survival of *Zieria granulata* in the wild by promoting the in-situ conservation of the species across its natural range (DEC 2005).

Providing relevant management actions (such as the recommendations in Section 7), are incorporated into the proposal, it will be consistent with objectives and actions of the recovery plan as it will not directly remove individuals or habitat, will control and manage edge effects, and will remove current threats to the population. Thus, the proposal has the potential to be consistent with the following objectives:

- To conserve *Z. granulata* using land-use and conservation planning mechanisms;
- To identify and manage the threats operating at sites that contain the species; and
- To raise awareness of the species and involve the community in the recovery program.

No relevant threat abatement plans have been prepared for this species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

A key threatening process is defined under the TSC Act as “a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities”.

No key threatening processes listed under Schedule 3 of the TSC Act are relevant to *Zieria granulata* and the current proposal. The proposal involves works upslope of the habitat for this species and has the potential to lead to habitat modification and favourable conditions for weeds. However, these processes are already operating at the site through the current land use. Given that no habitat will be removed and active management of the bushland interface will be required as part of the subdivision, the overall proposal has the potential to effectively control these threatening processes and improve habitat conditions for the species.

Conclusions

Provided that effective mitigation and control measures are integrated into the residential subdivision proposal and implemented before, during and after construction, as outlined in Section 7, it is considered unlikely that the proposal will result in a significant impact on *Zieria granulata*.

EPBC ACT SIGNIFICANT IMPACT CRITERIA ON THREATENED AND MIGRATORY SPECIES

The EPBC Act Administrative Guidelines on Significance set out ‘**Significant Impact Criteria**’ that are to be used to assist in determining whether a proposed action is likely to have a significant impact on matters of national environmental significance. Matters listed under the EPBC Act as being of national environmental significance include:

- Listed threatened species and ecological communities
- Listed migratory species
- Wetlands of International Importance
- The Commonwealth marine environment
- World Heritage properties
- National Heritage places
- Nuclear actions
- Great Barrier Reef

Specific ‘**Significant Impact Criteria**’ are provided for each matter of national environmental significance except for threatened species and ecological communities in which case separate criteria are provided for species listed as endangered and vulnerable under the EPBC Act.

Threatened and migratory species listed under the EPBC Act that are considered likely or potentially to occur within the study area are given in Appendix A of the Report. The relevant Significant Impact Criteria have been applied to these threatened and migratory species to determine the significance of impact of the proposal at this preliminary stage.

MATTERS TO BE ADDRESSED	IMPACT (COMMONWEALTH LEGISLATION)
a. any environmental impact on a World Heritage Property;	No
b. any environmental impact on Wetlands of International Importance;	The proposal will not affect any part of RAMSAR wetland.
c. any impact on Commonwealth Listed Critically Endangered or Endangered	Yes, three Commonwealth listed endangered species are known of considered to potentially occur in the study area: • <i>Cynanchum elegans</i> • <i>Daphnandra johnsonii</i>

MATTERS TO BE ADDRESSED	IMPACT (COMMONWEALTH LEGISLATION)
Species;	• <i>Zieria granulata</i> The significant impact criteria in terms of the endangered species are considered below. <i>a. lead to a long-term decrease in the size of a population</i> Unlikely, as no individuals will be removed and provided that adequate measures are taken to avoid and manage adverse indirect impacts of the development. Under these circumstances, the proposal is unlikely to lead to a long-term decrease in the size of the populations of these species. <i>b. reduce the area of occupancy of the species</i> Unlikely, as no habitat will be removed for these species and provided that adequate measures are taken to avoid and manage adverse indirect impacts of the development. Under these circumstances, the proposal is unlikely to reduce the area of occupancy of the populations of these species. <i>c. fragment an existing population into two or more populations</i> The minimal amount of clearing associated with the development will not lead to further fragmentation of the populations of any of these species. <i>d. adversely affect habitat critical to the survival of a species</i> No habitat on site is considered to be critical to the survival of these species. No habitat is likely to be adversely affected provided that adequate measures are taken to avoid and manage adverse indirect impacts of the development. <i>e. disrupt the breeding cycle of a population</i> The proposal will not disrupt the breeding cycle of any of these species, as all individuals and intact habitat will be retained. <i>f. modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</i> Unlikely, provided that adequate measures are taken to avoid and manage adverse indirect impacts of the development. <i>g. result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat</i> The proposal is unlikely to increase the risk from invasive species, provided that adequate measures are taken to avoid and manage adverse indirect impacts of the development. The proposal has the potential to substantially improve the condition of the habitat for these species by removing established invasive weeds. <i>h. introduce disease that may cause the species to decline; or</i> The proposal is not likely to introduce disease that may cause to these species to decline. <i>i. interfere with the recovery of the species.</i> The proposal will retain all individuals and habitat for these species, and provided that adequate measures are taken to avoid and manage adverse indirect impacts of the development, the proposal will support recovery actions.
d. any impact on Commonwealth Listed Vulnerable	Unlikely. Commonwealth listed vulnerable species that could occur in the study area include the Grey-headed Flying-fox <i>Pteropus poliocephalus</i> and Large-eared Pied Bat <i>Chalinolobus dwyeri</i>. These species would be occasional visitors to the surrounding

MATTERS TO BE ADDRESSED	IMPACT (COMMONWEALTH LEGISLATION)
Species;	vegetated areas, which provide foraging habitat, rather than permanent residents of the study area. No roosting sites are known or expected to occur close to the subject site. Given that negligible clearing of habitat would be involved with the proposal and no movement restrictions to highly mobile species such as bats, the proposal is not likely to have a significant impact on Vulnerable species.
e. any environmental impact on Commonwealth Listed Migratory Species;	Unlikely. Four Commonwealth listed migratory species have potential to occur in the study area: • Cattle Egret (<i>Ardea ibis</i>) • Black-faced Monarch (<i>Monarcha melanopsis</i>) • Satin Flycatcher (<i>Myiagra cyanoleuca</i>) • Rufous Fantail (<i>Rhipidura rufifrons</i>) The guidelines in terms of the migratory species are discussed below: <i>a. substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species</i> The Black-faced Monarch, Satin Flycatcher and Rufous Fantail may occur in more densely vegetated areas adjacent to the subject site. The proposal will not remove or modify any areas of important habitat for these species. The Cattle Egret may occur in the grazing pastures on the subject site, which will be removed by the proposal. However, the subject site does not represent an important area of habitat and similar habitat is widespread in the locality. <i>b. result in invasive species that is harmful to the migratory species becoming established in an area of important habitat of the migratory species</i> The proposal will not introduce or facilitate an invasive species that is harmful to these species in an area of important habitat or otherwise. <i>c. seriously disrupt the lifecycle (breeding, feeding, migration or nesting behaviour) of an ecologically significant proportion of the population of the species.</i> The proposal will not adversely affect habitat that is important for these species or disrupt the lifecycle of an ecologically significant proportion of the population of these species.
f. does any part of the Proposal involve a Nuclear Action;	No. The project does not include a Nuclear Action.
g. any environmental impact on a Commonwealth Marine Area;	No. There are no Commonwealth Marine Areas within the study area.
h. In addition, any direct or indirect impact on Commonwealth lands	No. The project does not directly or indirectly affect Commonwealth land.

CONCLUSION OF PRELIMINARY EPBC ACT ASSESSMENT

It is unlikely that the proposal will significantly impact on these threatened or migratory species, provided that adequate measures are taken to avoid and manage adverse indirect impacts of the development. Referral to the Commonwealth under the EPBC Act is unlikely to be necessary.

**HEAD OFFICE**

Suite 4, Level 1
2-4 Merton Street
Sutherland NSW 2232
T 02 8536 8600
F 02 9542 5622

CANBERRA

Level 2
11 London Circuit
Canberra ACT 2601
T 02 6103 0145
F 02 6103 0148

COFFS HARBOUR

35 Orlando Street
Coffs Harbour Jetty NSW 2450
T 02 6651 5484
F 02 6651 6890

PERTH

Suite 1 & 2
49 Ord Street
West Perth WA 6005
T 08 9227 1070
F 08 9322 1358

DARWIN

16/56 Marina Boulevard
Cullen Bay NT 0820
T 08 8989 5601

SYDNEY

Level 6
299 Sussex Street
Sydney NSW 2000
T 02 8536 8650
F 02 9264 0717

NEWCASTLE

Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
T 02 4910 0125
F 02 4910 0126

ARMIDALE

92 Taylor Street
Armidale NSW 2350
T 02 8081 2681
F 02 6772 1279

WOLLONGONG

Suite 204, Level 2
62 Moore Street
Austinmer NSW 2515
T 02 4201 2200
F 02 4268 4361

BRISBANE

PO Box 1422
Fortitude Valley QLD 4006
T 0400 494 366

ST GEORGES BASIN

8/128 Island Point Road
St Georges Basin NSW 2540
T 02 4443 5555
F 02 4443 6655

NAROOMA

5/20 Canty Street
Narooma NSW 2546
T 02 4476 1151
F 02 4476 1161

MUDGEES

Unit 1, Level 1
79 Market Street
Mudgee NSW 2850
T 02 4302 1230
F 02 6372 9230

GOSFORD

Suite 5, Baker One
1-5 Baker Street
Gosford NSW 2250
T 02 4302 1220
F 02 4322 2897