Flora and Fauna Management Plan, Emirates Luxury Resort Wolgan Valley

Urbis Pty Ltd

Final Report

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1 Introduction

Australian Museum Business Services (AMBS) has been commissioned by Emirates Resorts and Hotels Australia to submit a Flora and Fauna Management Plan as part of the Concept Plan Approval Conditions (DoP 2006) for the proposed Emirates Luxury Resort, Wolgan Valley. The Flora and Fauna Management Plan will be included in the Construction Management Plan (CMP) being prepared by Clifton Coney Group.

The proposed construction is of a luxury resort and conservation area with associated infrastructure. The study site has been divided into five landscape precincts based on the existing landscape character and environment, and the proposed use and management of each area. The main development area, comprising the Developed Precinct and Access Corridor Precinct, will be largely confined to existing cleared areas in the eastern portion of the site. The majority of the remainder of the site will be managed for passive recreation and environmental rehabilitation and conservation within Riparian Corridor, Managed Pasture and Nature Conservation Precincts.

1.1 Aims & Objectives

This management plan outlines measures to minimise the impact upon flora and fauna from the construction of the proposed development, Emirates Luxury Resort at Wolgan Valley. It includes the necessary information to satisfy Concept Plan Approval Condition 11 (g) that a Flora and Fauna Management Plan be included in the Construction Management Plan and describes the measures that would be implemented to:

- Protect the areas adjoining the disturbance areas;
- Undertake pre-clearance surveys;
- Minimise and manage the impacts on fauna;
- Conserve and reuse topsoil; and
- Collect and propagate seed for the rehabilitation of vegetation on the site.

1.2 Proposed Development Activities

The project to which the Concept Plan relates is a low density 'tourist facility' comprising 40 luxurious holiday villas and ancillary facilities, conference rooms, restaurant, helipad and other facilities (Urbis 2005).

The proposed development activities include:

- 40 villas;
- Ancillary facilities (including the main reception building);
- Staff accommodation;
- Associated infrastructure;
- Landscaping in 5 Precincts;
- Conserve the existing slab homestead; and
- Demolishing the 1957 homestead.

Other construction activities that relate to flora and fauna management include the erection of a feral-proof fence and construction of a large dam (Urbis 2006).

1.2.1 Landscape Precincts

The site has been divided into five landscape precincts based on the existing landscape character and environment, and the proposed use and management of each area.

Precinct 1 - the Development Precinct (DP), comprises two sub-precincts where buildings are proposed within a managed landscape. The resort, consisting of holiday villas, the main building, conference centre and spa building, is located either side of Carnes Creek. The Manager's accommodation, staff and maintenance facilities are located further north on the eastern bank of the Wolgan River.

Precinct 2 – the Riparian Corridor Precinct (RC), comprises all areas within 50 metres of the banks of watercourses, primarily Wolgan River and Carnes Creek.

Precinct 3 – Access Corridor Precinct (AC), comprises the road corridor between the main resort complex and Wolgan Road.

Precinct 4 – Managed Pasture Precinct (MP), surrounding the Development Precincts and the northern end of the Access Corridor Precinct.

Precinct 5 – Nature Conservation Precinct (NC), generally comprising the western half of the site and including the wetland areas and foothills fringing the site.

2 Existing Environment

2.1 Study site

The study site is located approximately 190km north-west of Sydney CBD, within the Lithgow Local Government Area. It is contained within the Wolgan Valley, 35km north of Lithgow and 3km south of Newnes. The Valley is almost completely enclosed by steep talus slopes, which occur at the base of the sandstone cliffs of the surrounding escarpment. Although most of the valley floor has been cleared, there are scattered trees in most grazed areas, as well as a narrow band of riparian vegetation along sections of the Wolgan River and Carnes Creek, which traverse the site. A series of drainage lines that originate in valleys on the talus-slopes flow through wetlands before emptying into the watercourses on site. Woodland and open-forest vegetation on the fringing foothills is contiguous with extensive tracts of vegetated land within surrounding National Parks, which form part of the Greater Blue Mountains World Heritage Area (GBMWHA).

The majority of the native vegetation on site, including the vegetated lower slopes, sedge wetlands and riparian vegetation has been substantially modified as a result of clearing, grazing of livestock and weed invasion. Riparian vegetation along the Wolgan River and Carnes Creek occurs in disjunct linear stands and sections of the River at the northern end of the valley have undermined banks and trees with exposed roots. Sedge species are common in wetland areas, although aquatic species in farm dams are mostly heavily grazed. The pasture areas include a mixture of native and

introduced grass species. Some exotic ornamental or fruit trees occur near farm dwellings and noxious weeds were recorded throughout the site.

Five native plant communities were identified on the subject site and adjoining lands; Talus-slope Woodland and Open Forest and Montane Gully Forest on the fringing slopes and in associated gullies, Tablelands Grassy Woodland on low rises and along river banks on the valley floor and Cox's River Swamp in low-lying areas. Open grassland dominated by introduced pasture with scattered trees covers the majority of the valley floor.

2.2 Flora and Fauna recorded

None of the vegetation types recorded on the study site are listed as endangered ecological communities under the TSC Act or as threatened ecological communities under the EPBC Act (AMBS 2005). The native vegetation types present are extensively distributed in the locality and region and are well represented in the surrounding National Parks.

No threatened plant species of state or national conservation significance listed under the TSC Act or EPBC Act were recorded on the study site during the targeted threatened plant surveys undertaken. It is possible that some species previously recorded in the locality occur within vegetated stands on the lower slopes and have either been overlooked, or were not visible because of grazing. Once cattle and horses are excluded from all foothills and escarpment vegetation, it is likely that a larger number of additional native plant species will become evident.

The site and surrounding lands provide habitat for a wide range of fauna species, including those reliant on woodland/forest, woodland/grassland ecotone, riparian/wetland and open grassland habitats. The vegetated lower foothills that fringe the site are contiguous with large and continuous tracts of open forest vegetation and fauna habitat within the adjoining Gardens of Stone and Wollemi National Parks. These national parks contribute to the extensive Greater Blue Mountains World Heritage area (GBMWHA) and provide more mature, less disturbed habitat for fauna which require high structural and floristic diversity and old growth elements (*eg*. tree-hollows).

A total of 132 vertebrate fauna species, comprising 32 mammals (including 9 introduced species and 11 microchiropteran bats), 96 birds (including 2 introduced species), 1 reptile and 3 frogs were recorded on the study site or in adjoining habitats during the field investigations (AMBS 2005). Of these, ten species (one arboreal mammal, one microchiropteran bat and eight bird species) are listed as threatened species on the schedules of the TSC. The threatened fauna species recorded include species likely to utilise all of the habitats on site (eg the Eastern Bentwing-bat), those reliant on woodland and open forest habitats (eg the Powerful and Sooty Owls, Glossy Black and Gang-gang Cockatoos, and Yellow-bellied Glider) and open woodland and woodland/grassland ecotones (eg the Brown Treecreeper, Speckled Warbler and Diamond Firetail).

It is possible that a number of additional threatened fauna species listed under the TSC Act and EPBC Act previously recorded within the locality (within 10km) could

also occur on the study site at least on occasion. Most of these species would be reliant on forest and woodland habitat for shelter and refuge but some are likely to also utilise the more open grassland habitats of the study site for foraging purposes.

No bird species listed under International Migratory Bird Agreements were recorded and the study site is not considered to provide critical or important habitat for these species or for other 'migratory' species listed under the EPBC Act.

2.3 Management Measures for Native Flora and Fauna

Management will focus on reducing and controlling impacts from construction activities and in particular minimising and managing the impacts upon threatened species from the construction of the resort.

Native fauna species of particular relevance for consideration in this regard include the following species known to utilise habitats within the proposed Riparian and Access Corridors and Development Precincts:

- Common Wombat
- Lace Monitor
- Microchiroptera
- Wallaroo and Grey Kangaroo
- Brown Treecreeper
- Speckled Warbler
- Diamond Firetail

Also of relevance are those threatened species known to occur in areas of adjoining habitat, including the:

- Glossy Black-cockatoo
- Gang-gang Cockatoo
- Yellow-bellied Glider
- Powerful and Sooty Owls

As no threatened plant species of state or national conservation significance were recorded on the study site, for the purposes of this report, no individual flora species will be targeted for management. Rather, management will minimise and control the impact of construction activities on vegetation communities and thereby the species within them.

3 Pre-Construction Phase - Flora and Fauna Management

3.1 Staff inductions

All persons involved in the construction will receive a copy of the CMP and participate in a site induction prior to the commencement of works. The site induction will be delivered by the Site Manager and will include but not be restricted to:

- the conditions of development approval and details of the works required;
- the importance of protecting the environmental values and native fauna of the site; and
- the requirement for protection of retained vegetation.

3.2 Fauna Protection

3.2.1 Pre-clearance Surveys

Applicable Precincts – *Developed Precinct, Access Corridor Precinct and areas associated with the Fence and Maintenance Track.*

Where the removal of trees or other native vegetation is required, a series of specific protocols would be implemented to protect native fauna that may be present as outlined below.

Pre-clearing surveys should be undertaken in vegetated areas to minimise the chances of death or injury to native fauna during the clearing and construction phases. Pre-clearing surveys of habitat trees (concentrating on trees with a diameter at breast height >20cm and those with obvious tree-hollows), specifically directed towards detecting hollow-dependent fauna (*eg.* microchiropteran bats and arboreal mammals) should also be undertaken. The pre-clearing survey should also involve general searches of the groundcover (*eg.* logs and rocks) to detect smaller terrestrial fauna (*eg.* small mammals, reptiles and amphibians). Surveys should include diurnal searches of potential bat roosting sites for bats or other evidence of bat utilisation, such as bat guano.

Any trees that are to be removed will be assessed for hollows and habitat features and flagged. Terrestrial fauna detected should be captured and released into adjacent retained habitat, with nocturnal fauna being released at dusk. Due to the low number of trees to be potentially removed it is unlikely to directly impact fauna in the area. However, at least one mature tree will be felled within the Developed Precinct and it may contain a hollow-dwelling animal. If trapping is unsuccessful then the tree should be felled with care (see Clearance Surveys).

Plate 1 The cleared and degraded nature of the Developed Precinct (trees lining Carnes Creek in the distance).

Pre-clearing surveys should be conducted by a qualified person and close communication maintained between the Construction Contractor and the NPWS and/or WIRES, to facilitate the care of injured or sick animals, or to remove fauna if necessary.

3.2.2 Road Mortality

Applicable Precincts – *Access Corridor Precinct*

Road mortality is unlikely to constitute a significant adverse impact on native fauna species given the anticipated low intensity traffic and that most traffic will be during the day. The potential for fauna road mortality could be reduced through the enforcement of speed limits and the erection of fauna crossing warning signs at appropriate locations. Such speed management features will be necessary in particular where vegetation extends up to the road verges and of particular relevance at night given that lighting will not be used along the access roads.

3.3 Habitat Protection and Improvement

Applicable Precincts – *Developed Precinct, Access Corridor and Riparian Corridor*

Temporary fencing is to be installed at the margin of the construction areas in order to prevent inadvertent access and damage to adjoining vegetation that is to be retained. The fencing will aim to restrict all activities to the construction area and in doing so:

- prevent mechanical damage of, or trampling of retained vegetation and fauna habitat;

- prevent parking of vehicle and machinery, storage of materials or dumping of rubbish in areas of retained vegetation; and
- reduce heavy vehicle compaction of the soil and reduce the potential for root damage in areas of retained vegetation (as a general rule tree canopy = root zone).

Where possible, all existing habitats will be retained in the Developed Precinct. Presently habitat for flora and fauna is confined to severely degraded grassland and a few isolated trees. The proposed development of the villas, staff accommodation, ancillary facilities, the main building and spa complex and associated infrastructure will remove only a small number of trees. Any other habitat features that occur in the construction areas such as logs and wood debris will be removed and relocated to other areas of habitat (or potentially replaced in the Developed Precinct as a landscaping feature once construction is complete).

All cattle will be systematically removed from the entire site. This will aid in the recovery and natural regeneration of the native vegetation.

3.4 Aquatic Habitat Protection and Improvement

Applicable Precincts – *Developed Precinct, Access Corridor and Riparian Corridor*

Erosion control devices will be installed at appropriate locations to prevent soil loss that could have an adverse impact on retained vegetation adjoining the construction area and on water quality in Carnes Creek and Wolgan River. These devices will conform to Department of Planning and Natural Resources (DIPNR) guidelines and will aim to prevent water run-off and the potentially damaging contaminants the water may contain after leaving construction areas (such as increased nutrient loadings, petrochemical residues and rubbish) from entering retained vegetation and watercourses.

3.4.1 Maintenance of erosion control devices

Soil and water management devices will be maintained in effective condition throughout the construction period and until the areas they protect have stable surfaces, protected by constructed drains or surfacing, or by an adequate level of established vegetation.

See the Landscape Management Plan for further details (Context 2006).

3.5 Bushland Regeneration

Applicable Precincts – *Developed Precinct, Access Corridor and Riparian Corridor*

3.5.1 Top soil and Seed Collection

The Developed Precinct is a heavily degraded area and it is likely that the top soil would be of minimal value as a seed bank to could be used in regeneration activities in other parts of the site. Even so, the top soil could be used in other landscaping activities such as creek stabilisation. This would be a more ecologically sound option

than using top soils sourced from an external site where weeds and contamination (such as the infectious disease Chytrid fungus) could potentially impact the site. Areas zoned for clearing and building should first have the top soil removed. This should be stored on site and used when necessary. Storage piles should be re-enforced so that sediment and soils do not run off into the creek system. Any necessary permits required to collect seed from surrounding areas will be applied for as early as possible.

Seed collection on the neighbouring property has already occurred and a large collection of seed is currently stored at the Lithgow Community Native Nursery (Context 2006). If further seed is required it will be collected prior to construction from areas to be cleared (see Appendix A for guidelines). Only tubestock specifically grown for the project from seeds of local provenance will be used and all seed will be collected from within a 10km radius of the site (See the Landscape Management Plan for further details on top soil reuse and regeneration plans).

3.5.2 Weed control

Prior to construction weed control protocols will be developed. The initial implementation of actions will be the identification areas for washing down vehicles and equipment between construction areas in particular following clearing activities in weed infested areas and developing weed destruction methods.

4 Construction Phase - Flora and Fauna Management

4.1 Fauna Protection

4.1.1 Preventing fauna on construction site

Applicable Precincts – *Developed Precinct*

Conscientious site management will ensure that the development site does not attract fauna. Construction sites can create conditions that are attractive to both feral and native fauna and this is undesirable during construction in both cases. Native fauna such as frogs may use habitat such as stored pipes, machinery or earthworks depressions that fill with water. House mice will also inhabit stockpiles, especially of wooden crates. Feral animals such as foxes and cats will be attracted to this site if there are scraps and rubbish left about, and if there are an increased number of small rodents such as the mice. Opportunists such as the Common Brushtail Possum may also be encouraged into the construction site by rubbish and left over foods. If the construction sites are not kept tidy and managed effectively native fauna can be harmed not only from construction activity but also from predation as a result of the increased numbers of feral animals in the vicinity.

Silt fences to be installed for the purpose of erosion and sediment control will also assist in preventing pollutants from the construction and works areas from entering retained vegetation and waterways. These features may also assist in the protection and management of frogs and reptiles at the site by minimising movements into the construction area. To be of assistance in this regard the silt fences would need to be at a minimum height of 0.5m.

4.1.2 Clearance surveys

Applicable Precincts – *Developed Precinct, Access Corridor and Fence and Maintenance Track.*

The investigation of trees and groundcover should be conducted on the day of clearing, to detect any individual animals present at the time. Larger fauna can be encouraged to vacate the site and be directed into areas of adjoining habitat. Although a number of threatened species that occupy hollows, such as the Yellow-bellied Glider and Glossy Black Cockatoo, breed around the proposed construction time (May 2007) (CCG 2006) they would usually be occupying larger hollows not detected on the construction area (NPWS 2003, NPWS 1999, Higgens 1999).

The smaller hollows and crevices in the trees on site are more likely to provide habitat for microchiropteran bats that do not generally breed during these cooler months. However, particular care still needs to be taken with clearances of microchiropteran bat habitat at this time because in order to conserve energy during colder months in which food resources are scarce, many bats hibernate or become torpid. Disturbance of hibernating bats can lead to premature exhaustion of energy reserves and death of animals. Although torpid bats may arouse and forage for food periodically, even during colder months, hibernating bats should not be disturbed (Environment

Australia 1999). At least five of the microchiropteran bats recorded in surveys of the site are known to hibernate (AMBS 2005, Churchill 1998).

If a potential bat roost site is located during pre-clearance surveys, roost sites are to be marked and monitored for nocturnal fly-out of bats. Roosting sites should be re-examined thoroughly during nocturnal surveys and stag watches. When it has been established that the roosts no longer contain bats, roost sites such as hollows should be completely blocked during nocturnal surveys to prevent re-entry to the roost. To prevent return of bats to roost sites under bark, loose bark should be stripped from those trees which are to be removed. Bats in torpor may potentially be relocated to other suitable habitat. Any hollows from trees to be removed should be salvaged and re-mounted on mature trees. A bat specialist may be required to be on site if a hollow is suspected of containing hibernating bats (determined in pre-clearance surveys).
Identified habitat trees will be carefully felled during clearing activities with an ecologist on site to minimise the potential for injury to fauna that may be occupying the tree and to preserve the tree intact.

Applicable Precincts – *Access Corridor Precinct.*

Fauna injury and fatalities could possibly occur from vehicular collisions along the access road while machinery, trucks and contractors vehicles use this one route to access the site. The traffic is unlikely to be frequent at night when most native fauna are active and incidents of road kill are not expected to be high. However, occurrences of road kill need to be recorded to ensure that high rates of road kill, especially threatened species, are detected and mitigation measures can be implemented. This may include road barrier fencing or overpasses depending on the affected species.

Applicable Precincts – *Managed Pasture Precinct.*

Any buildings, sheds or similar structures to be removed should also be inspected for roosting microchiropteran bats and owls. Owls can be flushed out of the area if detected. Appropriate protocols for bat removal and translocation will vary depending on the specific bat species and hibernating behaviour. In general, bats will have to be relocated to suitable habitat or kept during the day and released when in appropriate condition (ie not in torpor) (Churchill 1998).

4.2 Habitat Protection and Improvement

Applicable Precincts – *Developed Precinct and Access Corridor Precinct.*

Portions of any hollow-bearing trees removed from the construction area should be retained and either placed in adjacent bushland as hollow logs, or tied into large trees in adjacent woodland to provide shelter and nest sites for arboreal mammals, reptiles and birds. Large logs should also be removed from the proposed disturbance areas during clearing and placed in adjacent retained vegetation to maintain resources for native fauna (Gibbons and Lindenmayer 2002). The total number of hollows lost will be used to assess the need for supplementary habitat (ie. nest boxes).

Applicable Precincts – *Riparian Corridor Precinct, Managed Pasture Precinct and Nature Conservancy Precinct.*

Logs and trunks of native trees removed for construction purposes will be placed in existing and regenerating vegetated areas to improve existing modified habitats. In particular, trees containing hollows or abundant decorticating bark should be used for this purpose. Such features would provide supplementary foraging substrates for ground-feeding threatened birds (such as the Brown Treecreeper) and potential den sites for the Spotted-tailed Quoll and its prey (DEC 2005a,b).

4.3 Riparian Protection and Improvement

Applicable Precincts – *Riparian Corridor Precinct.*

The main watercourses within the study area are both currently experiencing substantial erosion as a result of cattle grazing, clearing of vegetation and flooding events. In particular, sections of the banks of the Wolgan River, at the northern end of the valley have undermined banks and trees with exposed root systems. Proposed management of the creek lines within the Riparian Corridor Precinct includes terracing within Carnes Creek to stabilise the creek banks and re-establishment of riparian vegetation to a minimum width of 40 metres from the top of the bank on either side of watercourses to provide habitat resources and wildlife corridors through the site. Measures will be implemented to ensure that woody debris removed or disturbed during creek stabilisation activities is replaced to maintain habitat for aquatic fauna.

To mange erosion and improve the creek system, it is proposed that some sections of the creek banks are to be recontoured and revegetated. Recontouring will be necessary for the following:

- Where limited existing vegetation exists, rehabilitation works will consist of the retention and enhancement of the existing canopy with extensive understorey planting and bank stabilizing using matting.
- Where extensive erosion has occurred, rehabilitation works will consist of bank recontouring, stone lined silt traps and mesh stabilisation (matting & spray seeding of grass species) will be undertaken along with the complete revegetation of canopy and understorey species.

These proposed stabilization works along the creek banks could have an adverse impact on individual wombats that currently utilise active burrows along Carnes Creek and Wolgan River. Recontouring work will be undertaken to avoid burrows where possible and earth moving machinery will avoid driving directly upslope of burrows to minimise chance of compaction and burrow collapse. Landscaping will be done in 100m sections, allowing for wombats to relocate of their own accord, which is likely due to the noise and disturbance from activities.

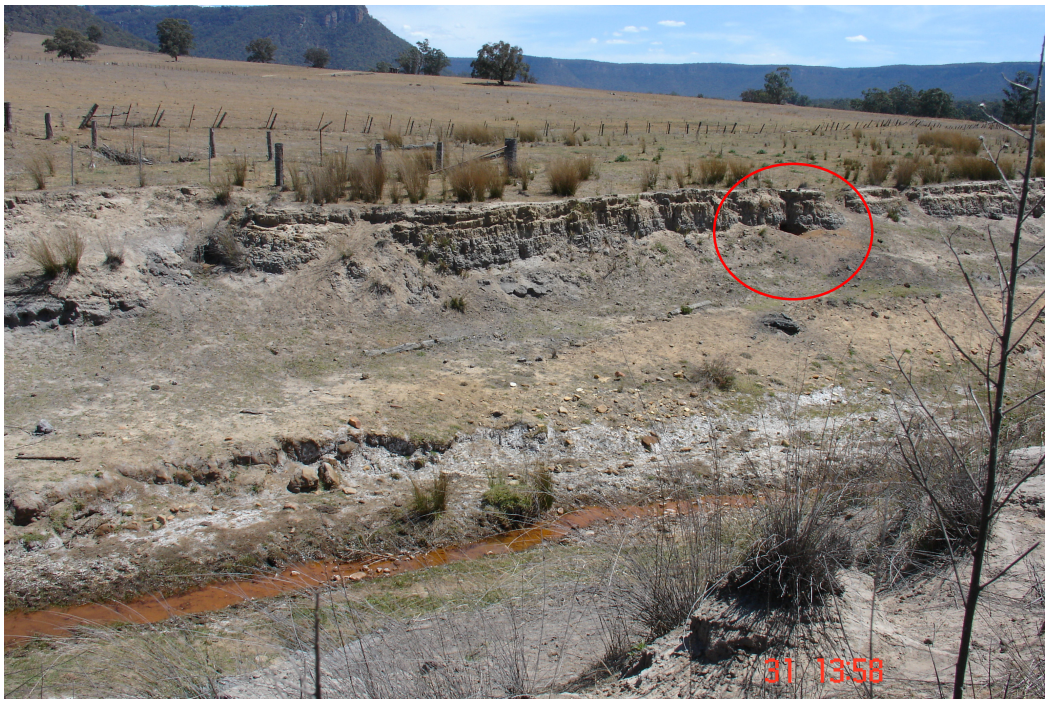

Plate 2 Erosion along the creek banks on the site and an example of a wombat burrow that occurs in potential recontouring locations.

4.4 Aquatic Habitat Protection and Improvement

Applicable Precincts – *Developed Precinct.*

Appropriate measures for the ongoing control and treatment of run-off from the construction area will be required to minimise adverse impacts on retained adjoining terrestrial and aquatic habitats as a result of discharges containing sediment, chemical pollutants and weed seeds. The following measures will be implemented:

- the stabilisation of exposed soil surfaces (*eg.* through sterile grass seeding, erosion control meshing, or mulching using vegetative material removed from the study area);
- the use of erosion and sediment control measures to collect sediment and to reduce flow velocities; and
- regular monitoring and maintenance of all erosion and sediment control structures throughout the construction phases to ensure their effective function.

Appropriate protocols and measures for the management of wastes and other possible contaminants in surface runoff arising from construction will also be implemented at relevant locations to limit the potential for adverse impacts on retained vegetation communities, habitats and watercourses. Specific measures to minimise the potential for pollution of surface runoff include:

- the construction of bund walls with sumps around chemical and fuel storage areas;

- appropriate management of fuels and other potential contaminants, human waste and rubbish at the project office site and other sites associated with the construction phase; and
- the preparation of an emergency response program for accidental spills.

Refer to the Soil and Water Management Plan for more information.

Applicable Precincts – *Access Corridor Precinct and Riparian Corridor Precinct.*

Creek crossings have been carefully located to reduce riparian vegetation clearance and will be constructed in accordance with NSW Fisheries Fish Passage Requirements for Waterways (Fairfull & Wetheridge, 2003) to have minimal disturbance and to facilitate fish passage. Disturbed areas surrounding bridge construction sites will be revegetated to ensure bank stabilisation, enhance connectivity and wildlife corridors and provide supplementary habitat for native fauna.

Applicable Precincts –*Riparian Corridor Precinct and Managed Pasture Precinct.*

Farm dams, which are currently degraded by cattle access and resulting grazing and trampling, are to be retained and rehabilitated under the Landscape Strategy. Rehabilitation will include the removal of stock and the planting of wetland vegetation and will aim to provide supplementary habitat for waterbirds and other aquatic and terrestrial fauna on the study site. It is also proposed that a large dam will be created to provide a permanent water source on site. This will involve the construction of a dam wall and a gradual filling through natural flows from the surrounding catchment.

4.5 Bushland Regeneration

Applicable Precincts – *Developed Precinct and Access Corridor Precinct.*

4.5.1 Weed control

The study site currently contains a large number of weed species, including eight species listed as noxious in the Lithgow LGA under the *Noxious Weeds Act*. Management of these species will need to be in accordance with management measures prescribed under the Act (see Table 6).

There is the potential for weed proliferation and spread of weeds onto adjoining lands as a result of the proposed development through soil disturbance during the construction phase, the removal of grazing, and increased traffic through the study area, recreational use of horses and altered soil moisture and nutrient levels.

It is likely that weed species will thrive in areas where grazing is reduced or withdrawn, either from existing propagules, or from later recruitments. Areas of particular concern include the wetland areas, especially around the margins, and along riparian zones. Blackberry has been greatly reduced from all wetland areas, being more prolific in drainage lines on private land immediately west of the site and in areas of the adjoining national parks estate. The paddocks have pasture species such

as rye and clover, in association with native grass species. There are, however, several introduced grass species which may become more extensive. These include: *Sporobolus indicus* var. *capensis, Vulpia bromoides, Setaria gracilis, Paspalum dilatatum, Phalaris aquatica* and *Bromus* spp.

Weed management will involve:

- the destruction of weed material removed from construction areas;
- minimising areas disturbed during construction;
- washing down vehicles and equipment between construction areas in particular following clearing activities in weed infested areas;
- the use of shredded native plant material removed from the site as a mulch and groundcover on disturbed soil surfaces to reduce the potential for weed establishment; and
- seeding of exposed soil stockpiles with a nursery crop to reduce the potential for weed infestation.

Further details on weed management for the site is provided within the Landscape Management Plan (Context 2006).

5 Work Programme

The required and recommended actions are summarised in chronological order below to provide a guide for the preparation of a work programme for the implementation of the CMP and associated activities.

It is considered that the likely limited adverse impacts of construction works on the site will be ameliorated by the above management measures and will be adequately offset by the retention and management of the majority of the site for conservation purposes and the contribution to vegetation rehabilitation and habitat creation and enhancement proposed under the Concept Plan and Landscape Strategy.

Table 1 Flora and Fauna Management Work Programme for Pre-Construction phase

Preconstruction Phase (Site Establishment)		Landscape Precinct					Other	Responsible
Objective	**Management Activity**	**DP**	**AC**	**RC**	**MP**	**NC**	**F&MT**	
Fauna Protection	Habitat tree and hollow inventory, including marking habitat trees to be felled	✓	✓	✓			✓	Ecologist
	Pre-clearance surveys	✓	✓	✓			✓	Ecologist
	Impose speed limit and erect fauna warning signs		✓					Operator
Habitat Protection and Improvement	Clearly identify and delineate the perimeter of the construction and associated work areas and native vegetation to be retained	✓	✓	✓				Contractor
	Install access exclusion zone fencing to protect remaining bushland habitat	✓	✓	✓				Contractor
	Collect logs and woody debris	✓	✓					Contractor/Site Manager
	De-stocking of cattle	✓	✓	✓	✓	✓		Site Manager
Aquatic Habitat Protection and Improvement	Sediment and erosion control measures	✓	✓	✓				Contractor
Bushland Regeneration	Identify weed control zones and wash down stations to manage risk of weed transferal.	✓	✓	✓				Weed Contractor
	Collect seed from proposed construction areas if deemed necessary	✓	✓	✓				Bush Regenerator/Site Manager
	Select donor and recipient sites for topsoil translocation	✓	✓	✓				Landscaper/Site Manager
	Apply for seed collection permit if necessary					✓		Bush Regenerator

DP=Developed Precinct, AC=Access Corridor, RC=Riparian Corridor, MP=Managed Pasture Precinct, NC=Nature Conservancy Precinct, F&MT=Fence and Maintenance Track

Table 2 Flora and Fauna Management Work Programme for Construction phase

Construction Phase (within 2 yrs)		Landscape Precinct					Other	Responsible
Objective	**Management Activity**	**DP**	**AC**	**RC**	**MP**	**NC**	**F&MT**	
Fauna Protection	Discourage fauna entry to development sites by keeping site clean and storing rubbish	✓						Contractor
	Erect siltation fencing to prevent amphibians and reptiles entering construction site	✓						Contractor
	Clearance surveys	✓	✓				✓	Ecologist
	Fell flagged trees intact and with care with a supervising ecologist present.	✓	✓				✓	Contractor/Ecologist
	Survey and clear buildings of bats/owls before demolition of any buildings or sheds				✓			Ecologist/Site Manager
	Record incidents of road kill from construction traffic		✓					Site Manager
Habitat Protection and Improvement	Maintain erosion control devices until soil and vegetation is stabilised and able to provide this function	✓	✓					Contractor
	Position vehicle and machinery parking bays and stockpiles sites in existing cleared areas and not within 50m of a waterway.	✓						Contractor
	Retain felled habitat trees for placement in conservation areas.							Contractor
	Confirm net loss of hollowed trees for consideration of habitat replacement (ie nest boxes)	✓						Contractor/Ecologist
	Place habitat features such as hollowed trees, logs and woody debris in conservation areas			✓	✓	✓		Site Manager
Riparian Improvement	Identification and planning of stabilisation of erosion areas on Wolgan River			✓				Site Manager
	Stabilisation and revegetaion of erosion in high risk areas			✓				Site Manager
Aquatic Habitat Protection and Improvement	Implement soil and water management strategies	✓						Contractor/Landscaper
	Crossing construction to allow fish passage		✓	✓				Contractor
	Revegetate disturbed areas surrounding bridge construction sites			✓				Bush regenerator

Construction Phase (within 2 yrs)		Landscape Precinct					Other	Responsible
Objective	**Management Activity**	**DP**	**AC**	**RC**	**MP**	**NC**	**F&MT**	
	Construct and vegetate wetlands and dams			✓	✓			Landscaper
Bushland Regeneration	Implement measures to control spread of weeds (such as vehicle wash-down areas & disposal of cleared weeds)	✓	✓					Weed Contractor
	Shred removed native veg (non-habitat) and use as mulch in disturbed areas	✓	✓					Contractor/Bush regenerator
	Excavation of soil from topsoil recipient sites	✓	✓					Contractor

DP=Developed Precinct, AC=Access Corridor, RC=Riparian Corridor, MP=Managed Pasture Precinct, NC=Nature Conservancy Precinct, F&MT=Fence and Maintenance Track

6 References

AMBS (2005) Flora and Fauna Impact Assessment for the Emirates Luxury Report, Wolgan Valley. Australian Museum Business Services. Prepared for Emirates Resorts and Hotels, Australia.

Churchill, S. (1998) Australian Bats. New Holland, Sydney

CCG (2006) Emirates Resorts Preliminary Master Control Programme. Prepared by Clifton Coney Group (NSW) Pty Ltd.

Context (2006) Landscape Management Plan – Emirates Luxury Resort, Wolgan Valley. Context Landscape Design. Prepared for Emirates Resorts and Hotels, Australia.

DEC. (2005a). *Brown Treecreeper (eastern subspecies). Threatened Species Profile*. Department of Environment and Conservation, Hurstville. www.threatenedspecies.environment.nsw.gov.au

DEC. (2005b). Spotted-tailed Quoll. Threatened Species Profile. Department of Environment and Conservation, Hurstville. www.threatenedspecies.environment.nsw.gov.au

DoP (2006) The Concept Plan Approval for the Emirates Luxury Resort. Department of Planning.

Environment Australia (1999). The Action Plan for Australian Bats, Environment Australia.

Fairfull, S and Witheridge, G. (2003). *Why do fish need to cross the road? Fish passage requirements for waterway crossings*. NSW Fisheries, Cronulla, 16pp.

Gibbons, P. and Lindenmayer, D.B. (2002). *Tree hollows and wildlife conservation in Australia.* CSIRO Publishing, Melbourne.

Higgins, P.J. (1999). *The Handbook of Australian, New Zealand and Antarctic Birds. Volume 4 Parrots to Dollarbird*. Oxford University Press, Melbourne.

NPWS. (1999). *Threatened Species Management: Species Information*. NSW National Parks & Wildlife Service, Hurstville.

NPWS. (2003). *Recovery Plan for the Yellow-bellied Glider* (*Petaurus australis*). NSW National Parks & Wildlife Service, Hurstville.

Urbis JHD. (2005). Emirates Luxury Resort, Wolgan Valley Concept Plan.

Urbis JHD. (2006). Emirates Luxury Resort, Wolgan Valley Modification of Concept Plan and Project Application.

Appendix A – Seed Propagation

6.1 Seed Collection for Emirates Resort, Wolgan Valley

6.1.1 General Points

Adhere to legislative and regulatory requirements when collecting native seed.

Consider vegetative propagation as an alternative to seed collection, because of:

- Small numbers of plants that are suitable for seed collection;
- Seasonal scarcity of seed;
- Logistical, environmental and climatic difficulties;
- The need for regular surveillance of seed set; and
- The importance of good timing.

Minimise damage to plants and soil when collecting.

Collect a maximum of 20% of the available seed from each individual plant, to ensure that the existing vegetation can continue to regenerate. Some references suggest a maximum of 10%.

6.1.2 Provenance

Seed collection should ensure adequate sampling of the existing gene pool. The more individuals from which seed is collected the greater the probability of obtaining good population representation.

Optimal collection zones around a restoration site are considered to be 100m radius for herbs and 1km for woody plants. Generally a 15 km radius is acceptable, as long as conditions are homogeneous.

Attempts should also be made to match the site conditions between the collection point and the restoration area. Variables relating to site conditions should include climatic, microclimatic, topographic and edaphic factors.

6.1.3 Grasses

- Ensure that seed is mature.
- Many grass seeds have a dormancy period.
- Allow seed to dry after collection and store in a sealed container in a cool, dark place. Sow after 6 months storage.

6.1.4 Seed Quantities

- 1 kg of wattle seed will contain 50 000 seeds

- 1 kg of eucalypt seed – 500 000 seeds
- 1 kg of melaleuca, callistemon, over 1 000 000.

15 grams of seed = 1,000 tubestock

On average, it is possible to pick 0.25 to 0.5 kg of wattle in half an hour
5 barrows of eucalypt branches will yield 1kg seed
2 barrows of Casuarina cones = 1kg

- As a general rule, with eucalypts, bottlebrushes and tea-trees the previous year's seed is ready for collection when the trees are flowering this year.
- Avoid collecting during rainy weather
- Don't store seed in plastic bags.
- Label bags (e.g. Plant name; date collected; GPS reference; vegetation type; position on slope; aspect; abundance of species; population size; number of plants collected from).

Casuarina cunninghamiana 1,800,000 seeds per kg
Acacia mearnsii 35,000-110,000 viable seeds per kg.

Table 3 Local plants and seed collection information.

Plant name	Optimal collection time	Viable seeds (per gram)
Acacia brownei	Dec	
Acacia implexa	Dec-Feb	28 viable seeds per gram
Acacia longifolia	Nov-Feb	
Acacia maidenii	Sept-Jan	
Acacia melanoxylon	Dec-Feb	58 viable seeds per gram
Acacia myrtifolia	Sept-Jan	76 viable seeds per gram
Acacia terminalis	Oct-Dec	
Ajuga australis	Dec-Jan	
Allocasuarina littoralis	all year	335 seeds
Allocasuarina verticillata	all year	200 seeds
Astroloma humifusum	Nov	
Banksia spinulosa	all year	160 seeds
Brachychiton populneus	July-Jan	
Breynia oblongifolia	Oct-Mar	
Bursaria spinosa	Feb-Apr	191 seeds
Callistemon citrinus	all year	2-4000 seeds
Callitris endlicheri	Dec-June	150 seeds
Carex spp.	Dec-Jan	
Eleocharis spp.	June	
Casuarina cunninghamiana	all year	
Centella asiatica	Jan-Mar	

Plant name	Optimal collection time	Viable seeds (per gram)
Cissus antarctica	Sept-Oct	
Clematis aristata	Jan-Feb	
Correa reflexa	Nov-Feb	
Daviesia ulicifolia	Nov-Jan	
Dianella revoluta	Dec-Jan	
Dodonaea viscosa	Oct-Jan	
Eucalyptus albens	all year	235 seeds
Eucalyptus blakelyi	Feb-May	
Eucalyptus bridgesiana	Dec-Feb	366 seeds
Eucalyptus cypellocarpa	Jan-June	
Eucalyptus dives	all year	78 seeds
Eucalyptus macrorhyncha	Dec-Feb	
Eucalyptus melliodora	Nov-Mar	354 seeds
Eucalyptus microcarpa	Nov-May	729 seeds
Eucalyptus polyanthemos	Mar-June	465 seeds
Eucalyptus punctata	Dec-Feb	
Eucalyptus tereticornis	Jan-Mar	642 seeds
Eucalyptus viminalis	July-Jan	471 seeds
Hardenbergia violacea	Dec	
Indigofera australis	Dec-Jan	
Juncus spp.	Dec-Jan	
Kennedia rubicunda	Nov-Feb	
Leptospermum spp	all year	500 seeds
Lomandra longifolia	Jan	
Lomandra multiflora	Oct-Mar	
Melaleuca spp.	all year	1500 seeds
Podolobium ilicifolium	Nov	
Pultenaea spp.	Oct-Feb	
Some Grasses		
Themeda australis	Dec-Feb	
Austrostipa spp.	Nov-jan	
Microlaena stipoides	Dec	
Chloris spp.	Jan-Mar	
Austrodanthonia spp.	Dec	
Dichelachne spp.	Dec	
Poa labillardieri	Dec	