THE UNIVERSITY OF WESTERN AUSTRALIA

PT LOT 4 UNDERWOOD AVENUE SHENTON PARK 2006 DEVELOPMENT AND CONSERVATION PROPOSAL

EVALUATION OF ENVIRONMENTAL FACTORS

VERSION 3

JANUARY 2007

REPORT NO: 2006/263

ATA Environmental
environmental scientists

Referral of proposed action

Project title	Pt Lot 4 Underwood Avenue, Shenton Park, Western Australia

1 Contacts

1.1	**Referring party**	Person, agent or agency who is making the referral Dr Paul van der Moezel Principal ATA Environmental Dilhorn House 2 Bulwer Street PERTH WA 6000 (08) 9328 3488 paul.vdm@ataenvironmental.com.au
1.2	**Responsible party**	Person responsible for or who will carry out the proposed action. If same as 1.1, write 'as above' The University of Western Australia Facilities Management Mail Point M458A 35 Stirling Highway CRAWLEY WA 6008 (08) 6488 2022 JSchumann@admin.uwa.edu.au
1.3	**Proponent**	Person responsible for preparing assessment documentation, if approval is required. If same as 1.2, write 'as above' As above

2 Summary of proposed action

NOTE: You must attach an A4 size map/plan(s) showing the location and approximate boundaries of the area in which the project is to occur.

2.1 **Short description**

The University of Western Australia (The University) propose to develop the eastern portion of Lot 4 Underwood Avenue, Shenton Park for residential purposes.

Included in the proposal is the retention of approximately 11.9ha of high quality bushland for conservation and passive recreational purposes representing almost 36% of the total developable area (33ha).

2.2 **Latitude and longitude**

	Latitude			Longitude		
location point	degrees	minutes	seconds	degrees	minutes	seconds
NW corner	31	56	52	115	47	45
NE corner	31	56	52	115	48	13
SE corner	31	57	07	115	48	14
SW corner	31	57	07	115	47	46

2.3 **Locality**

The subject land comprises the eastern portion of Lot 4 Underwood Avenue, Shenton Park in the City of Nedlands. Figure 1 shows the regional location of the subject land, which is south of Underwood Avenue and west of Selby Street. The Cancer Foundation and Paraquad Association complexes form the southern boundary. The site is located approximately 5km west of the Perth Central Business District.

2.4 **Size of the development footprint or work area (hectares)**

The proposed conservation and development plan for Lot 4 is shown in Figure 2. The total developable area is approximately 33ha covering the eastern portion of Lot 4. This figure includes the conservation and POS area to be retained (11.9ha), proposed residential development area (approximately 12.64ha) and the proposed future development area (approximately 8.44ha).

The western portion of Lot 4 outside of the developable area is currently (and will continue to be) used for University research purposes.

2.5 **Street address of the site**

Corner of Underwood Avenue and Selby Street, Shenton Park.

2.6 **Lot description**

Lot 4 Underwood Avenue.

2.7 **Local Government Area and Council contact (if known)**

City of Nedlands

2.8 **Project life**

Site works will commence at the earliest possible time once all relevant approvals have been obtained. It is anticipated that these works will commence in 2007/2008.

2.9 **Alternatives**

X	No
	Yes, complete section 3.2

2.10 **State assessment**

	No
X	Yes, complete Section 3.5

2.11	**Component of larger action**	X	No
			Yes, complete Section 3.6

3 Detailed project description

NOTE: The proposal described here is the action(s) on which ALL subsequent decisions under the EPBC Act will be made, including decisions on significance, level of assessment (if needed) and approval (if needed). It is therefore important that the description is complete and includes all components and activities associated with the action, as well as any specific alternatives to be assessed. If certain related components are not intended to be included within the scope of the referral, this should be clearly explained in Section 3.6.

3.1 Description of proposal

The proposal is to develop the eastern 33ha portion of Lot 4 Underwood Avenue for residential purposes (Figure 2). Included in this proposal is the retention of approximately 11.9ha of high quality bushland with the balance of the 33ha developable area to be developed. It should be noted that approximately 8.44ha of land is identified for 'future development' (Refer to Figure 2) which is intended to be developed in the longer term. Residential development in the 'future development' area is currently constrained by odour emissions from the nearby Subiaco Wastewater Treatment Plant. However, should odour be adequately addressed at a future stage, this area could potentially be developed for residential purposes by The University.

The 11.9ha of native vegetation being retained will be in the form of two conservation areas linked together with a Public Open Space (POS) area. The POS area will be managed for conservation and passive recreation uses consistent with conservation objectives. A bushland management plan will be prepared for the conservation areas and POS area.

A fauna friendly clearing protocol will be used as part of the clearing operations. All tree hollows, nests and vegetated debris will be inspected for fauna prior to clearing.

3.2 Alternative locations, time frames or activities that form part of the referred action

Not relevant

3.3 Previously considered alternatives and the 'do nothing' case

The University is an internationally recognised tertiary education institution providing high quality education to the Western Australian community. Lot 4 Underwood Avenue was vested with The University by the State of Western Australia for the purposes of generating income to fund future educational requirements. Residential development of Lot 4 is consistent with its zoning under the Metropolitan Region Scheme and the City of Nedlands Town Planning Scheme.

The western portion of Lot 4 is currently used by The University for research purposes. It is intended that this research use will continue into the long term as The University has invested substantial funds into a biomedical research facility on this site.

Lot 4 is inner city land zoned for residential development and the eastern portion is intended to be developed by The University at a medium to high density to efficiently utilise the land. Development of Lot 4 is consistent with the principles of the Western Australian State Government's Network City in that the site is well located with respect to access to public transport and other services and infrastructure. The development of Lot 4 is consistent with principles of proper town planning and sustainability.

The 'do nothing' option significantly reduces The University's opportunity to generate income from this site. The funds generated from the development of the eastern portion of Lot 4 would be returned to The University and used for educational purposes. It is for this reason that The University considers that the do nothing option is not feasible.

The current conservation and development proposal has evolved from a lengthy and detailed planning process for the development of Lot 4. Two development proposals have previously been prepared and assessed by the Environmental Protection Authority (EPA). The EPA reported its findings in Bulletin 1034 (first proposal) and Bulletin 1099 (second proposal).

The Bulletin 1099 proposal was referred in 2004 to the Department of Environment and Heritage (DEH) (Referral 2004/1479) who determined that development on Lot 4 was a 'controlled action' due to its potential impacts on Carnaby's Black Cockatoo. Since this decision, The University has undertaken further planning and refined previous development proposals taking into account advice received from various stakeholders as well as commissioning an investigation into the significance of Lot 4 for Carnaby's Black Cockatoo (refer to ATA Environmental 2007a).

3.4 Context, planning framework and state/local government requirements

Lot 4 is zoned 'Urban' in the Perth Metropolitan Region Scheme and 'Development Zone' in the City of Nedlands Town Planning Scheme No. 2. The subject land is recognised in Perth's Bush Forever – Site 119 (Government of Western Australia, 2000). Part of the subject land is currently used as a research park for botanical, zoological and agricultural studies. The proposed conservation and development proposal (Figure 2) is consistent with these zonings.

3.5 Environmental impact assessments under Commonwealth, state or territory legislation

As indicated in Section 3.3, The University has undertaken a lengthy and detailed planning process for the development of Lot 4. Two proposals have previously been prepared and assessed by the Environmental Protection Authority (EPA). The EPA reported its findings in Bulletin 1034 (first proposal) and Bulletin 1099 (second proposal). An overview of each of these proposals and the assessment outcomes follow:

Bulletin 1034 Proposal

The initial proposal presented to the EPA protected a conservation area of approximately 8.5ha located in the southeast corner of the study area. In its assessment (EPA Bulletin 1034), the EPA considered that the 8.5ha proposal was insufficient to protect the core conservation area/s of the Bush Forever Site (119) and that a larger area, 'but not substantially so', should be set aside for conservation. The proposed 8.5ha bushland area for retention contains Jarrah-Banksia Woodland that is in mostly Very Good to Good or Very Good condition. The University requested that the EPA suspend its assessment process under Section 40(3) of the *Environmental Protection Act 1986* while a second proposal was prepared. Consequently, the original proposal was not referred to the then DEH.

Bulletin 1099 Proposal

A second proposal was prepared following an enquiry-by-design process and an Appeal mediation process. This proposal resulted in the relocation and enlargement of the conservation area. The total area increased from 8.5ha to 12ha plus 0.7ha Public Open Space (POS). This proposal was supported by the EPA (EPA Bulletin 1099) subject to a range of conditions. However, the Western Australian Minister for the Environment considered the proposal not to be environmentally acceptable in terms of biodiversity and conservation outcomes. This proposal retained a greater diversity of vegetation associations than the initial proposal.

This proposal was referred to the DEH under the *Environment Protection and Biodiversity Conservation Act 1999* (Referral 2004/1479). The DEH advised the proponent that the proposed development was a controlled action and that "the assessment documentation will need to provide an analysis as to the impacts of clearing at Underwood Avenue in the context of suitable habitat at the local and regional level, including potential implications for movement between Bold Park and Kings Park". The species of concern to the DEH were Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*). ATA Environmental (2007a) addresses these issues in detail (report enclosed with this referral).

Current Conservation and Development Proposal

Under Section 43A of the *Environmental Protection Act 1986*, the EPA may consent to the proponent (in this case The University) changing the proposal without a revised proposal being re-assessed by the EPA, if the EPA considers that the change is unlikely to significantly increase any impact that the proposal may have on the environment.

The University has prepared a proposal, shown in Figure 2, which is a modification of the initial Bulletin 1034 proposal presented to the EPA. The revised proposal will result in significantly improved environmental outcomes when compared with the original Bulletin 1034 proposal. An environmental assessment report (ATA Environmental, 2007b) comparing the current conservation and development proposal with the original Bulletin 1034 proposal is enclosed with this referral. This report has been prepared for the EPA to demonstrate that the current proposal will result in significantly improved environmental outcomes.

The current conservation and development proposal has taken into consideration the EPA's and the Minister for Environment's previous comments. In particular, the current proposal will:

- Retain a greater area of native vegetation than the initial proposal;
- Protect a more diverse range of vegetation associations (five associations compared with one);
- Protect two populations of Priority 3 species *Jacksonia sericea*; and
- Retain a stand of *Eucalyptus decipiens*, a species that is not a common species in the Perth metropolitan region (although it is not listed as Declared Rare Flora or Priority species).

The environmental assessment report comparing the current conservation and development proposal with the Bulletin 1034 proposal will be formally advertised for public comment. In advance of this public consultation period, The University has undertaken a series of briefings with key stakeholders and interest groups outlining the current proposal.

The current conservation and development proposal is the subject of this referral to the Department of Environment and Water Resources.

3.6 A staged development or component of a larger project

NOTE: The Minister for the Environment and Water Resources may not accept a referred action that is a component of a larger action and may request the person proposing to take the action to refer the larger action for consideration under the EPBC Act (Section 74A, EPBC Act).

If you wish to make a referral for a staged or component referral, read 'Fact Sheet 6 Staged Developments/Split Referrals' and contact the EPBC Act Referrals Section (1800 803 772).

Figure 2 illustrates two areas of the subject land that are proposed for future development. The two areas identified for future development occupy a land area of approximately 8.44ha. These areas will not be developed in the initial phase of the proposed residential development. At the time of preparing this referral, these areas are subject to odour emissions associated with the nearby Subiaco Wastewater Treatment Plant. The timeframe for the development of these areas has not been confirmed.

The southern portion of the 'future development area' is mostly Degraded vegetation with a number of introduced plant species. The northern portion of the 'future development area' is of variable condition ranging from Cleared to Good-Very Good. This area is not entirely vegetated (Figure 3).

4 Affected environment

NOTE: You must attach a map(s)/plan(s) clearly showing the location of the action in relation to any matters of national environmental significance

4.1 Matters of national environmental significance

4.1 (a) World Heritage Properties

Nil

4.1 (b) National Heritage Places

Nil

4.1 (c) Wetlands of International Significance (Ramsar)

Nil

4.1 (d) Listed threatened species and ecological communities

The subject land contains native vegetation over most of the site (Figure 3). The vegetation, flora and fauna of the site are described in more detail in Section 4.2.

The *EPBC Act 1999* website identifies three threatened species of fauna as potentially occurring within, or may relate to, the development site. These species identified are as follows:

Threatened Species

Fauna

- *Calyptorhynchus latirostris* (Carnaby's Black Cockatoo) – Endangered
- *Calyptorhynchus baudinii* (Baudin's Black Cockatoo) – Vulnerable
- *Dasyurus geoffroii* (Chuditch) - Vulnerable

Further information on the potential presence of these species and the impact of the development is contained in the following sections.

4.1 (e) Listed migratory species

The *EPBC Act 1999* website identifies two Migratory species and five Listed Marine species that might overfly the area or have habitat within the area as follows:

Migratory Species

- *Haliaeetus leucogaster* (White Bellied Sea Eagle) - Migratory
- *Merops ornatus* (Rainbow bee-eater)

Listed Marine Species

- *Apus pacificus* (Fork-tailed Swift)
- *Ardea alba* (Great Egret, White Egret)
- *Ardea ibis* (Cattle Egret)
- *Haliaeetus leucogaster* (White-Bellied Sea Eagle)
- *Merops ornatus* (Rainbow bee-eater)

4.1 (f) Nuclear actions

Nil

4.1 (g) Commonwealth marine areas

Nil

4.2 Important or unique aspects of the environment, if relevant

4.2 (a) Soil and vegetation characteristics

The study area is comprised primarily of deep calcareous sand of aeolian origin. The soils of the study area are part of the Spearwood Dune System and consist of shallow to deep yellow, medium to fine-grained quartz and Pleistocene aeolianite limestone (Semeniuk and Glassford, 1989).

The Spearwood Association can be further divided into the Cottesloe and Karrakatta soil types. Within the study area, the yellow sand of the Karrakatta type soil predominates and at the central ridge, the underlying Tamala limestone is partially exposed.

The vegetation and flora on the subject land has been surveyed by ATA Environmental. An initial interpretation of the vegetation of the study site was conducted using colour aerial photograph (1:1,000) to determine patterns in the vegetation in 1998. Preliminary field surveys were undertaken in January and July 1998 to record flora, determine the distribution of vegetation units and identify the location of any significant flora populations present at the site. Field reconnaissance and a number of 10m x 10m quadrats defined the floristic composition, vegetation condition and weed invasion of each unit. A further flora survey was undertaken in September 2000 to record ephemeral species such as orchids, annual grasses and herbs.

Floristic surveys completed on the site identified 149 species of flora in the bushland (ATA Environmental, 2000). Of these, 112 species are native to the site and 37 are introduced species (including native Australian species that are garden escapes). No Declared Rare Flora was recorded during site visits to the study area including species listed for protection under the *EPBC Act 1999*. However, four (4) populations of the Priority 3 species, *Jacksonia sericea,* were located in the western part of the site.

Priority 3 species are defined by Department of Environment and Conservation as:

> *Taxa which are known from several populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.*

Jacksonia sericea has been recorded in other nearby bushland areas, including Shenton Bushland (south of the study area), Kings Park (east of the study area) and at Bold Park (west of the study area). Approximately 50% of the population of the Priority 3 species will be retained in the current proposal within the western conservation area.

Vegetation Associations

The vegetation in the study area is dominated by a *Eucalyptus/Banksia/Allocasuarina* Low Woodland to Open Woodland with species variations in upper and lower stories. The variation in species composition reflects the depth of soil, proximity of limestone to the surface and past fire regimes.

The principal vegetation unit has been divided into three vegetation associations consisting of a *Banksia* Low Woodland, a *Banksia prionotes* Closed Scrub and Jarrah (*Eucalyptus marginata*) Woodland (Figure 3) with significant variation in structure and composition.

Banksia Low Woodland

The *Banksia* Low Woodland is structurally dominated by *B. menziesii* and *B. attenuata* and, less consistently, by *Allocasuarina fraseriana.* In places, there are stunted Jarrah and emergent Tuart (*E. gomphocephala).* Species that are common in the understorey of the Woodland include *Hakea prostrata* up to 2m and low shrubs including *Mesomelaena pseudostygia, Xanthorrhoea preissii, Petrophile linearis* and *P. macrostachya. Alexgeorgea nitens, Desmocladus flexuosus, Dryandra lindleyana* and several weed species dominate the ground cover.

This vegetation association occurs over much of the western region of the study area and contains four populations of the Priority 3 species, *Jacksonia sericea.* In addition, a small population of the mallee *Eucalyptus decipiens* was found on the lower slopes of the site. *Eucalyptus decipiens* is not a Priority or DRF species but is uncommon in the Perth Metropolitan Region.

Banksia prionotes Closed Scrub

The *Banksia prionotes* Closed Scrub dominates the northern part of the central ridge at the site along Underwood Avenue. This vegetation type has been adversely affected by fire as evidenced by the extent of weed invasion, particularly Veldt Grass, and the apparent young age of the *Banksias.* Throughout the Closed Scrub are scattered young *Banksia menziesii* and *B. attenuata* and mature or dead Tuart trees. The native species diversity in the Closed Scrub is very low as the understorey layer is dominated by weeds. Other species such as *Acacia saligna* and *Pelargonium capitatum,* which are often associated with disturbed areas, are present at the periphery of the Closed Scrub.

Jarrah Low Woodland to Open Woodland

The Jarrah Woodlands at the site vary significantly in species composition and density. The eastern area comprises a Jarrah Woodland with scattered Tuarts and Marri trees over a lower tree canopy of *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana.* An isolated stand of *Banksia grandis* was found in a relatively open and degraded area of the eastern Jarrah Woodland.

Typical taller shrub species include *Jacksonia furcellata, Hakea prostrata, Xanthorrhoea preissii* and *Macrozamia fraseri.* Common smaller shrubs include *Gompholobium tomentosum, Hibbertia hypericoides, Acacia pulchella, Calytrix fraseri, Mesomelaena pseudostygia, Desmocladus flexuosus* and *Petrophile linearis.* Parrot Bush (*Dryandra sessilis*) occurs in one small stand near the eastern boundary, possibly indicating the presence of limestone at shallow depths below the sand.

Vegetation Condition

The condition of the vegetation was assessed using the condition rating scale of Keighery published in Bush Forever (Government of Western Australia, 2000) and is mapped in Figure 4.

Keighery's condition rating scale ranges from Pristine (where the vegetation exhibits no visible signs of disturbance) to Completely Degraded (where the vegetation structure is no longer intact and without native plant species). A description of the vegetation condition ratings applicable to the study area are outlined below:

Very Good (VG): Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.

Good (G): Vegetation structure significantly altered by obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate. For

example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

Degraded (D): Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

The vegetation condition of the study area ranges from very good to degraded. All of the vegetation types recorded at the site show some signs of disturbance including the presence of non-aggressive and aggressive weeds, partial clearing, frequent fires, and informal tracks.

The vegetation towards the western and eastern boundaries of the site is in very good condition and are the least disturbed regions of the site. While the vegetation structure in these areas has been affected by clearing or selective logging in the past, the native understorey layer is intact with minimal signs of disturbance.

Areas of high disturbance are found at the higher elevations and at the ridge where informal tracks and weeds are numerous because of clearing and fires. The installation of Water Corporation infrastructure in the existing easement resulted in some clearing of vegetation in this area.

4.2 (b) Water flows, including rivers, creeks and impoundments

There are no natural drainage channels or expressions of the groundwater within the study area. Depth to groundwater varies from approximately 38m at the central ridge to 17m at the western boundary and a low of 8m at the northeast corners of the site. There is a regional groundwater flow of between 50m and 100m per year in the study area in a south-westerly direction.

4.2 (c) Outstanding natural features, including caves

There are no outstanding natural features such as caves.

4.2 (d) Gradient

The site gently rises from 15m AHD (Australian Height Datum) at the eastern boundary up to 44m AHD at the central ridge and falls gradually to 25m AHD at the western boundary. The central ridge provides a vantage point to other prominent regional landmarks include Kings Park, Perth City and Bold Park.

4.2 (e) Buildings or other infrastructure

Water Corporation infrastructure has been installed within the Water Corporation easement located in the eastern region of the study area resulting in the clearing of some native vegetation.

4.2 (f) Marine areas

Not applicable.

4.2 (g) Kinds of fauna

A fauna assessment of the site was conducted in November 2003. This assessment included a desktop assessment of potentially occurring species, field assessment of habitat values,

establishing eight separate trapping grids, a half-day bird survey recording sightings and calls and hand searching at each trapping site. All fauna trapping was conducted under licence # SF 004367 as issued by the Department of Conservation and Land Management (now Department of Environment and Conservation).

The vegetation assessment identified one principal habitat in the study area consisting of *Eucalyptus/Banksia* woodlands although there is local variation in composition and structure due to disturbance factors and minor changes in soil. Fauna present will be typical of mixed *Banksia* Woodlands within the Perth Metropolitan Area although some species may no longer be represented due to development of surrounding areas and fragmentation of habitat.

The fauna assessment determined that 111 species of vertebrate fauna are potential inhabitants of the site (see Appendices 1 and 2). This is based on the size and range of habitat available, surveys of similar habitats in Lemnos Street bushland and Bold Park and the known distribution and habitat of species. This list consists of 3 amphibians, 28 reptiles and 80 birds. However, it is expected that not all of these species will be present in the study area.

Fauna trapping recorded 22 birds and 7 reptile species. No amphibian species were recorded during the site survey.

No Priority or Threatened Fauna were recorded in the study area. An assessment of the vertebrate fauna likely to occur on the study site is based on studies conducted at nearby Bold Park (How and Dell, 1990) and a study undertaken in the Lemnos Street Bushland in 1997 and 1998 (Berry and Berry, 1998).

While no Priority or Threatened Fauna were recorded at the site, two species of Threatened Fauna (Carnaby's Black-Cockatoo and Baudin's Black-Cockatoo) may utilise the site and are common in woodland areas in the Perth Metropolitan Region on the Swan Coastal Plain. In addition, the Rainbow Bee-eater has been observed in the study area by ATA Environmental and the Fork-tailed Swift may occasionally visit the site. These species are listed under the Migratory Bird Agreements (CAMBA and JAMBA).

All species recorded at the site have been identified in nearby reserves containing similar habitats (Shenton Bushland, Bold Park and Kings Park)

In addition to the above fauna assessment, ATA Environmental has undertaken an appraisal of suitable habitat within an approximate 5km radius of the nearby Bold Park. It is ATA Environmental's view that the proposed conservation and development proposal should not be a 'controlled action' under the *EPBC Act 1999* because:

- The Underwood Avenue site represents less than 3% of the high quality feeding habitat for Carnaby's Cockatoo in the Perth western suburbs; and
- Proposed clearing of native vegetation on Underwood Avenue is unlikely to influence potential breeding patterns of Carnaby's Cockatoo in Bold Park, as there is sufficient suitable foraging habitat within 4km of Bold Park.

Full details of ATA Environmental's Black Cockatoo habitat investigation for the western suburbs area is provided in ATA Environmental (2007a), which is enclosed with this referral.

4.2 (h) Current state of the environment

The subject land consists of *Eucalyptus/Banksia/Allocasuarina* Low Woodland to Open Woodland with condition varying across the site from Degraded to Very Good with most of the site at the upper end of this scale (Figure 4). The northern portion of the site is in Good to Very Good condition with some informal tracks and cleared areas. The vegetation in the southwest corner of

the study area is degraded with weed intrusion and other forms of disturbance evident. Further east the southeastern portion of the site is considered to be in Very Good condition.

4.2 (i) Commonwealth Heritage Places and places on the Register of the National Estate

Not applicable.

4.2 (j) Known Indigenous heritage values

A search of the Department of Indigenous Affairs website returned five sites within the study area. These are summarised below:

- Scarred tree
- Two campsites
- Historical site with spiritual significance
- Inter-locking Jarrah trees

The University has been engaged in discussions with Aboriginal Elders to obtain an understanding of how Aboriginal people used the land and how their use might be recognised either public open space or land set aside for conservation. Further consultation with Elders is planned with respect to the new proposal in line with a previous commitment made to Elders. The University proposes to establish an Aboriginal Interpretative Centre to recognise the cultural significance of the site. The location of the interpretative centre is to be determined.

4.2 (k) Other important or unique values of the environment

Not applicable

4.2 (l) Tenure of the action area (e.g. freehold, leasehold)

The land is freehold.

4.2 (m) Existing land uses

The eastern portion of Lot 4 is predominantly unused, although parts of Lot 4 are used for University research purposes.

4.2 (n) Proposed land uses

The University proposes to develop the eastern portion of Lot 4 in accordance with the current land use zoning of 'Urban' under the Metropolitan Region Scheme and 'Development Zone' under the City of Nedlands' Town Planning Scheme No.2. The subject land will be developed for residential purposes.

5 Nature and extent of likely impacts

5.1 Likely impacts on matters of national environmental significance (NES)

5.1 (a) Likely impact on the world heritage values of a declared World Heritage property

Not applicable

5.1 (b) Likely impact on the heritage values of a listed National Heritage place

Not applicable

5.1 (c) Likely impact on the ecological character of a declared Ramsar wetland

Not applicable

5.1 (d) Likely impact on the members of a listed threatened species or ecological community, or their habitat

Fauna

Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) - Endangered

Carnaby's Black-Cockatoo has been identified as likely to occur at the site. This species is listed as a Threatened Species under the *EPBC Act* 1999. Carnaby's Black-Cockatoo may utilise the Jarrah and Banksia Woodlands at the site for feeding but is not known to breed in the area. This species has been recorded in Bold Park and is known to regularly occur within the Metropolitan area on a seasonal basis, utilising native bushland and suitable vegetation along roads and within backyards.

Carnaby's Black Cockatoo is unlikely to rely on the site in their pattern of movement within or through the Perth Metropolitan Region, as the species is known to utilise native bushland and suitable vegetation along roads and within backyards. It is considered that implementation of the proposal will not have a significant impact on this species due to the retention of approximately 11.9ha of habitat within the proposed development and the presence of similar habitat nearby.

Further details relating to possible impacts on Carnaby's Black Cockatoos is provided in ATA Environmental (2007a).

Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) - Vulnerable

Baudin's Black-Cockatoo is most common in the far southwest of Western Australia where it breeds. It is known to breed in the southern forests north to Collie and east to near Kojonup. Baudin's Black-Cockatoo is typically found in vagrant flocks and utilises the taller, more open Jarrah and Marri woodlands where it feeds mainly on Marri seeds and various Proteaceous species. When seasonally present, Baudin's Black-Cockatoo are most likely to occur along the eastern side of the coastal plain.

This species may infrequently use the site for feeding purposes as suitable feeding habitat exists. However, Baudin's Black-Cockatoo is more commonly found on the eastern margin of the Swan Coastal Plain. Baudin's Black-Cockatoo was not sighted during the fauna assessment.

Implementation of the proposal will result in clearing of potential foraging habitat for Baudin's Black-Cockatoo. However, suitable feeding habitat will be retained within two conservation areas

and a central-linking POS area. There are also suitable feeding habitats near the site within conservation reserves and parks that may be utilised by the Black-Cockatoos. Therefore, it is unlikely that implementing the proposal will have a significant impact on this species, as it is unlikely that this species would restrict its range to the subject land. In addition, it is unlikely that the study area would be used for breeding by Baudin's Black-Cockatoo.

Chuditch (*Dasyurus geoffroii*) - Vulnerable

Formally known to inhabit over 70% of Australia, the Chuditch now has a patchy distribution throughout the Jarrah forest and mixed Karri/Jarrah/Marri forest of southwest Western Australia, but they have been found in dry sclerophyll forests, riparian vegetation, beaches and deserts.

The Chuditch are solitary animals for most of their life. They den in hollow logs and burrows and have been recorded in tree hollows and cavities. Chuditch are opportunistic feeders, and forage primarily on the ground at night. Their diet can include other mammals, birds, lizards, bird and reptile eggs, but the majority is a mixture of large invertebrates (spiders, scorpions, crickets).

Habitat alteration and removal of suitable den logs and den sites following land clearing, grazing and frequent wildfire have contributed to a decline in Chuditch numbers. Competition for food and predation by foxes and cats, hunting and poisoning have contributed to its decline. The last captured Chuditch in the area was in 1921 and it is unlikely to occur in the study area.

The proposal will not have an impact on this species.

5.1 (e) Likely impact on the members of a listed migratory species or their habitat

Migratory Species and Listed Marine Species

- *Apus pacificus* (Fork-tailed Swift)
- *Ardea alba* (Great Egret, White Egret)
- *Ardea ibis* (Cattle Egret)
- *Haliaeetus leucogaster* (White-Bellied Sea Eagle) – Migratory
- *Merops ornatus* (Rainbow bee-eater)

Fork-tailed Swift (*Apus pacificus*)

This species breeds in northeast and mid-east Asia and winters in Australia and southern New Guinea. It is a visitor to most parts of Western Australia, beginning to arrive in the Kimberley in late September, in the Pilbara and Eucla in November and in the southwest land division in mid-December, and leaving by late April. It is common in the Kimberley, uncommon to moderately common near northwest, west and southeast coasts and rare to scarce elsewhere. Usually flocks (up to 2,000) occur when changed weather conditions (e.g. storms and cyclones) occur.

Fork-tailed Swifts are vagrant visitors to the study area and the proposed development is unlikely to modify, destroy or isolate an area of important habitat of the migratory species or disrupt the lifecycle of a significant population of the species due to the presence of similar habitat nearby.

Great Egret, White Egret (*Ardea alba*)

The Great Egret is the largest of the Australian egrets. Its overall plumage is white, and, for most of the year, when not breeding, the bill and facial skin are yellow. Its preferred habitat are rivers, shallow wetlands and inter-tidal mud flats where it feeds on fish, molluscs, amphibians, aquatic insects, small reptiles, crustaceans and occasionally other small animals. The Great Egret typically breeds from October to December in the south and March to May in the north.

The proposal will not have an impact on this species, as suitable habitat is not present within the study area.

Cattle Egret (*Ardea ibis*)

The Cattle Egret is a partial migrant in that some individuals stay close to breeding areas from one nesting season to the next, but majority leave to return next breeding season. The Cattle Egret forages on pasture, marsh, grassy road verges, rain puddles and croplands, but not usually in the open water of streams and lakes, and they typically avoid marine areas. They eat a wide range of small animals.

The proposal will not have an impact on this species, as its preferred habitat is not present in the study area.

White-Bellied Sea Eagle (*Haliaeetus leucogaster*)

The White-Bellied Sea Eagle is the second largest bird of prey found in Australia. White-Bellied Sea Eagles are a common sight in coastal and near coastal areas of Australia. It mainly feeds on aquatic animals, but it will take other birds and mammals. They typically breed from May to October and construct large stick nests, which are used for many seasons.

The proposal will not have an impact on this species, as there is limited habitat suitable for this species in the study area.

Rainbow Bee-eater (*Merops ornatus*)

The Rainbow Bee-eater is found across the better-watered parts of Western Australia including islands. It prefers lightly wooded, preferably sandy country near water. It is a resident, breeding visitor, postnuptial nomad, passage migrant and winter visitor. Wintering from the Gascoyne north to Indonesia. It moves south mainly in late September and early October and north from February to April. It is scarce to very common across its range.

This species has been recorded at the site by ATA Environmental. Rainbow Bee-eaters are relatively common in sandy bushland areas in Perth.

The proposed development is unlikely to substantially modify, destroy or isolate an area of important habitat of the migratory species or seriously disrupt the lifecycle of an ecologically significant proportion of the population of the species due to the retention of 11.9ha of suitable habitat in the study area and the extent of similar habitat nearby.

5.1 (f) Likely impact on the environment in part of the Commonwealth marine area

Not applicable

5.2 Likely impacts for nuclear actions, actions affecting Commonwealth land or actions taken by the Commonwealth

Not applicable

6 Measures to avoid or reduce impacts

Commitment 1 ***The University will set aside approximately 11.9ha of high quality bushland for conservation and passive recreational purposes in a contiguous link running broadly east – west in order to retain existing ecological linkages.***

There are significant areas of protected vegetation near the proposed development. Those areas include Bold Park, Kings Park and Shenton Bushland. The University will set aside 11.9ha of high quality bushland in an east-west configuration for conservation and passive recreational purposes. This option retains the greatest diversity of vegetation on the site and retains ecological linkage opportunities southwards to Shenton Bushland and nearby reserves such as Bold Park and Kings Park.

At a regional scale, the bushland is representative of the Karrakatta Central and South Vegetation Complex and Floristic Community Type 28. The Conservation and POS Area includes a range of structural vegetation units as follows:

- *Banksia menziesii* and *B. attenuata* Low Woodland over *Allocasuarina fraseriana* and *Hakea prostrata*;
- *Eucalyptus marginata* and *E. gomphocephala* Open Woodland over *Acacia saligna, A. rostellifera* and *Hakea prostrata*;
- *Eucalyptus marginata* Open Woodland over *Banksia menziesii* Low Woodland;
- *Eucalyptus marginata* Low Woodland over a *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana* Low Woodland; and
- Scattered *Eucalyptus decipiens* trees.

In addition, the proposed Conservation and POS Area provides for the protection of a diversity of structural vegetation units and includes the main populations of the Priority 3 species, *Jacksonia sericea*.

The Conservation and POS Area includes the highest point of the site and therefore retention of native vegetation in this area will maintain the line of sight for the movement of birds, including signification species such as Carnaby's Cockatoo and the Peregrine Falcon, which may utilise the site while moving between nearby bushland areas.

Commitment 2 ***The University will implement a fauna-friendly clearing protocol.***

The University will implement a fauna-friendly clearing protocol as a part of the clearing operations. This will involve inspecting all tree hollows, nests and vegetated debris for fauna prior to clearing.

Commitment 3 ***The University will prepare a bushland management plan to guide long-term management of the conservation and POS area.***

The University previously prepared a bushland management plan for the Conservation and POS area contained in the Bulletin 1099 proposal. The management recommendations contained in this management plan remain valid. However, The University will review and update this plan for the Conservation and POS area in the current conservation and development proposal. The management plan will address the following matters:

- Vegetation management;
- Access management including fencing;
- Control of feral animals and domestic pets;

- Fire management;
- Community involvement;
- Interpretative signage;
- Rehabilitation of degraded areas including weed management and revegetation; and
- Monitoring.

Commitment 4 ***The University is committed to rehabilitating the POS area of bushland that is currently in less than Good condition back to a state of Very Good condition.***

A portion of the POS Area is in less than Good Condition and will be rehabilitated by The University to Very Good Condition consistent with the requirements of the EPA. The management of the Conservation and POS Area will be in accordance with a comprehensive management plan. The University has already implemented native seed collection and propagation, weed control and rehabilitation of degraded areas.

Commitment 5 ***The University will retain ownership and management of the conservation areas.***

The University will retain ownership and management control of the conservation areas. Management will be conducted in accordance with a management plan for the specific purpose of conservation. The University recognises the value of the conservation area in terms of aesthetic benefits for future residents as well as an educational resource for surrounding schools and its own students.

7 Conclusion on the likelihood of significant impacts

NOTE: Under the EPBC Act, you must identify in the referral whether or not you believe significant impacts on the matters protected under the Act are likely. If you identify that significant impacts are likely, you must identify the relevant protected matters in section 7.2.

Do you THINK your proposed action is likely to have significant impacts?

X	No, complete section 7.1
	Yes, complete Section 7.2

7.1 Proposed action is NOT LIKELY to have significant impacts

Key reasons

It is ATA Environmental's opinion that development of the eastern portion Lot 4 will not influence the habitation of this region by Carnaby's Cockatoos and as such should not be considered a controlled action under the *EPBC Act 1999*. The basis for this position is detailed in ATA Report No. 2005/067 (enclosed with this referral).

More specifically, the current proposal should not be a controlled action because:

- It is considered that the proposal will not adversely affect the breeding or feeding patterns of Carnaby's Cockatoos.
- Significant areas of bushland near the study area containing similar habitat are secured in conservation reserves.
- Approximately 11.9ha of high quality Carnaby's Cockatoo feeding habitat on Lot 4 will be retained for conservation and passive recreational purposes.
- Lot 4 represents less than 3% of the high quality habitat in the Perth western suburbs and a much less percentage of habitat in the wider Perth metropolitan region, therefore it is unlikely that Carnaby's Cockatoo rely on Lot 4 for its survival
- Carnaby's Cockatoo have not shown signs of breeding in the nearby Bold Park and if they did, the clearing of native vegetation on Lot 4 Underwood Avenue is not likely to influence the breeding success of this species, as there is sufficient foraging habitat within 4km of Bold Park.
- The bushland to be retained as a part of the proposed development of Lot 4 is in a continuous east-west corridor, thereby not compromising the supposed ecological linkage provided by Underwood Avenue.

7.2 Proposed action is LIKELY to have significant impacts

Matters likely to be impacted

	sections 12 and 15A (World Heritage)
	sections 15B and 15C (National Heritage places)
	sections 16 and 17B (Wetlands of international importance)
	sections 18 and 18A (Listed threatened species and communities)
	sections 20 and 20A (Listed migratory species)
	sections 21 and 22A (Protection of the environment from nuclear actions)
	sections 23 and 24A (Marine environment)
	sections 26 and 27A (Protection of the environment from actions involving Commonwealth land)
	section 28 (Protection of the environment from Commonwealth actions)

Key reasons

8 Assessment approach under the EPBC Act

NOTE: If a decision is made that a proposal needs approval under the Act, the Minister will also decide the assessment approach needed to satisfy the objectives of the Act. While the information you have provided in this referral will be taken into account in making this decision, the final decision rests with the Minister.

Level of assessment

	Bilateral Agreement applies
	Accredited assessment
X	Assessment on referral information
	Preliminary information
	Public Environment Report
	Environmental Impact Statement
	Commission of Inquiry
	No comment/Not sure

Key reasons

The University has commissioned a comprehensive investigation into the potential impact on Carnaby's Black Cockatoo arising from future development of Lot 4 Underwood Avenue. This information was not available at the time of the 2004 referral for a different development proposal for Lot 4. This information, combined with earlier investigations provides sufficient information for the Department of Environment and Water Resources to determine that the proposed conservation and development proposal will not have a significant impact on matters of national significance.

The University believes that the current conservation and development proposal provides an improved conservation outcome from the previous proposal and implementing the commitments outlined in Section 6 will minimise potential adverse impacts on matters of national significance.

In addition to the above points, The University believes that matters of national significance have been sufficiently addressed through the state environmental assessment process.

9 Environmental history of the responsible party

NOTE: The EPBC Act Regulations provide for the environmental history of the party proposing to take the action to be taken into account when deciding the assessment approach for actions that need approval under the Act.

		Yes	No
9.1	**Does the party taking the action have a satisfactory record of responsible environmental management?** • **If Yes, provide details** The University recognises its environmental obligations, both locally and globally, to present and future generations. To fulfil its obligations, The University works within the framework of an Environmental Policy. This policy ensures that The University maintains it status as a progress tertiary institution, operating in a manner that protects the environment.	X	
9.2	**Is the party taking the action subject to any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources?** • **If Yes, provide details**		X
9.3	**For an action for which a person has applied for a permit under the EPBC Act, is the person making the application subject to any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources?** • **If Yes, provide details**		X
9.4	**If the party taking the action is a corporation, will the action be taken in accordance with the corporation's environmental policy and planning framework?** • **If Yes, provide details of environmental policy and planning framework**		

10 Information sources and attachments

10.1 References

ATA Environmental (2007a). Carnaby's Cockatoo (*Calyptorhynchus Latirostris*) Assessment, Swan Coastal Plain. ATA Environmental Report No. 2005/067.

ATA Environmental (2007b). *Pt Lot 4 Underwood Avenue Shenton Park 2006 Development and Conservation Proposal. Evaluation of Environmental Factors.* ATA Environmental Report No. 2006/263.

10.2 Reliability of information

The information is current and is based on extensive research and field investigation undertaken as part of the preparation of the above ATA Environmental reports.

10.3 Attachments

You must attach	figures, maps or aerial photographs showing the project locality (section 2)	X
	figures, maps or aerial photographs showing the location of the project in respect to any matters of national environmental significance or important features of the environments (section 4)	X
If relevant, attach	copies of any state or local government approvals and consent conditions (section 3.4)	
	copies of any completed assessments to meet state or local government approvals and outcomes of public consultations, if available (section 3.5)	
	copies of any flora and fauna investigations and surveys (section 4) (Details contained in ATA Environmental, 2007b)	
	technical reports relevant to the assessment of impacts on protected matters and that support the arguments and conclusions in the referral (section 4 and 5)	X
	report(s) on any public consultations undertaken, including with Indigenous Stakeholders (section 4)	

11 Signatures and declarations

NOTE: Providing false or misleading information is an offence punishable on conviction by imprisonment and fine (Section 489, EPBC Act).

Project title

11.1 **Party who prepared the referral**

I declare that the information contained in this form is, to my knowledge, true and not misleading. I request that the person named in 11.3 below (if any) be designated as the proponent for the action.

Signature

Date

Full name Dr Paul van der Moezel

11.2 **Party who is responsible for action**

I declare that the information contained in this form is, to my knowledge, true and not misleading.

Signature

Date

Full name On behalf of The University of Western Australia

11.3 **Proponent (complete only if different from 11.2)**

I, being the person nominated in Section 1.3 of this referral form as the nominated proponent (or agent acting on behalf of), agree to be designated as the proponent for the action described above if it is decided that the action requires approval under Part 9 of the EPBC Act.

Signature

Date

Full Name

If the referring party is a small business (fewer than 20 employees), estimate the time, in hours and minutes, to complete this form (include your time reading the instructions, working on the questions and obtaining the information and time spent by all employees in collecting and providing this information).

Hours	Minutes

DISCLAIMER

This document is published in accordance with and subject to an agreement between ATA Environmental **("ATA")** and the client for whom it has been prepared The University of Western Australia **("Client")** and is restricted to those issues that have been raised by the client in its engagement of ATA and prepared using the standard of skill and care ordinarily exercised by Environmental Scientists in the preparation of such Documents.

Any person or organisation that relies on or uses the document for purposes or reasons other than those agreed by ATA and the Client without first obtaining the prior written consent of ATA, does so entirely at their own risk and ATA denies all liability in tort, contract or otherwise for any loss, damage or injury of any kind whatsoever (whether in negligence or otherwise) that may be suffered as a consequence of relying on this Document for any purpose other than that agreed with the Client.

QUALITY ASSURANCE

ATA Environmental has implemented a comprehensive range of quality control measures on all aspects of the company's operation and has Quality Assurance certification to ISO 9001.

An internal quality review process has been applied to each project task undertaken by us. Each document is carefully reviewed by core members of the consultancy team and signed off at Partner level prior to issue to the client. Draft documents are submitted to the client for comment and acceptance prior to final production.

Document No: UWA_2003_001_051_PZ_V3

Report No: 2006/263

Checked by:	Signed:		Date:	29 January 2007
	Name:	Paul Zuvela Senior Environmental Scientist		
Reviewed by:	Signed:		Date:	29 January 2007
	Name:	Paul van der Moezel Principal		
Approved by:	Signed:		Date:	29 January 2007
	Name:	Paul van der Moezel Principal		

TABLE OF CONTENTS

LIST OF TABLES

LIST OF PLATES

LIST OF FIGURES

LIST OF APPENDICES

1. INTRODUCTION

1.1 Background, Purpose and Scope

In 2001, The University of Western Australia (The University) prepared a development and conservation proposal for Lot 4 Underwood Avenue, Shenton Park (Figure 1). This proposal was for the subdivision of the eastern portion of the landholding encompassing approximately 32ha (hereby referred to as Bulletin 1034 proposal). The proposal was referred to the Environmental Protection Authority (EPA) for assessment.

In Bulletin 1034, the EPA (2001) concluded that the *"8.5ha of bushland identified for bushland conservation is considered inadequate to protect the core (highest conservation value) area/s of the Bushplan site"* and *"that a larger area...but not substantially so, should be set aside for conservation"*. The University proposed an addition to the 8.5ha conservation area and this was considered acceptable by the EPA at its 21 November 2002 meeting.

On 22 November 2002, The University entered into an agreement with the Water Corporation, EPA and the Western Australian Planning Commission (WAPC), which resulted in The University requesting that EPA Assessment 1403 relating to the Bulletin 1034 proposal, be suspended until further notice, and that a new proposal be prepared for the subject land. The power of the EPA to suspend the assessment is derived from section 40(3) of the *Environmental Protection Act 1986*.

Under section 43A of the *Environmental Protection Act 1986*, the EPA may consent to the proponent (in this case The University) changing the proposal without a revised proposal being referred to the EPA, if the EPA considers that the change is unlikely to significantly increase any impact that the proposal may have on the environment. The University has prepared a revised proposal (Figure 2) incorporating the EPA comments on the Bulletin 1034 proposal. The revised proposal also takes into consideration the Minister for the Environment's decision on a separate proposal for Lot 4. The EPA has requested that The University prepare a report comparing the current proposal with the Bulletin 1034 proposal to identify whether there is a net benefit to the environment.

This report has been prepared on behalf of The University to compare the current conservation and development proposal for the eastern portion of Lot 4 with the Bulletin 1034 proposal against relevant environmental factors.

2. CURRENT PROPOSAL

The current proposal is to develop the eastern portion of Lot 4 Underwood Avenue, Shenton Park for residential purposes and includes the retention of approximately 11.9ha of bushland for conservation and passive recreation (Figure 2). The retention of approximately 11.9ha for conservation and passive recreational purposes represents almost 33% of the total developable area of 36ha, which includes the area shown as future development in Figure 2.

The balance of the developable area will be for residential purposes and the remainder of Lot 4 continued to be used for University purposes.

This proposal represents an improvement of the original proposal assessed in Bulletin 1034. The current proposal incorporates the recommendations of the EPA in Bulletin 1034, embraces the underlying principles identified during the Shenton Park/Mt Claremont Structure Plan Charrette process initiated in 2001 and the Minister for the Environment's decision on a separate proposal for Lot 4.

2.1 Conservation and Public Open Space Areas

It is proposed to retain two conservation areas (8ha and 2ha for a total of 10ha) joined by a vegetated Public Open Space (POS) area. The 10ha of bushland set aside for conservation is 1.5ha more than the original Bulletin 1034 proposal and represents an approximate 22% increase on the agreed 8.23ha Negotiated Planning Solution as depicted in Bush Forever (Government of Western Australia, 2000).

The approximate 1.9ha of POS is strategically located between Conservation Areas A and B. This in effect represents an addition to the conservation areas by virtue of the fact that this open space is predominantly vegetated with native species and will be managed in a way that recognises and enhances the adjacent conservation values while maximizing compatible passive recreational opportunities. It constitutes part of the future subdivisional open space requirement of the residential subdivision. It will perform both conservation and passive recreational functions with rehabilitation of degraded areas using locally native species and restoration of understorey species together with walk trails, tables and seating in a natural bushland setting. The POS is a critical element in the overall linkage objective as defined within the Shenton Park/Mt Claremont Structure Plan Charrette process initiated in 2001 and is an important recreational asset for those residents that will ultimately live within this residential estate. Included in the POS are the two important Jarrah trees (known as the interlocking Jarrahs).

The current proposal will result in 40% more bushland (including the POS area) being retained than the original Bulletin 1034 proposal, which retained 8.5ha of bushland.

2.1.1 Conservation Area A

Conservation Area A occupies a total area of 8ha and is located in the southeast corner of Lot 4 adjacent to Selby Street.

The vegetation of Conservation Area A (Figure 3) consists entirely of a Jarrah dominated Woodland with scattered Tuart and Marri trees over a lower tree canopy of *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana*. Typical taller shrub species include *Jacksonia furcellata, Hakea prostrata, Xanthorrhoea preissii* and *Macrozamia fraseri*. Common understorey species include *Gompholobium tomentosum, Hibbertia hypericoides, Acacia pulchella, Calytrix fraseri, Mesomelaena pseudostygia, Desmocladus flexuosus* and *Petrophile linearis*.

The bushland in Conservation Area A is mainly in Very Good to Good condition or better (Figure 4).

2.1.2 Conservation Area B

Conservation Area B occupies 2ha and is located in the western portion of the proposed developable area. Conservation Area B contains a greater variety of vegetation associations than Conservation Area A (Figure 3). It mostly comprises *Banksia menziesii – B. attenuata* woodland over *Allocasuarina fraseriana* and *Hakea prostrata*. In places, there is stunted Jarrah or emergent Tuart. Species common in the understorey of the *Banksia* Low Woodland include *Hakea prostrata* up to 2m and low shrubs of *Mesomelaena pseudostygia, Xanthorrhoea preissii, Petrophile linearis* and *P. macrostachya. Alexgeorgea nitens, Desmocladus flexuosus, Dryandra lindleyana* and several weed species dominate the ground cover. However, also protected in this area is Jarrah Open Woodland over *Banksia menziesii* Low Woodland and a *Eucalyptus decipiens* stand. Conservation Area B also protects two significant plant species which were not protected in the original Bulletin 1034 proposal. Conservation Area B also protects a stand of *Eucalyptus decipiens,* which is not a Priority or DRF species but is uncommon in the Perth Metropolitan Region, usually occurring in very small stands on shallow sand over limestone. Also protected in this conservation area are two populations of the Priority 3 species *Jacksonia sericea* that were not protected in the Bulletin 1034 proposal.

The bushland in Conservation Area B is mapped mainly as Good to Very Good condition (Figure 4). The balance of Conservation Area B is mapped as Good.

2.1.3 Public Open Space

The central POS spine that links Conservation Areas A and B comprises of two vegetation associations, the Jarrah dominated Woodland with scattered Tuart and Marri trees over a lower tree canopy of *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana* and the Jarrah and Tuart Open Woodland over *Acacia saligna, A. rostellifera* and *Hakea prostrata* (Figure 3).

The vegetation condition in the POS area is variable and ranges from Good through to Degraded (Figure 4).

The central region of the POS area includes the highest point of the site at 44mAHD. This high point has been modified by partial clearing in the past and the installation of tracks and firebreaks.

The University is committed to rehabilitating the POS area and other weedy sections back to a Good to Very Good condition (Refer to Section 5.2). The University has demonstrated its ability to rehabilitate the site through its rehabilitation of two degraded sites on Lot 4 in 2004 and 2005. The results achieved to date at these two sites are provided in Appendix 1.

3. BULLETIN 1034 PROPOSAL

3.1 Background

The University has considered a number of options for the delineation of a conservation area at the Shenton Park landholding. The Bush Plan/Bush Forever process and community guided the preparation of the various proposals initially and with agency consultation resulted in a proposed 8.23ha Negotiated Planning Solution.

The proposal assessed by the EPA (Bulletin 1034) was formulated following a protracted planning and negotiation process as outlined below.

The University commissioned a preliminary environmental assessment of Lot 4 to determine if the environmental values of the site could be protected while meeting the objectives of Bush Forever (formerly Bush Plan) by retaining a representative portion of the bushland as part of a Structure Plan. The environmental assessment guided the preparation of an Outline Development Plan (ODP) that contained an 'L-shaped' area of bushland mapped as Very Good condition along Selby Street and Underwood Avenue. The University lodged a submission to the Ministry for Planning (now Department for Planning and Infrastructure) in 1999 delineating an area of bushland of high conservation value to be retained as Conservation Open Space in any future development on Lot 4. The Ministry for Planning agreed with the proposal and subsequently, in 2000 the Minister for Planning endorsed the agreed negotiated outcome. This proposal is shown in Bush Forever (Government of Western Australia, 2000) as the 8.23ha Negotiated Planning Solution for Lot 4.

Further discussions with the former Department of Environmental Protection (DEP) regarding the optimal shape of the conservation area identified that a reduced perimeter to area ratio would be preferred. This resulted in the formulation of a rectangular-shaped conservation area.

Further refinement of the conservation area was requested by the DEP following extensive consultation and site inspections with officers and the project team. During a site inspection, and subsequent meeting in May 2001 the DEP and EPA confirmed preference for a 'square' shaped conservation area. Correspondence was received from the EPA Chairman on 20 June 2001 indicating provisional support for the square reservation.

Consequently, a revised subdivision application was lodged in June 2001 followed by an ODP in September 2001 delineating the square conservation area encompassing 8.5ha in the south-eastern region of the site (Figure 1). The EPA assessed this application and Bulletin 1034 was released in November 2001.

3.2 Conservation Area

The proposed conservation area in the original proposal occupied a total area of 8.5ha and is located in the southeast corner of Lot 4 adjacent to Selby Street.

The vegetation of the conservation area consisted entirely of a Jarrah dominated Woodland with scattered Tuart and Marri trees over a lower tree canopy of *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana*. Typical taller shrub species include *Jacksonia furcellata, Hakea prostrata, Xanthorrhoea preissii* and *Macrozamia fraseri*. Common understorey species include *Gompholobium tomentosum, Hibbertia hypericoides, Acacia pulchella, Calytrix fraseri, Mesomelaena pseudostygia, Desmocladus flexuosus* and *Petrophile linearis*.

The bushland in the conservation area is mainly in Very Good to Good condition or better.

3.3 EPA Assessment of Bulletin 1034 Proposal

In relation to the conservation area, the EPA provided the following recommendation to the Minister for the Environment in Bulletin 1034:

'That the Minister notes that the EPA has concluded that in its current form the proposed 8.5ha identified for bushland conservation is considered inadequate to protect the core (highest conservation value) area/s of the Bush Plan Site. The EPA is of the view that a larger area of the Bush Plan Site, but not substantially so, should be set aside for conservation.'

The particular issues that were raised by the EPA in its report and recommendations are summarised as follows:

- Impact on populations of *Jacksonia sericea*
- Impact on a population of *Eucalyptus decipiens*
- Ecological Linkage
- Tuart trees
- Size of the bushland conservation area

The Minister for the Environment received a number of appeals on the content of the EPA's report and recommendations. In determining the appeals, the Minister forwarded the proposal back to the EPA to more fully consider the area of native vegetation that should be conserved on site.

Discussions were held with the DEP/EPA to determine the appropriate size and configuration of the conservation area. An additional area was provisionally agreed between the EPA and The University, which expanded the reservation to include additional bushland to the west of the square shape.

4. ENVIRONMENTAL EVALUATION OF THE CONSERVATION AND PUBLIC OPEN SPACE AREAS

The following sections provide an environmental evaluation of the current proposal and compare this proposal with the original Bulletin 1034 proposal according to recognised criteria (i.e. Bush Forever[1]).

An area of regionally significant bushland (Site 119) was identified on the site under the heading of a 'Negotiated Planning Solution' in Bush Forever mapping (Government of Western Australia, 2000). The selection criteria used to identify the regionally significant parcel at the site was that of '*representation of ecological communities*'. According to Bush Forever, other criteria used to determine the selection of regionally significant bushland areas, including diversity, rarity, maintaining ecological processes, scientific or evolutionary importance are not considered relevant to this area of bushland.

The evaluation of the conservation area in the following sections, however, does not exclude the other criteria listed under Bush Forever.

4.1 Representation of Ecological Communities

According to Bush Forever, the State Government's objective is to protect at least 10% of the original extent of each vegetation complex in the Perth Metropolitan Area and in at least five geographically distinct areas if possible. The Karrakatta Complex-Central and South has approximately 5.6% of its original extent with some level of existing protection (e.g. included within existing reserves). Implementation of Bush Forever initiatives will increase this figure by approximately 2.4% to bring the total to 8% of the original extent currently retained or proposed for retention. Outside the Perth Metropolitan Region, the amount of Karrakatta Central and South Vegetation Complex remaining is well over the 30% target set by the Government in non-urban areas.

In comparison with the original Bulletin 1034 proposal, the current proposal has a minor positive impact on the conservation status of the Karrakatta Central and South vegetation complex (Table 1).

TABLE 1
AREAS OF VEGETATION RETAINED IN PREVIOUS AND CURRENT PROPOSALS

Proposal	Area
Original Bulletin 1034 proposal	8.50ha
Current Proposal (excluding POS)	10.00ha
Current Proposal (including POS)	11.90ha

[1] Government of WA (2000) Bush Forever. Volume 1 – Policies, Principles and Processes.
Government of WA (2000) Bush Forever. Volume 1 – Policies, Principles and Processes – Appendix 3: Site Implementation Guidelines – Practice Notes.
Government of WA (2000) Bush Forever. Volume 2 – Directory of Bush Forever Sites.

4.2 Diversity

The current proposal contains a greater representation of vegetation associations of the Karrakatta Central and South Complex than the Bulletin 1034 proposal (five compared with one), as shown in Table 2. Consequently, it would be expected that the current proposal would also provide a greater diversity of flora and fauna.

TABLE 2
AREA OF VEGETATION ASSOCIATIONS RESERVED IN PREVIOUS AND CURRENT PROPOSALS

Vegetation Type	Original Bulletin 1034 Proposal	Current Proposal	
		Conservation Areas A and B	POS
Jarrah/Banksia/Sheoak Low Woodland	8.50	7.98	1.03
Jarrah/Tuart Open Woodland	-	-	0.72
Banksia attenuata/B. menziesii Woodland	-	1.57	-
Banksia prionotes Closed Scrub	-	-	-
Eucalyptus decipiens Low Woodland	-	0.1	-
Jarrah over *Banksia menziesii* Low Woodland	-	0.33	-
Cleared	-	0.005	0.14

In considering the regional significance of the vegetation, it is useful to compare the vegetation of the site to nearby reserves. The Jarrah/*Banksia* Woodland vegetation type of the conservation and POS areas (and balance of the subject land) are well represented at other local reserves and open spaces. Bold Park is composed of up to 70% (approximately 145ha) *Banksia* Low Woodland and Kings Park is composed predominantly of a mixed *Eucalyptus/Allocasuarina/Banksia* Open Woodland. Jarrah Woodlands are not as well represented locally, comprising only 2% (10ha) of the vegetation in Bold Park. Bush Forever (Government of Western Australia, 2000) identified that the vegetation associations present at the nearby Shenton Bushland (Bush Forever Site 218) are similar to those present on Lot 4 Underwood Avenue. Kings Park and Shenton Bushland both consist solely of Karrakatta Complex-Central and South.

The vegetation in the conservation and POS areas can also be categorised according to floristic community types (Gibson *et al.*, 1994). Floristic community types group vegetation with similar species composition rather than based on geomorphology and climate, as is the case with the Heddle *et al.* vegetation complexes. All vegetation types in the conservation and POS areas belong to Floristic Community Type 28 - Spearwood *Banksia attenuata* or *B. attenuata - Eucalyptus* species woodlands. Within the local area, Floristic Community Type 28 is abundant at Kings Park and at Shenton Bushland and is common in other metropolitan reserves with Spearwood soil types.

Floristic Community Type 28 is not a Threatened Ecological Community at the state level (English and Blyth, 1997) or at the Commonwealth level.

The current proposal has a minor positive impact on the conservation status of floristic community types compared to the Bulletin 1034 proposal.

The current proposal retains representative examples of five of the six vegetation associations at the site and based on the general high quality of the bushland it can be expected that a significant proportion of the species recorded at the site occur in the conservation and POS areas.

In terms of fauna values, the principal habitat of the proposed Conservation Areas A and B (mixed *Eucalyptus/ Banksia* woodland) is consistent with the vegetation of the original Bulletin 1034 proposal. A key advantage of the current proposal over the original Bulletin 1034 proposal is that the current proposal incorporates a representative sample of most vegetation associations occurring over the balance of the site. However, it is anticipated that modifying the conservation areas from 8.5ha to 11.9ha would make little difference to the species of vertebrate fauna protected on the site, as species recorded previously are generally not habitat specific.

4.3 Rarity

In total, 149 species of vascular plants were recorded from the six principal vegetation associations identified at the site. Of the total species recorded, 112 are native to the site and 37 are introduced species not native to the area (includes native Australian species which are garden escapes). One species recorded at the site is listed as a Priority 3 species *Jacksonia sericea.* Although *Jacksonia sericea* is a Priority species it is not a species of high importance and has not been declared as rare. It is not uncommon in this locality and is present in significant numbers in nearby Bold Park, Kings Park and Shenton Bushland. The original Bulletin 1034 proposal did not include the main populations of this species on the site but committed to protecting some of the populations in open space within future developments. The current proposal retains the two largest populations of the Priority 3 species, representing protection of approximately 50% of the population present on Lot 4 rather than a commitment to protect some populations in POS in the future development of that area.

Eucalyptus decipiens is not a Declared Rare or Priority species and communities in which it is dominant are not Threatened Ecological Communities. However, stands of *Eucalyptus decipiens* are uncommon in the Perth Metropolitan Region. The original Bulletin 1034 proposal did not include the stand of this species but committed to protecting it in open space within future developments. The current proposal retains this small stand of *Eucalyptus decipiens* rather than a commitment to protect the area in future POS.

4.4 Maintaining Ecological Processes or Natural Systems

ATA Environmental has previously identified that the existing bushland at Underwood Avenue primarily provides (to an extent) ecological linkage with other nearby bushland areas, catering mainly for birds. The extent of surrounding development, particularly the existing road network, would prevent the movement of reptiles and amphibians.

The original Bulletin 1034 proposal only provides a link in part to Shenton Bushland located south of Lot 4. There is no westerly connection. The current proposal provides linkage functions to both the west and south.

4.5 Scientific or Evolutionary Importance

The original Bulletin 1034 proposal and the current proposal do not meet the criteria for identification as a site of scientific or evolutionary importance. However, current scientific

research would be able to be maintained, as The University would retain ownership and management of the bushland.

4.6 General Criteria for the Protection of Wetland, Streamline and Estuarine Fringing Vegetation and Coastal Vegetation

This criterion is not relevant, because the subject land does not contain any of these features.

4.7 Other Criteria

Other criteria that are important or can add to the value of the bushland and enhance its contribution to Bush Forever not specifically addressed in the above criteria are addressed in the following sections.

4.7.1 Vegetation Condition

Vegetation condition was assessed using the condition rating scale of Keighery published in Bush Forever (Government of Western Australia, 2000). Keighery's condition rating scale ranges from Pristine (where the vegetation exhibits no visible signs of disturbance) to Completely Degraded (where the vegetation structure is no longer intact and without native plant species). A description of the vegetation condition ratings is presented in Table 3.

Vegetation condition as mapped by ATA Environmental is shown in Figure 4.

TABLE 3
VEGETATION CONDITION RATING SCALE

Code	Description
P	Pristine Pristine or nearly so, no obvious signs of disturbance
Ex	Excellent Vegetation structure intact, disturbance affecting individual species and weeds are non aggressive species
VG	Very Good Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
G	Good Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Deg	Degraded Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
CD	Completely Degraded The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora composing weed or crop species with isolated

Code	Description
	native trees or shrubs.
C	Cleared The area is totally devoid of native vegetation.

(Government of Western Australia, 2000)

The current proposal (including the POS area) protects the largest area of vegetation with a condition rating of Good or better (10.42ha) when compared with the original Bulletin 1034 proposal (8.32ha) (refer to Table 4). Excluding the POS area, the current proposal protects 9.7ha of vegetation classed as Good or better, which exceeds the entire area of vegetation proposed to be retained in the original Bulletin 1034 proposal.

TABLE 4
VEGETATION CONDITION OF RETAINED BUSHLAND IN BULLETIN 1034 PROPOSAL AND CURRENT PROPOSAL

Vegetation Condition	Original Bulletin 1034 Proposal	Current Proposal	
		Conservation Areas A and B	POS Area
Very Good	6.35ha	4.87ha	-
Very Good to Good	1.37ha	2.19ha	0.33ha
Good to Very Good	-	1.48ha	-
Good	0.6ha	1.16ha	0.39ha
Good to Degraded	0.18ha	-	0.63ha
Degraded to Good	-	0.12ha	-
Degraded	-	0.05ha	0.53ha

4.7.2 Aboriginal Significance

Previous consultation with indigenous people by The University has identified a preference for the retention of the elevated portion of the landscape with recognition for its indigenous heritage values. The current proposal retains this part of the landscape in the POS area whereas the original Bulletin 1034 proposal did not retain this landscape feature. The mature interlocking Jarrah trees will also be retained in the POS area.

There is an opportunity to acknowledge indigenous heritage through interpretive signage and other means.

4.7.3 Landscape Features

The POS area is a more aesthetic passive recreational area than previous reservations as it is located across the upland ridge with panoramic views including the City and to Bold Park.

4.7.4 Shape of Conservation Areas

The original Bulletin 1034 proposal is the most regular shape, which is generally more optimal in minimising degrading edge effects, compared to narrow, elongated shaped areas of bushland. The current proposal includes conservation areas that are divided into two regular shaped rectangular areas, one of 8ha (Conservation Area A) and the other of 2ha (Conservation Area B) with an inter-connecting POS area in between. If considered as two parcels, then each parcel is regular and meets desirable reserve shape criteria. However, if considered one 10ha parcel separated by POS then the shape is not as regular as the original proposal.

The shape of the conservation and POS area in the current proposal is compromised by the retaining an east-west linkage. The EPA noted *"the prominent location and high visibility of the Tuart trees on the crest of the ridge is also likely to be a significant factor in maintaining the ecological linkage functions of the Underwood Avenue Bushland for the movement of birds through surrounding suburbs and bushland areas"*. The current proposal maintains an east-west linkage as well as retaining the Tuart trees on the crest of the ridge in the proposed POS area.

The University proposes that management of the POS area be for conservation and passive recreation activities that are consistent with the conservation intent. The POS will be rehabilitated to improve its vegetation condition in accordance with the preliminary management measures outlined in section 5.

The perimeter to area ratio for the original Bulletin 1034 proposal was 135m/ha (the smaller the number the better from a reserve design viewpoint). The perimeter to area ratio for the two separate parcels of bushland in the current proposal are 144m/ha for Conservation Area A and 286m/ha for Conservation Area B. Direct comparison of perimeter to area ratios for different sized areas of bushland is strictly not statistically valid, hence the relatively large number for Conservation Area B. Furthermore, in terms of reserve size, all configurations on the subject land are relatively small, and regardless of shape would require intensive management to maintain biodiversity values.

5. PROPOSED MANAGEMENT OF BUSHLAND AND PUBLIC OPEN SPACE AREAS

5.1 General

The University commits to preparing a management plan for the conservation and POS areas. The University will retain ownership and manage the conservation areas in conjunction with an appropriate body (such as the Botanic Gardens and Parks Authority). The University proposes that the POS area is vested with the City of Nedlands. However, The University is willing to enter into a Memorandum of Understanding with the local authority to assist in the management of the POS area.

The retention of bushland in an urban setting will provide an important function of improving the community's appreciation and understanding of the local bushland flora, vegetation and associated fauna. In this way, while conservation of the flora and fauna values of the bushland will be the management priority, the bushland will also function as an educational resource for the local and broader community.

On this basis, the objectives of the conservation areas will be to:

- Ensure the native flora, vegetation and fauna values are maintained and protected through appropriate management of the site;
- Improve community awareness and appreciation by utilising the conservation area for educational purposes consistent with maintaining the conservation value of the bushland; and
- Maintain linkages with other nearby bushland areas.

The POS area will provide the local community with opportunities for passive recreation in a manner that will not further degrade existing conservation values. This area is currently degraded in part and establishment of the POS will involve retention of any native trees and understorey species, where appropriate, and establishment of grass and installation of seating and tables. The balance of the POS area will be rehabilitated and managed for conservation purposes.

The following sections provide an overview of the key environmental strategies that will be addressed in a Management Plan for bushland and POS areas. The primary aim of the Management Plan will be to maintain the conservation value of the bushland following development of the adjacent land for residential purposes.

5.2 Rehabilitation

The upland region of the POS area has been somewhat degraded through past land use activities that have resulted in the loss of native vegetation and allowed subsequent weed invasion. This area will require rehabilitation to restore and maintain a bushland ecosystem to ultimately promote natural regeneration by reducing or eliminating disturbance factors such as weed invasion, fire, pests, and disease.

While it is anticipated that the bushland may change over time because of subtle changes in climatic conditions and natural events such as fire, it is anticipated that the natural plant community will regenerate naturally and will be resilient if managed properly.

The rehabilitation and restoration of degraded areas within the conservation area will involve two main processes:

1. Removal and prevention of the disturbances that lead to the deterioration of the bushland such as weed control, control of access, fires; and

2. Implementation of revegetation techniques such as brush/mulch application, direct seeding and tube or seedling planting.

The implementation of revegetation works may not be required in areas which regenerate well naturally, however, parts of the POS area are currently degraded and will therefore require assistance to restore the natural bushland.

A management plan for the conservation and POS areas will be prepared and will describe in detail the guidelines for the implementation of restoration measures, including species selection, planting densities, protection measures, and timing of works.

5.2.1 Weed Control

The introduction and spread of weeds in bushland areas presents a major threat to biodiversity including the loss of native floristic diversity, vegetation structure and native fauna habitat. In addition, the prevalence of weeds in bushland areas increases the threat of fire. The control of weeds in the conservation and POS areas will form an important component of the rehabilitation strategy and will be the focus of primary works in the area.

A number of weeds are present in the conservation area including invasive grasses (Perennial Veldt Grass, Buffalo Grass and Couch Grass), tuberous/cormous species (Freesia, Gladiolus), herbs (Pigface, Geranium and Lupin) and woody plants (Geraldton Wax).

Many of these species were introduced to the bushland as garden escapes or from the dumping of garden rubbish in the surrounding area prior to the installation of the boundary fence. Some weeds such as Ursinia and Gladiolus have been introduced by wind-borne seed and have become established in already degraded areas of the bushland such as along tracks and firebreaks.

The most effective method of keeping weeds out of the conservation area will be to control and prevent the source of invasion. For example, prevent dumping of garden refuse, keep irrigated lawns away from the bushland and minimise disturbance by installing fewer tracks and firebreaks.

In most instances, it is not possible, nor desirable, to remove all weeds initially as the factors contributing to weed invasion will be continually operating. Therefore, for a successful weed control program it will be important to re-weed the site on a regular basis. The program should focus on implementing the following principles:

- Work from areas in good condition towards weed infested areas;

- Ensure minimal disturbance to soil and vegetation;

- Let the rate of regeneration of native plants determine the rate of weed removal (as appropriate); and

- Implement a long-term maintenance program to monitor weed control methods and native flora regeneration.

The following management recommendations are proposed for bushland areas:

- The control of invasive weeds should be a major priority in the management of the conservation area.
- Investigate the feasibility and implications of extending the native understorey layer to the road kerbing so that the road acts as a firebreak.
- Grassed areas adjacent to the conservation area should be reticulated in such a manner that water does not impinge on the bushland area.
- Weed control programs should not be undertaken in isolation but as a component of a vegetation rehabilitation program.

5.3 Fire Management

The protection of life, property and environmental and community values in the bushland will be the important components of fire management within the proposed development area.

The incidence and impact of potential unplanned fires in the conservation area will be reduced by maintaining a strategic fire access system and implementing measures to control weeds which contribute to a high fuel load (such as Grass species – Veldt Grass). Fire control measures within the conservation area and surrounding development will comply with WAPC and FESA guidelines in "Planning for Bush Fire Protection" (WAPC and FESA, 2001).

In addition, early detection of fires and rapid attack will play an important role in fire control in the conservation area. Importantly, no burning for fuel reduction purposes will be undertaken in the bushland area.

5.4 Access

Access within bushland areas will be managed with designated paths designed to protect conservation values. The installation of paths in bushland areas requires careful consideration as too many paths can cause problems such as fragmentation of bushland and increase the boundary to area ratio. Consequently, heavily disturbed edges are open to weed invasion and may result in the loss of sensitive native species found within the bushland.

Following the fencing of the site in 1995, the establishment of informal paths and tracks in the bushland has been significantly reduced. However, a number of tracks have been cleared in and around the bushland to allow vehicle access for fire and maintenance purposes.

The maintenance of conservation values will require that some of the more appropriately aligned tracks are formalised for pedestrian access and those that are surplus to these requirements be rehabilitated.

All paths which are to be maintained and upgraded in the conservation area will be sealed with crushed limestone to a width of 2m and enclosed with pine bollards to prevent further establishment of informal tracks.

5.4.1 Fencing

To ensure that the environmental values of the conservation areas are maintained in the long-term, a 1.5m high pine post and ring-lock fence and 2.0m high cyclone fence will be installed at the periphery of the bushland areas. The 1.5m high fence will be along the boundaries between the bushland areas and future residential areas.

The construction materials will be selected to ensure that the fence prevents uncontrolled access and is aesthetically pleasing in areas adjacent to residential areas.

Gates will be installed at appropriate locations to provide pedestrian access but prevent entry by bicycles and trail bikes. Lockable gates will be installed where appropriate to provide vehicle access for maintenance and emergency purposes.

5.4.2 Interpretative Signage

Interpretive signage will be installed at key locations in bushland areas to provide the local community and visitors with information relating to the natural environment, orientation and to advise of user restrictions.

Interpretive signage will be an important mechanism in influencing the level of interest and involvement of the community in enhancing the value of the area.

Interesting and informative signage may be installed which provides straightforward information and diagrams describing native fauna, the attributes of native flora, and vegetation patterns.

5.5 Stewardship and Public Participation

5.5.1 Working Groups

Local community interest in the management and appreciation of urban bushland parcels is evidenced by the number of established working groups associated with nearby bushland remnants including the Friend of Shenton Bushland, Friends of Bold Park and Friends of Kings Park.

The proposed development of The University's land prompted the formation of a community interest group in 1999 - the Friends of Underwood Avenue. The continued involvement of this group in generating community interest and enthusiasm for bushland protection and management is strongly encouraged by The University.

5.5.2 Research Opportunities

As opportunities arise, The University anticipates opportunities to encourage research relevant to the management of the proposed conservation areas. Research may be linked to current studies being undertaken at The University or by the Botanic Gardens and Parks Authority or the Department of Environment and Conservation.

Research may include determining and updating methods of weed control, fire management, replanting techniques and identification of appropriate genetic sources of seeds or seedlings to be used in re-vegetation programs. Another element, which will require continued research, will include determining the impact of access on the vegetation and fauna habitats in the conservation area.

5.5.3 Schools

The conservation areas in the current proposal are located in proximity to five schools including Jolimont Primary, Rosalie Primary, Floreat Park Primary, John XXIII College and Shenton College. Some of these schools may have already commenced projects to rehabilitate local bushland areas or established nurseries to grow local native seedlings and may prefer to utilise other local bushland areas such as Bold Park and Kings Park, which can adequately accommodate educational activities without significant disturbance to the bushland.

The University will however, encourage educational use of the conservation areas on the basis that it does not conflict with the conservation objectives of the bushland.

Activities to promote the conservation area to schools and other institutions may include the following:

- Utilise the conservation area as the focus of demonstrating the theoretical and practical aspects of bush regeneration.
- Provide expert advice and guidance to school groups during theoretical and practical exercises.

5.5.4 Heritage Groups

The University will discuss the management and rehabilitation of the POS and bushland areas with the Nyungah Circle of Elders to ensure any proposals do not conflict with the recognised heritage values of the site.

6. CONCLUSIONS

The current proposal includes two areas of bushland totalling 10ha set aside for conservation purposes and an inter-connecting vegetated POS area covering approximately 1.9ha. The current proposal results in a significantly improved conservation outcome when compared with all other proposals, including the original Bulletin 1034 proposal because it:

- Provides for the protection of a larger area of native vegetation than the original Bulletin 1034 proposal;
- Increases the biodiversity in terms of increased number of vegetation associations and fauna values;
- Offers improved opportunities for linkages to Shenton Bushland and Bold Park;
- Protects two populations of the Priority 3 species *Jacksonia sericea*;
- Allows for immediate protection of the *Eucalyptus decipiens* stand; and
- Provides better social amenity with the most elevated portion of the site protected in Public Open Space.

The University will prepare a management plan for Conservation Areas A and B and the POS area, demonstrating its commitment to protecting the area for conservation purposes with some passive recreational use. As a part of implementing the management plan, The University will rehabilitate portions of the Conservation Area and POS areas, further increasing the ecological value of the area.

REFERENCES

English, V. and Blyth, J. (1997). *Identifying and Conserving Threatened Ecological Communities (TEC's) in The South West Botanical Province.* National Parks and Wildlife; Environment Australia; Department of Conservation and Land Management. Perth, Western Australia.

Gibson, N., Keighery, B.J., Keighery, G.J, Burbidge, A.H. and Lyons, M.N. (1994). *A Floristic Survey of the Southern Swan Coastal Plain.* Unpublished Report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia.

Government of Western Australia (2000). *Bush Forever – Keeping the Bush in the City. Volume 1 – Policies, Principles and Processes.* Perth, Western Australia.

Government of Western Australia (2000). *Bush Forever – Keeping the Bush in the City. Volume 2 – Directory of Bush Forever Sites.* Perth, Western Australia.

WAPC, Western Australian Planning Commission and FESA, Fire and Emergency Services Authority of Western Australia (2001). *FESA Planning for Bush Fire Protection.* Fire and Emergency Services Authority of Western Australia and Western Australian Planning Commission, Perth, Western Australia.

PLATES

Plate 1
Former animal pen adjacent to 2004 rehabilitation site. Note extent of weed invasion.

Plate 2
2004 rehabilitation site prior to planting.

Plate 3
2004 rehabilitation site one year after planting.

Plate 4
2004 rehabilitation site two years after planting.

Plate 5
2004 rehabilitation site two years after planting.

Plate 6
2005 rehabilitation site just after planting.

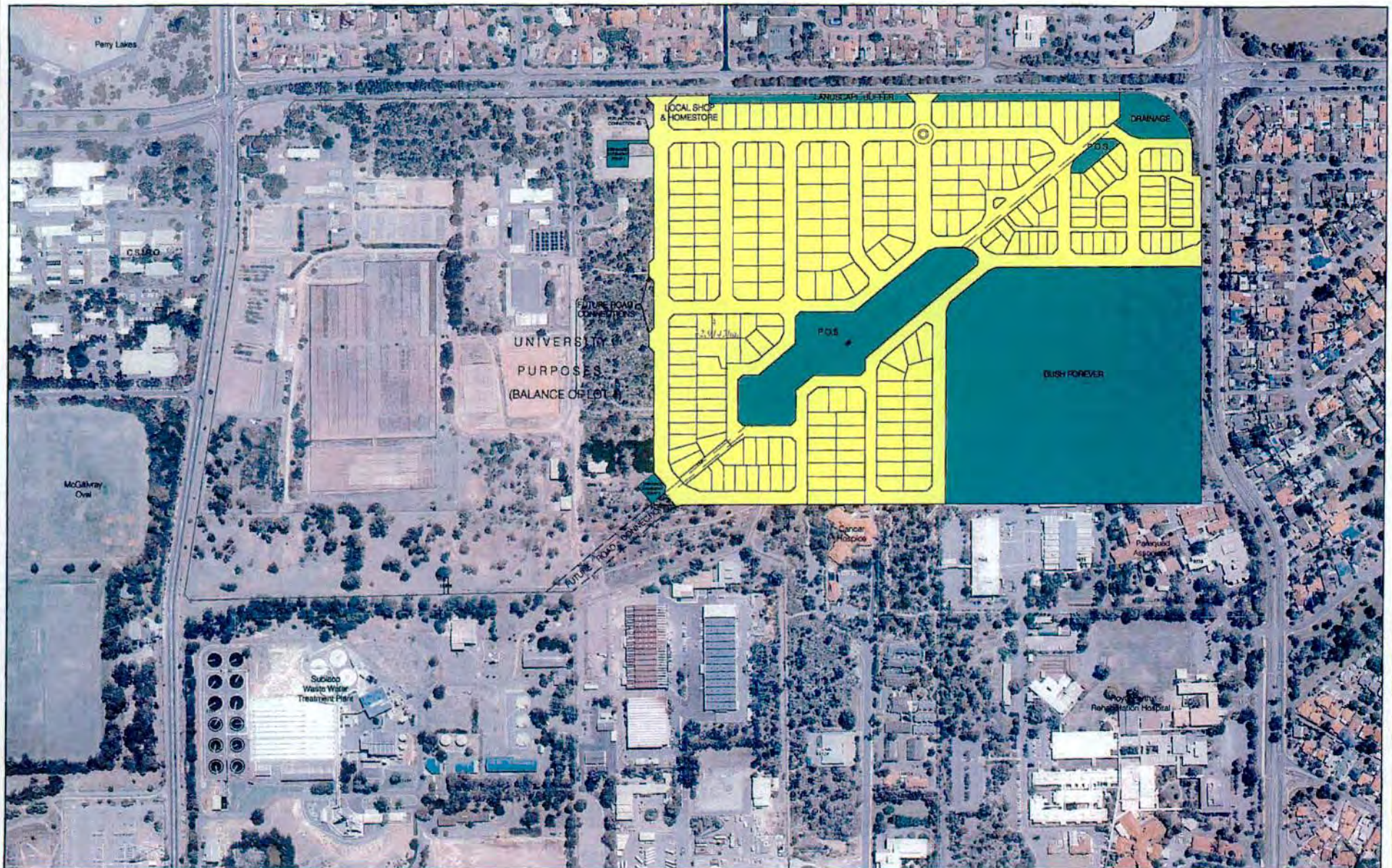
Plate 7
2005 rehabilitation site one year after planting.

FIGURES

UWA-2003-001/26_263F1.dgn DATUM: MGA50 DRAWN: EDS 21-12-06 CHECKED: PZ 21-12-06 PRINTED: Thu 15 Feb 07

ATA Environmental
environmental scientists

PT LOT 4 UNDERWOOD AVE, SHENTON PARK
2006 DEVELOPMENT & CONSERVATION PROPOSAL:
EVALUATION OF ENVIRONMENTAL FACTORS
BULLETIN 1034 PROPOSAL
FIGURE 1



BULLETIN 1034 PROPOSAL
LOT 4 UNDERWOOD AVENUE, SHENTON PARK
CITY OF NEDLANDS

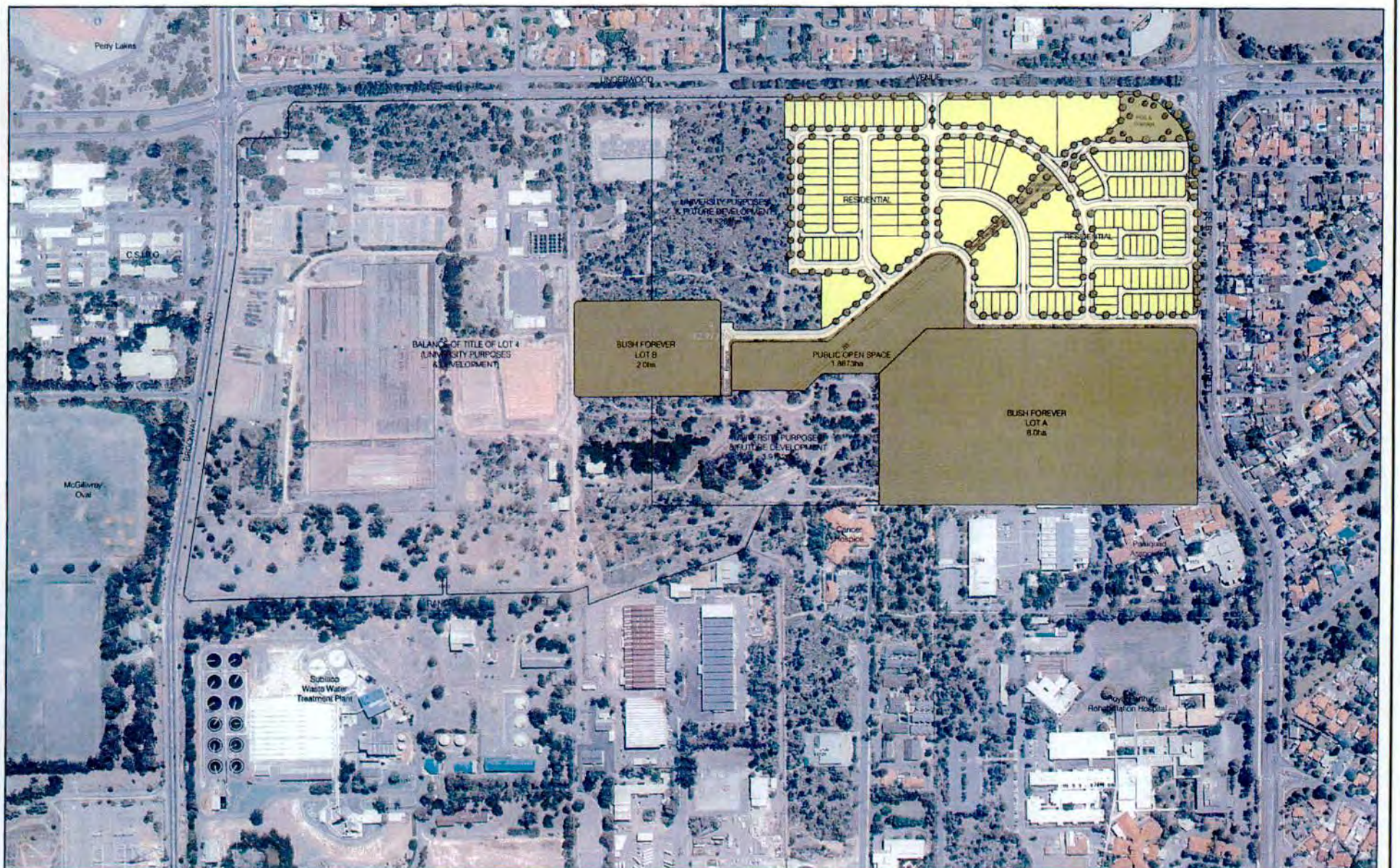
CHAPPELL LAMBERT EVERETT
TOWN PLANNING + URBAN DESIGN

DATE:	08.12.06
REVISED:	
COMPILED:	CLE, MAPS
SCALE:	1:2000 (A1)
PLAN No.	778-139

UWA-2003-001/26_263F2.dgn DATUM: MGA50 DRAWN: EDS 21-12-06 CHECKED: PZ 21-12-06 PRINTED: Thu 15 Feb 07

ATA Environmental
environmental scientists

PT LOT 4 UNDERWOOD AVE, SHENTON PARK
2006 DEVELOPMENT & CONSERVATION PROPOSAL:
EVALUATION OF ENVIRONMENTAL FACTORS
CURRENT PROPOSAL
FIGURE 2



PROPOSED RESIDENTIAL SUBDIVISION
LOT 4 UNDERWOOD AVENUE, SHENTON PARK
CITY OF NEDLANDS

CHAPPELL LAMBERT EVERETT
TOWN PLANNING + URBAN DESIGN

DATE:	13.09.06
REVISED:	06.12.06
COMPILED:	CLE, MAPS
SCALE:	1:2000 (A1)
PLAN No:	778-121L

PRINTED: Thu 01 Feb 07

UNDERWOOD AVENUE

SELBY STREET

DAPS TO ENSURE SURVEILLANCE AND ORIENTATION TOWARDS UNDERWOOD AVENUE

LANDSCAPE BUFFER

FUTURE ROAD CONNECTION

EmAf

Bp

LAND TO BE CLEARED FOR FUTURE DEVELOPMENT (BmBa)

Cleared

DRAINAGE

R60 Apartments 1829m² (9 D.U.'s)

R60 Apartments 4113m² (22 D.U.'s)

R60 Apartments 2046m² (12 D.U.'s)

R60 Apartments 2546m² (14 D.U.'s)

R60 Group Housing 3309m² (17 D.U.'s)

R60 Apartments 2720m² (15 D.U.'s)

R60 Group Housing 294m² (1 D.U.)

R60 Group Housing 2217m² (12 D.U.'s)

R60 Group Housing 2767m² (12 D.U.'s)

EmBaBm

Ed

Conservation Area B

EmEg

Public Open Space 1.8873ha

Public Open Space

EmBm

Conservation Area A

LAND TO BE CLEARED FOR FUTURE DEVELOPMENT 3.9152ha

BALANCE LOT 30.4203ha

Cleared

CANCER FOUNDATION

PARACHUTE ASSOC

metres

0 20 40 60 80 100

SCALE 1 : 2 500 @ A3

LEGEND

- Boundary of Subject Land
- Subdivision Detail
- Conservation and POS Area Boundaries
- Vegetation Association Boundary
- Interlocking Jarrah trees
- Approximate location of *Jacksonia sericea* (Priority 3) populations

VEGETATION ASSOCIATIONS

BmBa — Banksia Low Woodland, including *Banksia menziesii* and *B. attenuata* over *Allocasuarina fraseriana* and *Hakea prostrata*

EmEy — Jarrah *(Eucalyptus marginata)* and Tuart *(E. gomphocephala)* Open Woodland over *Acacia saligna*, *A. rostellifera* and *Hakea prostrata*

EmBm — Jarrah Open Woodland over *Banksia menzesii* Low Woodland

EmBaBm — Jarrah Low Woodland over *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana* Low Woodland

EmAf — Jarrah Woodland over *Allocasuarina fraseriana*

Bp — *Banksia prionotes* Thicket with *B. menziesii* and *B. attenuata*

Ed — *Eucalyptus decipiens* Very Open Tree Mallee

Cleared — Cleared

BASE SOURCE: Chappell, Lambert & Everett, Photo 2002, Subdivision November 2006 (778121i)

UWA3-1/26_263f3.dgn DATUM: MGA50 DRAWN: EDS/GLM 29-1-07 CHECKED: PZ 29-1-0

ATA Environmental
environmental scientists

PT LOT 4 UNDERWOOD AVE, SHENTON PARK
2006 DEVELOPMENT & CONSERVATION PROPOSAL:
EVALUATION OF ENVIRONMENTAL FACTORS

VEGETATION ASSOCIATIONS

FIGURE 3

PRINTED: Thu 01 Feb 07

CHECKED: PZ 21-12-06

DRAWN: EDS/GLM 21-12-06

DATUM: MGA50

UWA3-1/26_26314.dgn

UNDERWOOD AVENUE

STREET

SELBY

DAPS TO ENSURE SURVEILLANCE AND ORIENTATION TOWARDS UNDERWOOD AVENUE

LANDSCAPE BUFFER

Good to Degraded

Cleared

Good to Degraded

Cleared

FUTURE ROAD CONNECTION

Good to Very Good

Good

Cleared

LAND TO BE CLEARED FOR FUTURE DEVELOPMENT (4.5282ha)

Good

Apartments 1829m² (16 D.U.'s)

Apartments 4121m² (22 D.U.'s)

Apartments 4093m² (22 D.U.'s)

DRAINAGE

R60 Apartments 2546m² (14 D.U.'s)

R60 Group Housing 3209m² (17 D.U.'s)

R60 Apartments 2720m² (15 D.U.'s)

R60 Group Housing 2047m² (9 D.U.'s)

R60 Group Housing 3217m² (17 D.U.'s)

R60 Group Housing 2707m² (12 D.U.'s)

Good to Degraded

Good to Degraded

Good to Very Good

Good

Conservation Area B

Public Open Space

1.8873ha

Good

Public Open Space

Very Good

Very Good to Good

Conservation Area A

LAND TO BE CLEARED FOR FUTURE DEVELOPMENT 3.9152ha

Good

Degraded to Good

Good

BALANCE LOT 201 29.4209ha

Degraded

CANCER FOUNDATION

PARAQUAD ASSOC

BASE SOURCE: Chappell & Lambert, Photo 2002, Subdivision November 2006 (778121i)

metres

0 20 40 60 80 100

SCALE 1 : 2 500 @ A3

LEGEND

- Subject Land Boundary
- Subdivision Detail
- Conservation and POS Area Boundaries
- Vegetation Condition Boundary

VEGETATION CONDITION
(Legend Source: BUSH FOREVER Govt. of W.A.)

Pristine Pristine or nearly so, no obvious signs of disturbance (Not Applicable)

Excellent Vegetation structure intact, disturbance affecting individual species and weeds are non aggressive species (NA)

Very Good Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing

Good Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing

Degraded Degraded. Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing

CD Completely Degraded. The structure of the vegetation is no longer intact and the areas is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora composing weed or crop species with isolated native trees or shrubs (NA)

ATA Environmental
environmental scientists

PT LOT 4 UNDERWOOD AVE, SHENTON PARK
2006 DEVELOPMENT & CONSERVATION PROPOSAL:
EVALUATION OF ENVIRONMENTAL FACTORS
VEGETATION CONDITION
FIGURE 4

APPENDICES

APPENDIX 1
REHABILITATION RESULTS

APPENDIX 1
REHABILITATION RESULTS

In 2004, The University commenced rehabilitation of an area on Lot 4 that was mapped as 'Degraded'. In 2005, an additional area mapped as 'Degraded' was also rehabilitated.

Rehabilitation involved a seed collection program from Lot 4 involving Aboriginal people and supervised by contract seed pickers. The seed collection program involved educating participants about collection methods, plant species, seed storage and plant propagation.

2004 Rehabilitation

A 0.92ha area within disused animal pens was selected as the first site to be rehabilitated. The site was fenced and had existing irrigation and was in a highly degraded condition. The past land use involving repeated grazing has ensured that the seed store within this site has been substantially depleted and as such, natural regenerative processes were anticipated to be limited. The area also had a very high density of weeds from a variety of species.

Similar pens containing extensive weeds adjacent to the 2004 rehabilitation site are shown in Plate 1. Significant weed control was undertaken on this site prior to revegetation occurring. Plate 2 shows the site prior to planting. The 0.92ha areas was then planted with seedlings grown from the seed collected on site earlier in the year and supplemented by other species, which either were not collected or had unviable seed. Altogether 11,692 seedlings from 29 native species were planted in spring 2004.

Following planting, the rehabilitation area received regular watering over the first summer, which assisted plant establishment. Regular watering also encouraged weed growth, which was monitored and periodically controlled. In densely planted areas, weed species have largely been suppressed. The area is not currently irrigated.

Plate 3 shows the site approximately 1 year after planting. Plates 4 and 5 show the site two years after planting in October 2006. An assessment of the site in on 30 October 2006 identified successful establishment and growth of a number of species. The most common species present in the rehabilitation area are listed in Table 5.

TABLE 5
2004 REHABILITATION ASSESSMENT RESULTS

Common native species	Height (m)
Acacia rostellifera	2 – 2.5
Allocasuarina fraseriana	1
Banksia attenuata	0.3 – 0.4
Banksia grandis	0.8
Banksia menziesii	0.6
Banksia prionotes (less common)	0.5 – 1
Eucalyptus decipiens	3
Eucalyptus gomphocephala (Tuart)	4
Gompholobium tomentosum	0.6
Hakea prostrata	1
Hardenbergia comptoniana	Groundcover
Kennedia prostrata	Groundcover

Common native species	Height (m)
Phyllanthus calycinus	1
Common weed species	
Ehrharta calycina (Veldt Grass)	
Euphorbia terracina (Geraldton Carnation Weed) – occurs mostly at eastern end	
Sonchus oleraceus (Sow Thistle)	
Trifolium campestre and other spp. (Clover)	

Initial irrigation has undoubtedly promoted rapid growth of several species including *Acacia rostellifera, Eucalyptus gomphocephala* and *E. decipiens*.

2005 Rehabilitation

The 2005 rehabilitation site has been treated a little differently to the 2004 rehabilitation site in that it has not be irrigated and the site was ripped prior to planting. In addition, the area was revegetated with a different species composition. The density of overstorey species was reduced, in particular some *Eucalyptus* species and *Acacia* species.

Plate 6 shows the site just after planting in 2005. Plate 7 shows the same site in October 2006. The reduction in weeds present at this site is probably due to the absence of regular watering and controlled spraying. Growth rates are satisfactory given the absence of regular watering and a species composition that includes a greater proportion of slower growing species. Common species in the rehabilitation area are listed in Table 6.

TABLE 6
2005 REHABILITATION ASSESSMENT RESULTS

Common native species	Height (m)
Acacia cyclops	0.3
Acacia pulchella	0.5
Allocasuarina fraseriana	0.3
Allocasuarina fraseriana	1
Eucalyptus gomphocephala (Tuart)	0.3
Eucalyptus marginata	0.3
Gompholobium tomentosum	0.4
Hakea prostrata	0.4
Hardenbergia comptoniana	Groundcover
Kennedia prostrata	Groundcover
Common weed species	
Avena fatua (Oats)	
Conyza bonariensis (Fleabane)	
Ehrharta calycina (Veldt Grass)	

Summary of Rehabilitation Results

The results achieved to date for the two areas rehabilitated in 2004 and 2005, demonstrate that The University has made significant progress towards rehabilitating degraded land. Further efforts will concentrate on adding a greater variety of understorey species to the rehabilitation areas. Weeding will continue to remain a management priority. Selected thinning of *Eucalyptus gomphocephala* and possibly *Acacia rostellifera* may be required in the next few years to achieve a more natural density.