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SECTION 1

INTRODUCTION

1.1 Aim of the Brief.

The aim of this brief is to re-assess the bushfire risk posed by a vegetated Molonglo River corridor, including the Aprasia Habitat located to the northwest of the north-eastern portion of the Estate, southeast of Misery Point; the risk posed by the vegetation on the land to the northwest of Holdens Creek and the vegetation in the reserve between Cotter Road and the suburbs of Duffy/Holder and prepare a bushfire risk assessment for the new suburb of Coombs, in accordance with Australian Standard for Risk Management, AS/NZS 4360:2004 and the ACTPLA "*Planning for Bushfire Risk Mitigation"* guideline.

1.2 Background Information.

1.2.1 Pink Tailed Worm Lizard [PTWL] Study.

The Coombs Bushfire Risk Assessment prepared by ABPP [April 2010] examined the Coombs Estate Development Plan, identified the level of risk to the future suburb from a bushfire occurrence in the Molonglo River corridor and recommended the provision of an Outer Asset Protection Zone and Inner Asset Protection Zone to the temporary and permanent urban edge, south of Holdens Creek.

The Coombs Bushfire Risk Assessment [April 2010] recommended fire protection zones which occupied the area up to and beyond the south-eastern bank of the Molonglo River and to the northwest of Holdens Creek.

Investigations undertaken as part of the Molonglo River Corridor Study identified a large area of Aprasia Habitat between the north-western edge of the new suburb and the Molonglo River, within the recommended fire protection zones.

A confirmatory survey was undertaken by David Wong and William Osborne from the Institute for Applied Ecology, University of Canberra [UC] and a report prepared for the ACT Planning and Land Authority [ACTPLA] – dated 18 February 2010.

The UC report confirmed an area of Aprasia Habitat, nominated as 'Area 7', on the northwest facing slope of the ridgeline, between the proposed Coombs Estate and the Molonglo River. The investigation only found one skin even though 2816 stones were turned, suggesting that Pink-Tailed Worm Lizards occur at very low densities within Area 7.

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Figure 11 of the report identifies that Area 7 contains High Quality and Moderate Quality Potential Habitat. These Habitat Classifications are defined as:

(1) High Quality Potential Habitat:
Suitable rocky areas generally dominated by, or with a large component of Kangaroo Grass *[Thereda triandra]* and also often containing *Poa sieberiana* and, in some cases, a range of native forb species. Exotic annual species such as Haresfoot Clover *[Trifolium arevense]* and *Vulpia* spp. May also be present.

(2) Moderate Quality Potential Habitat:
Suitable rocky areas usually dominated by Spear Grasses *[Austrostipa* spp.*]* and Wallaby Grasses *[Austrodanthonia* spp.*].* Native forb species and exotic annual grasses such as Haresfoot Clover *[Trifolium arevense],* Wild Oats *[Avena* sp.*]* and Saffron Thistle may also be present.

The UC report concludes "Planning should take into account the national significance of the population and environmentally sensitive planning should take place in order to conserve the species at this location. Important considerations include appropriate positioning of future roads and careful planning of the location of other infrastructure and utilities so as not to impact on the population. Habitat areas protected for the species should contain appropriate buffer zones. Protection of the existing population and the habitat of the species will serve to fulfil legislative requirements for protecting the Pink-tailed Worm Lizard, whilst also providing broader environmental benefits and an ecological benefit for other species and communities that exist in the Molonglo River Corridor".

1.2.2 EPBC Approval.

The Commonwealth Department of Sustainability, Environment, Water and Population on the 28th September 2009 determined, pursuant to the *Environmental Protection & Biodiversity Conservation Act 1999 [EPBC Act]* that the Coombs Estate *EPBC* referral was not a controlled activity, subject to a number of conditions.

On the 16th April 2010, the Commonwealth Department of Sustainability, Environment, Water and Population, at ACTPLA's request, amended the original approval and downgraded the potential Aprasia Habitat located on the ridge in Coombs to low quality.

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Item 8.2 of the amended decision [16th April 2010] directly relates to the fire management of the potential PTWL Habitats and states that any fire, biomass management or fuel reduction required as a result of the action within 20 metres of moderate and high quality habitat will be conducted in an ecologically sympathetic manner with the conservation of Pink-tailed Worm Lizard. Grazing can only be used as a management technique when it is undertaken in accordance with expert advice.

1.2.3 Management of Native Grasslands in the ACT.

As native grass dominates PTWL Habitats, the *ACT Lowland Native Grassland Conservation Strategy* can be used as a guide to inform the management of the native grasses within the PTWL Habitat

The *ACT Lowland Native Grassland Conservation Strategy* builds on more than ten years of survey, monitoring, research, conservation planning and management in relation to lowland native grasslands in the ACT with Section 3.7.2 – Key Aspects of Best Practice Management of Native Grassland identifying the need for active management and monitoring.

The Strategy states "It is widely accepted that natural temperate grasslands need appropriate disturbance as part of a specific management regime.

The main type of disturbance needed for management is highlighted in a 'model' of *Themeda triandra* dominated natural temperate grassland, developed by Lunt and Morgan [2002]. Under the model, the key disturbance required is managing the biomass of the dominant grass [e.g. by burning, mowing/slashing and/or grazing] to maintain its health and retain a high diversity of forb species [Lunt and Morgan]".

"Activities that should generally be avoided in conservation based disturbance of grassland include ploughing, earthworks that alter drainage patterns, clearing, rock removal, cultivation, pasture improvement, adding fertilizer, excessive livestock grazing, topsoil removal and stockpiling, dumping or spreading soil [Eddy 2002; Wildlife Research Unit 1994; Sharp and Rehwinkel 1998]".

Section 3.7.4 of the *ACT Lowland Native Grassland Conservation Strategy* expands on the management of native grassland and states that "some form of defoliation is essential to maintaining the structure and botanical composition of most native grasslands *[Eddy 2002].* Without regular removal of some herbage, excess grass will accumulate and die and can inhibit the growth of many plant species in the sward".

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“Inter-tussock forbs are particularly affected; however there may also be loss of vigour of dominant grasses e.g. Kangaroo Grass. Kangaroo Grass or *Poa* tussock will need more intensive treatment than areas of poorer soils carrying spear and wallaby grasses which have much less biomass and shorter life spans”.

Grazing:

“In designing a suitable grazing management regime, the timing, selectivity, intensity and duration of grazing need consideration *[Eddy 2002].*

- *Timing:* Native grassland must be allowed to grow freely enough to replenish root reserves, flower and set seed. During flowering and seed production [mainly in late spring/early summer] grazing should be light or completely removed;

- *Selectivity:* Higher stocking for a shorter period can reduce selectivity;

- *Intensity & duration:* Stock should be removed when quantity becomes too low to maintain livestock condition.

Mowing & Slashing:

“Any mowing/slashing regime should allow for periods of good plant growth between each mowing and permit the grassland species to flower and set seed at least every few years.

Grassland should not be mowed when significant plant species are flowering or setting seed, or when animals likely to be harmed by mowing are active and depend on the vegetation for shelter or food”.

- *Season/Height prescriptions:* Minimum height of 100mm above the ground and mowing is restricted to no more than once or twice in any 12 month period.

Burning:

“Fire has been an integral part of the evolution of native grasslands and is used as a management tool to maintain biodiversity in *Themeda triandra* grasslands”

“If burning is to be used as a management tool, similar considerations apply as for other means of defoliation:

- *Timing:* Fires should be timed to allow grassland species to flower and set seed. Eddy [2002] suggests burning between the end of seed set [mid to late summer] and when the plants begin to produce flowers in spring;

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- *Intensity:* Hot, dry summer conditions and a large dry grass biomass can result in fires that are too hot. Fires should only be lit when soil is reasonably moist and temperature and wind conditions will enable the fire to be kept under control *[Eddy 2002];*

- *Frequency:* Fires should be carried out only as often as is needed to reduce excessive biomass. In the ACT a burn frequency of once every two to three years has been recommended but on low productivity sites may never or only occasionally be necessary *[Eddy];*

- *Fauna impacts:* Fire can threaten small native fauna. For this reason, patch burning is recommended *[Eddy].*

1.2.4 Current ACT Fire Management Practices for PTWL.

The ACT Parks Conservation and Lands provide the following guidelines on how to manage Pink-tailed Worm habitat whilst undertaking operations such as burning, slashing, grazing and physical removal of bushfire hazards:

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Pink Tailed Worm Lizard *(Aprasia parapulchella)*
Fuel and Fire Suppression Guidelines

(NB. In managing for good conservation outcomes, it is important to consider the ecosystem as a whole, including animals, plants, soil and soil biota, rather than thinking in terms of individual species. Disturbance to the composition or structure of the community can have impacts on the functioning of the system as a whole.)

Description
The Pink-tailed Worm Lizard is about 24 cm long with a maximum snout–vent length of about 14 cm (Jones 1992, in ACT Government 2007). The species has a dark brown to black head region and a grey to grey-brown body, becoming pink or reddish-brown beneath the tail. The body appears to have faint longitudinal lines on the upper surface because of the presence of a dark dot or longitudinal bar at the centre of each scale (Osborne and Jones 1995, in ACT Government 2007).

At most sites the Pink-tailed Worm Lizard is found sheltering beneath partially embedded rocks, thus, rocks are an important microhabitat feature for the species. Disturbance to the ground layer (particularly removal of rocks and weed infestations) remains a threat to the lizard. Livestock grazing and agricultural activities (e.g. pasture improvement, cropping) have had the greatest impact on populations of the species and their habitat through ground disturbance and changes to groundcover vegetation.

Legal Status: Vulnerable (ACT); Vulnerable (Cwlth)

Appropriate inter-fire interval if known:

Activity	**Potential impact (H=high; M=moderate; L=low; C=conditional)**	**Comments**
Low intensity fire	MC	Burning must be patchy with a low intensity mosaic over the area and no more than 70% of the area burnt. Vegetation around rocky outcrops not to be burnt.
High intensity fire	H	
Slashing	MC	Do not disturb surface rocks during the process. Do not slash below 10cm.
Physical and mechanical removal of naturally occurring shrubs, trees or ground layer plants	MC	Do not disturb surface rocks. Ground layer should not be disturbed and original structure and composition of the habitat should be preserved.
Tree and limb removal	MC	Do not disturb surface rocks during the process.
Rock picking & surface reshaping	H	This will impact directly on Pink-tailed Worm Lizard habitat.
Herbicide application	MC	No broad application – only species specific spot spraying and cut/paint methods for shrubs and trees.
Livestock grazing	MC	Grazing has impacted on Pink-tailed Worm Lizard in the past. Grazing should only be undertaken under strict conditions and after consultation with Research and Planning. Timing and intensity of grazing is important

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		and should be monitored. If grazing is impacting adversely on the habitat (rocks or vegetation composition), stock should be removed. Do not graze tussock levels below 20cm height as it is important to maintain tussock structure and inter-tussock spaces.
Use of fire suppression chemicals – fire retardant (high in phosphorous)	H	Increasing phosphorous is likely to increase weed infestation. The Pink-tailed Worm Lizard is usually associated with native grass species and does not tolerate weed infestations.
Use of fire suppression agents – fire-fighting foam (wetting agent)	H	Use of foam has been shown to have adverse effects on plants and may lead to plant damage and a decrease in species richness. The Pink-tailed Worm Lizard is usually associated with native grass species and does not tolerate weed infestations.
Being driven over by vehicles or trampled by people	MC	Surface rock is not to be disturbed.
Minor soil disturbance by hand tools (e.g. rakes)	MC	Soil disturbance only if absolutely necessary and with limited extent (e.g. fire break). Surface rocks are not to be disturbed.
Major soil disturbance (e.g. dozer/backhoe line)	H	This will impact adversely on the habitat.
Aerial water bombing (up to 1500kg of water from 100m up)	MC	As long as this practice does not cause adverse impacts on the lizard's habitat (e.g. rocks, grasses, soil).
Other – please add any other.		Disturbance of habitat can threaten this species. Any activity that dislodges surface rocks or may lead to a potential decrease in native grass cover or introduction of weed species must be avoided.

References

ACT Government 2007. *Ribbons of Life: ACT Aquatic Species and Riparian Zone Conservation Strategy*. Action Plan No. 29. Department of Territory and Municipal Services, Canberra

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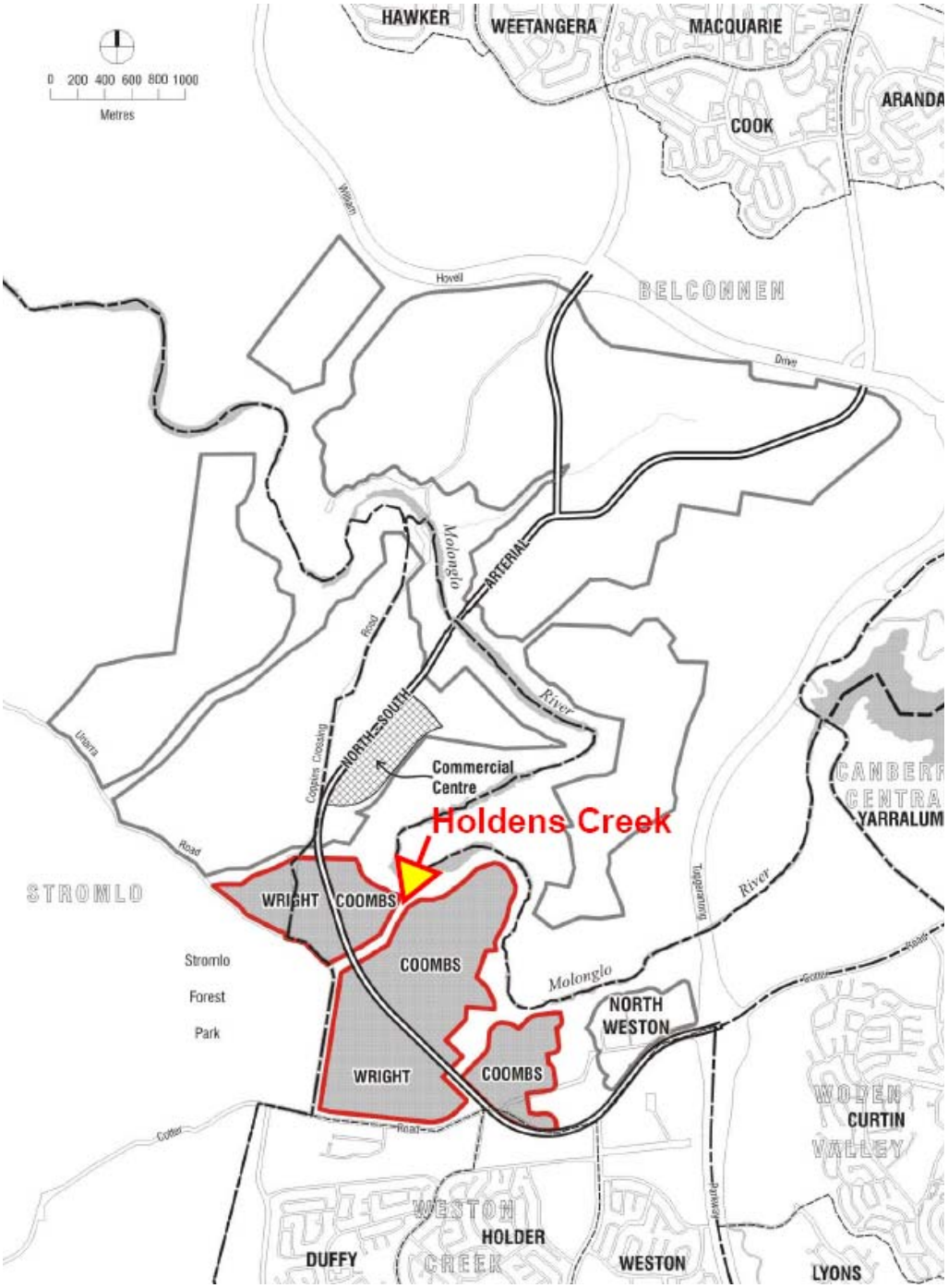
SECTION 2
DESCRIPTION OF THE COOMBS STUDY AREA

2.1 Location.

The proposed suburb of Coombs is situated in the south-eastern corner of Molonglo, north from Cotter Road, west of North Weston and south of the Molonglo River, northeast of the proposed north/south arterial. The northern extremity of the site examined in this risk assessment is Holdens Creek.

Figure 1 - Location of the Coombs development precinct.



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2.2 Existing Land Use.

The Coombs development precinct contains former Forestry ACT land, which contained prior to the 2003 bushfires, the Stromlo Radiata Pine Forest. The northern portion of the Coombs development precinct consists of former grazing land.

2.3 Surrounding Land Use.

a) North

The land to the northwest of the Coombs development precinct, beyond Holdens Creek, forms the northern portion of the future suburbs of Coombs and Wright. This land is currently being managed by TAMS.

b) Northeast & east

The land to the northeast of the Coombs development precinct consists of the Molonglo River corridor. The land to the east of the southern portion of the precinct consists of vacant land within the North Western development precinct. This precinct is proposed for residential development.

c) South

The Cotter Road carriageway extends along the southern boundary of the Coombs development precinct. Open Space land extends to the east of the Stromlo Village precinct, through to Weston Creek and Streeton Drive.

d) Southwest

The proposed north/south arterial road link forms the south-western boundary of the Coombs precinct. The new suburb of Wright occupies the land beyond the arterial road.

2.4 Topography.

2.4.1 Within the Development Precinct.

The Coombs development precinct contains two ridgelines which extend from within the Wright development precinct in a northeast direction towards the Molonglo River. The sides of the southern ridgeline slope to the southeast towards Weston Creek and to the northwest into a gully line between the southern and northern ridgeline. The southern face of the northern ridgeline falls to the southeast into the latter gully line whilst the north face falls into Holdens Creek.

The gradient of the ridgelines increases as they progress to the northeast towards the river corridor.

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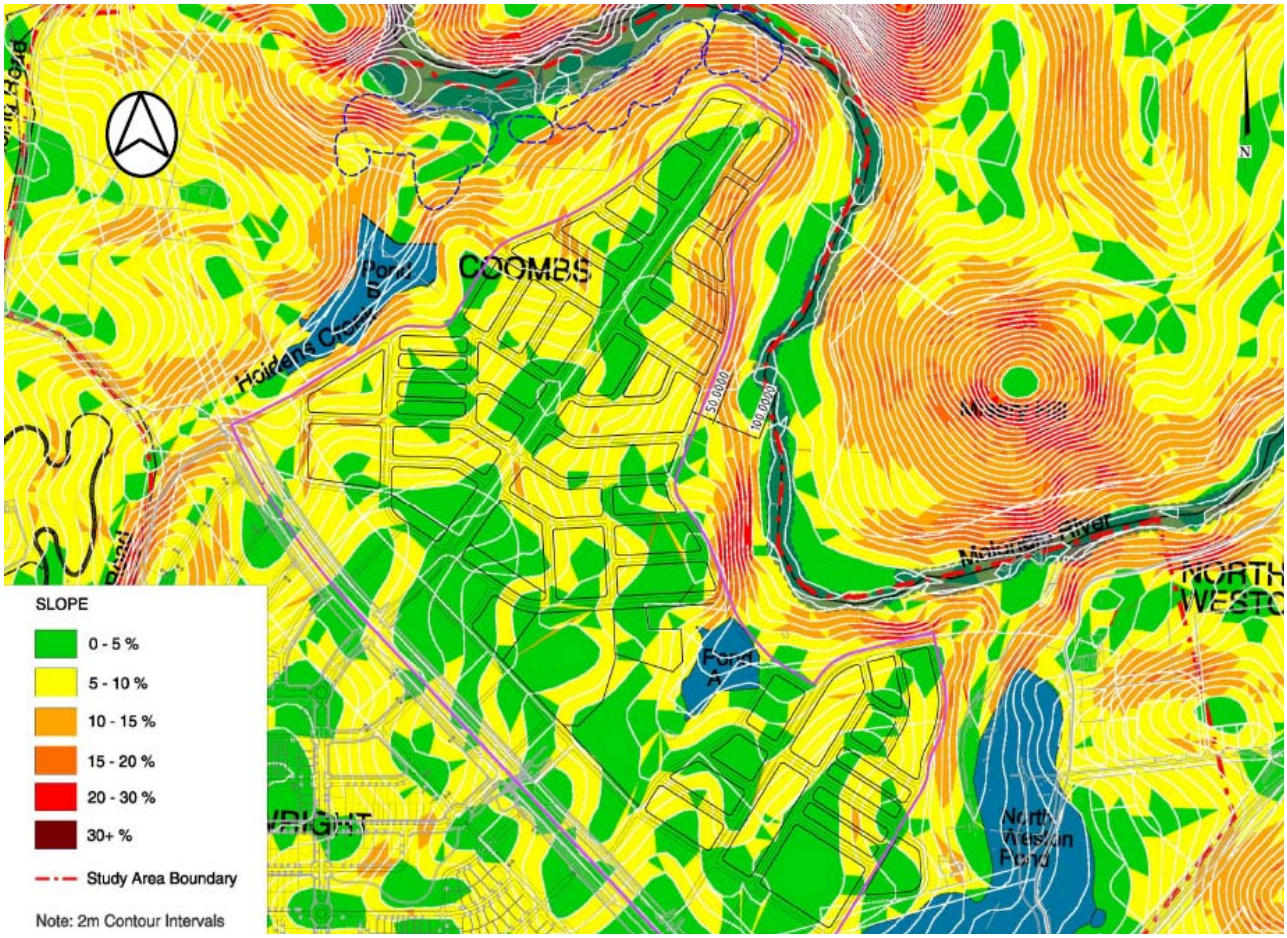
2.4.2 Beyond the Development Precinct.

The land to the north of the development precinct, within the northern portion of the Coombs/Wright precinct, rises to the northwest beyond the Holdens Creek corridor.

Land to the northeast of the Coombs development precinct, within the Molonglo River corridor forms the steep, rocky side of the river. Gradients exceed 20% in most locations, with slopes in excess of 30% common.

The land to the south of the Coombs development precinct falls to the south towards the suburb of Holder into a watercourse that flows to the east into Weston Creek. The land to the southwest, within the new suburb of Wright, rises to the southwest to a low knoll at 595 metres, adjacent to Uriarra Road, before falling to the northwest towards Holdens Creek, rising to the west and northwest towards the foot-slopes of Stromlo Mountain.

Figure 2 – Topographic Map.



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2.5 Vegetation within the Development Precinct.

The vegetation within the ACT Forests section of the development precinct consists of regrowth Pinus Radiata, weeds and grass whilst the former grazing land within the northern portion of the development precinct contains grassland which is still being grazed.

2.6 Vegetation on adjoining lands.

(a) Northwest [within the future suburb of Coombs & Wright North]

At the time of the site inspection the vegetation to the northwest of the Coombs development precinct, north from Holdens Creek, consisted of grassland whilst the vegetation within the future suburb of Coombs/Wright consisted partly of grazed grassland and partly regrowth Pinus Radiata, weeds and grass.

(b) South [Open Space between Holder & Cotter Road]

The Open Space to the east of Stromlo Village contains an area of vegetation replanting which includes a number of tree species.

(c) Southwest [within the suburb of Wright]

The suburb of Wright presently contains grassland and regrowth Pinus Radiata and weeds. This vegetation will be removed/modified as part of the development of this suburb.

(c) Northeast [within the Molonglo River corridor]

At the time of the site inspection the eastern portion of the Molonglo River corridor, being that part of the corridor previously forming part of the Stromlo Forest, contained a mixture of River Sheoak, remnant woodland species and introduced species such as Willow, Liquid Amber and Flame Trees with a dense weedy understorey. That part of the corridor which was part of the former grazing lease contains pockets of River Sheoak on the floodplain of the river with woodland being the dominant species on the steeper land.

The former grazing land contains grasses and the river corridor is relatively free of the introduced species found in the corridor to the south.

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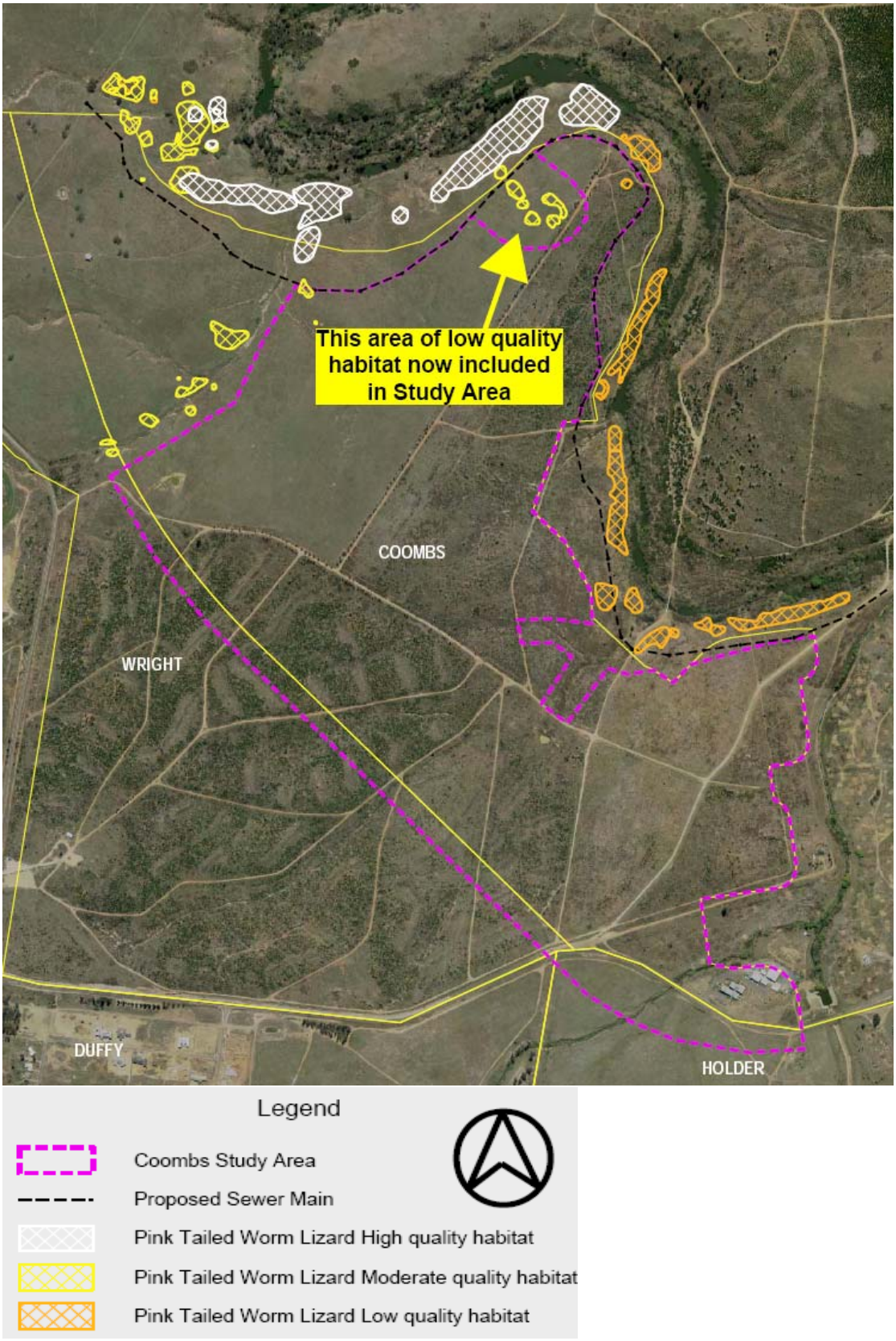
Figure 3 – Plan of Coombs and the Pink Tailed Worm Lizard Habitat - prepared by the University of Canberra [July 2009] for the proposed Molonglo Trunk Sewer.



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Note:
The *'Assessment of Pink-tailed worm lizard [Aprasia parapulchella] habitat'* prepared by the University of Canberra [July 2009] for the proposed Molonglo Trunk Sewer, reports:

'A large, and regionally important, population of Pink-tailed Worm-lizards occurs in the Molonglo Valley from near Western Creek to the confluence with the Murrumbidgee River. Much of the better habitat forms an important wildlife corridor along the southern and northern slopes of the Molonglo River'.

The indent in the north-western edge of Coombs represents an area of medium PTWL Habitat which was originally excluded from development as a result of the UC Assessment for the Trunk Sewer. This area has been downgraded to low value habitat and is now included as part of the urban area.

The *Molonglo Riparian Strategy* for Coombs & North Weston has also identified the extent of areas in the river corridor which are recommended for rehabilitation and re-vegetation as a habitat / riparian corridor. This rehabilitation intends to remove weeds and introduced species and to replant with River Sheoak and woodland/forest in order to replicate the original river corridor vegetation.

Figure 4 – Landuse Diagram provides the extent of the river corridor and its' relationship to the adjoining suburb.

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Figure 4 – Wright/Coombs Master Plan [December 2009] showing extent of the Molonglo River open space corridor.

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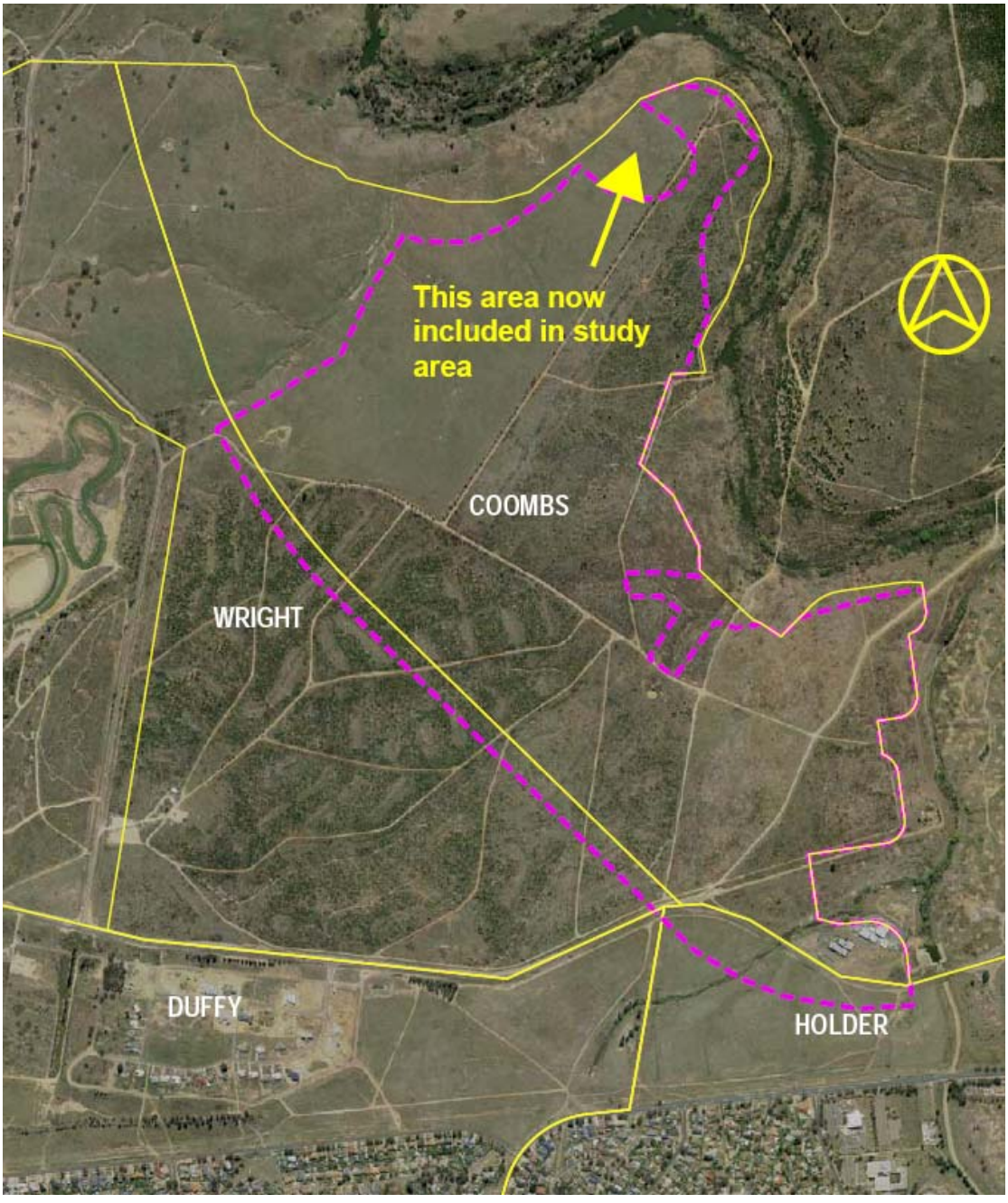
Figure 5 – Aerial Photograph of Coombs development precinct and surrounding lands.



Legend

Coombs Study Area

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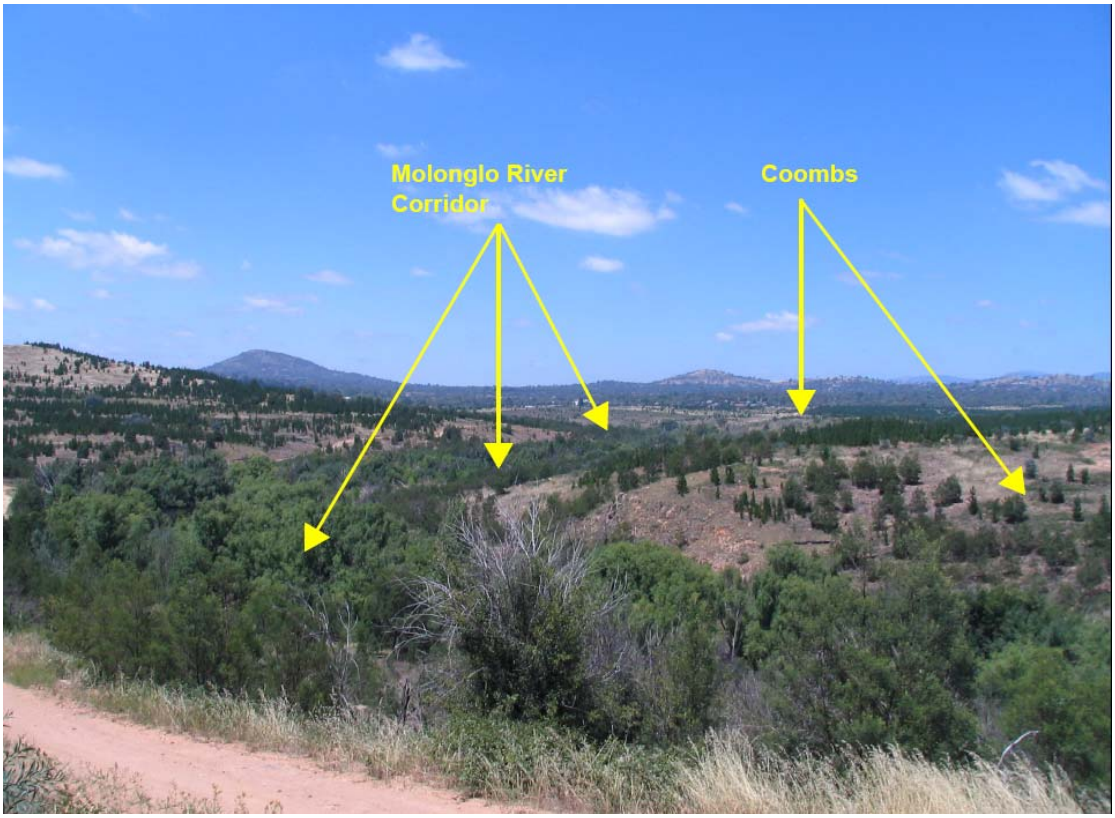
2.7 Site Photographs

Photograph No. 1 - Photograph taken from Misery Point looking southwest across Coombs to Wright – Narrabundah Hill in the background.



Photograph No. 2 - Photograph taken from the fire trail south of Misery Point looking southeast along the Molonglo River corridor.

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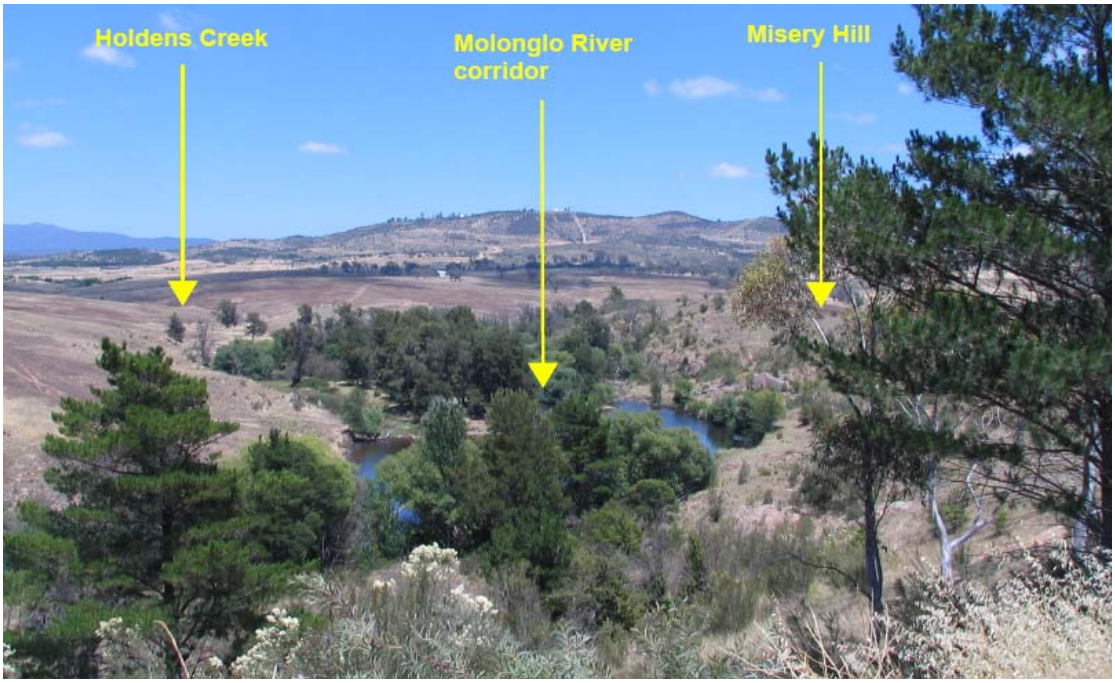
Photograph No. 3 - Photograph taken from fire trail south of Misery Point looking southwest across the Molonglo River corridor to the northern ridgeline within the Coombs development precinct – Narrabundah Hill is in the background.



Photograph No. 4 - Photograph taken from fire trail south of Misery Point looking southwest across the Molonglo River corridor to the northern ridgeline within the Coombs development precinct – Mt Stromlo is in the background.

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SECTION 3
REVIEW OF BUSHFIRE RISK ASSESSMENT

3.1 Introduction.

The Bushfire Risk Assessment undertaken by ABPP in April 2010 examined the various matters which assist in the determination of bushfire risk to future development within the new suburb of Coombs. A precise of this assessment is provided in Sections 3.2 – 3.6.

Note: The indent in the north-western edge of Coombs represents an area of medium PTWL Habitat which was originally excluded from development. This area has now been downgraded to low value habitat and is now included as part of the urban area.

3.2 Fire Paths.

The land within the river corridor, southeast from the northern ridgeline, forms the steep, rocky embankment to the River. Gradients increase to more than 25% on the steeper sections of the corridor, decreasing as the corridor turns to the northeast where it meets Weston Creek. The upslope fire path along the river, under north-westerly winds influences, will also be affected by the wind turbulence created by the shape of the river.

Figure 5 – Severe Weather Fire Paths – Northwest.

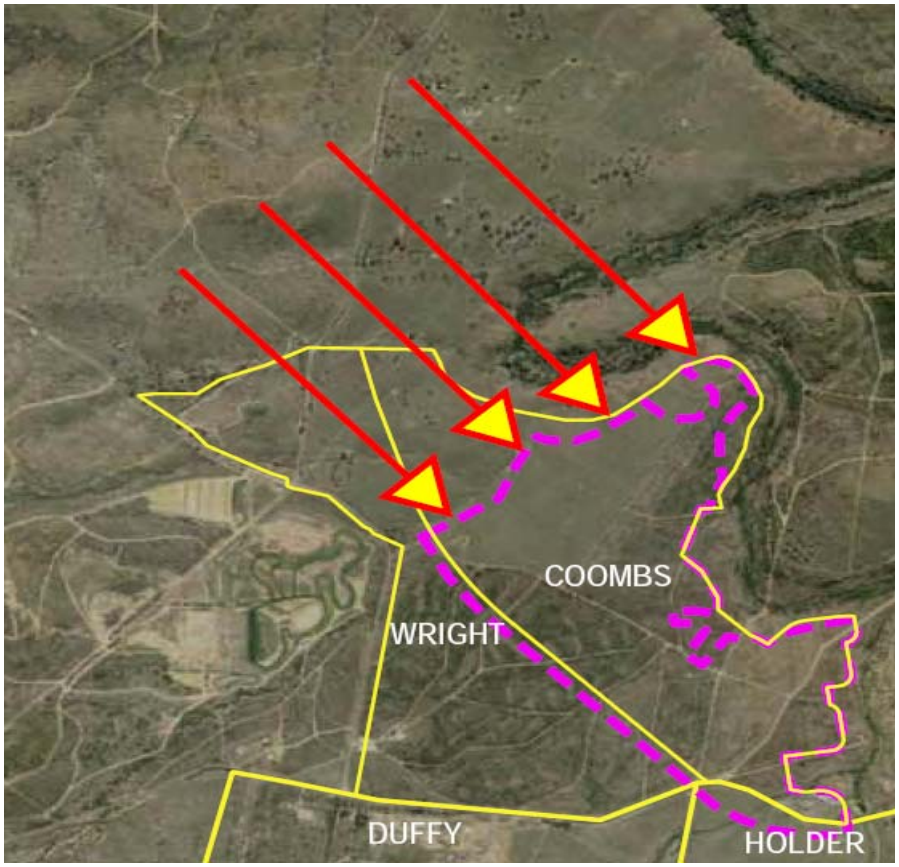

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Figure 6 – Severe Weather Fire Paths – West.

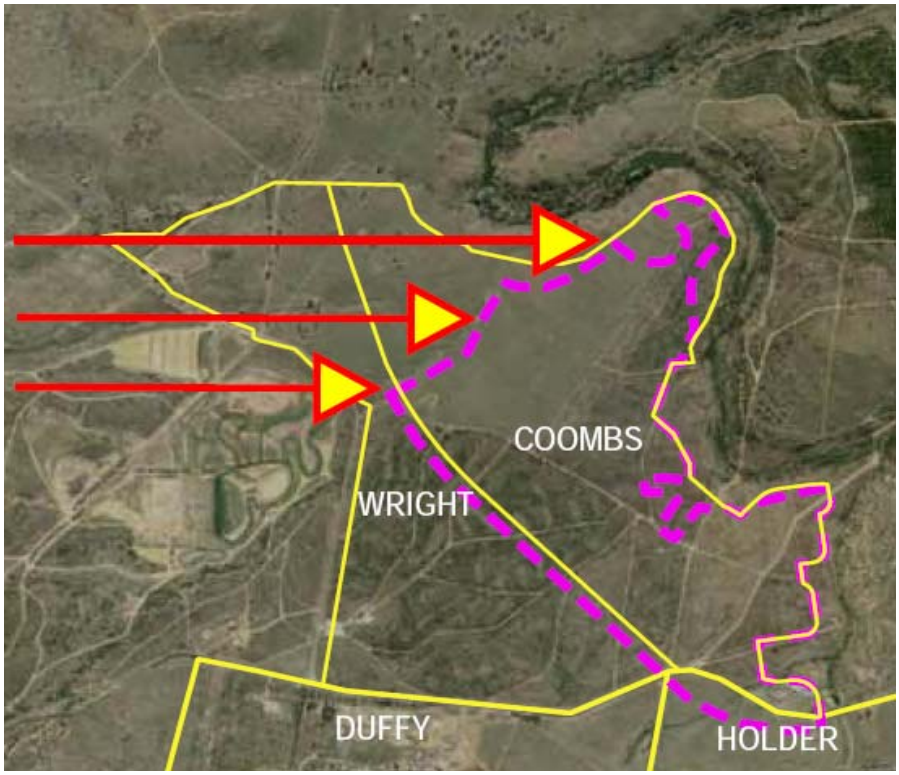

Figure 7 – Severe Weather Fire Paths – North.

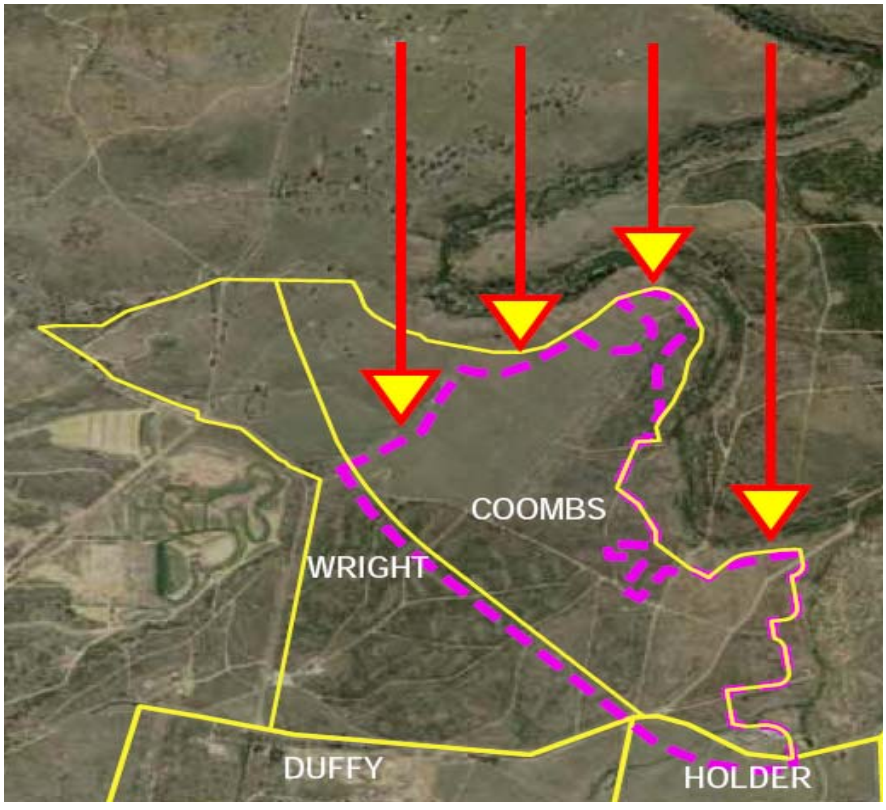

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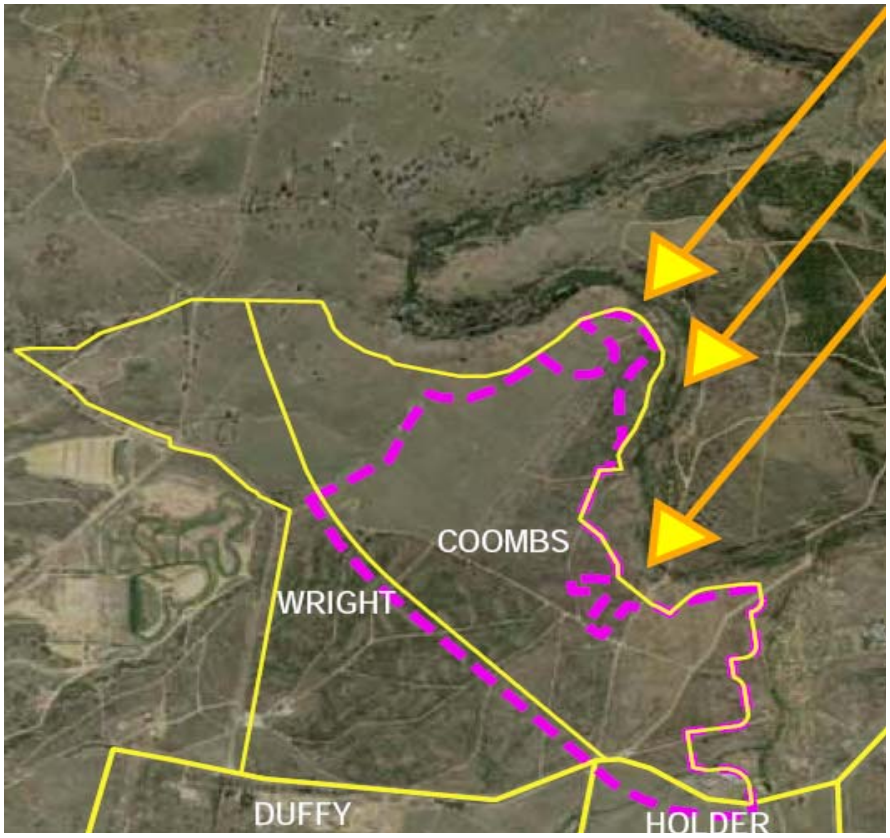
Figure 8 – Moderate Weather Fire Paths – Northeast.



3.3 Assessment of Fuel Hazard.

An overall Fuel Hazard for vegetation within the grazing land to the north, the 'woodland/forest' vegetation within the Molonglo River corridor to the northeast can be determined, from an assessment of the contributing fuel hazards.

The predominant vegetation that will create the most significant fire impact on the Coombs development precinct will be the grassland / woodland vegetation on the land to the north and the woodland/forest vegetation in the riparian corridor to the Molonglo River.

3.3.1 *Forest/Woodland vegetation within the riparian corridor to the Molonglo River.*

Using the methodology provided within the NRE Overall Fuel Hazard Guide, the following Fuel Hazard observation was determined for the Forest/Woodland vegetation in the riparian corridor to the Molonglo River.

- ***Bark Hazard*** **:**

The Forest/Woodland vegetation in the rehabilitated riparian corridor will include planted Eucalypt species some of which have a smooth trunk and long ribbons of bark into the crown of the tree. Therefore this vegetation has a High Bark hazard.

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- ***Elevated Fuel Hazard*** **:**

Elevated fuel comprises shrub, heath and suspended material. The level of hazard depends on the fuel continuity (horizontal and vertical), height, and proportion of dead material, thickness of the foliage and twigs and flammability of the live foliage.

The flammability of the elevated fuel is highest when:

- The foliage, twigs and other fuel particles are very fine (e.g. maximum thickness 1-2 mm);
- The proportion of dead material is high;
- The fuels are arranged with a high level of density and horizontal and vertical continuity that promotes the spread of flame;
- The live foliage has low, live fuel moisture content.

The vegetation type and time lapse since the most recent fire substantially determines the level of elevated fuel hazard. An estimated Elevated Fuel Hazard of Very High is likely to occur in the river corridor as part of the rehabilitation process.

- ***Surface Fine Fuel Hazard*** **:**

Surface Fine Fuel Hazard is assessed by measuring litter-bed height. Near surface fuels – i.e. grass tussocks, dead bracken, low shrubs or low wiregrass up to 0.5m high – interact with surface litter to increase fire behaviour and therefore need to be considered when assessing Surface Fine Fuel Hazard and the next highest Surface Fine Fuel Hazard rating.

Due to the extent of the 'near-surface fuels' component of this vegetation an estimated Surface Fine Fuel Hazard of High was determined for this vegetation.

Assessment of Overall Fuel Hazard – Forest/Open Woodland Vegetation:

The Overall Fuel Hazard for the Forest/Woodland vegetation within the river corridor [without management] is Very High.

3.4 Asset Interface Classification [AIC].

The ACT ESA & Rural Fire Service have developed a methodology for determining the classification of potential exposure of the urban edge to severe bushfires and introduces Asset Interface Classification [AIC], which is defined as the boundary between an asset and the bushfire paths that approach it. It is determined by an assessment of:

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- The maximum fire size an asset may be subject to;
- The part of the fire [head, flank, back] an asset maybe subject to recognizing the major fire threat from the north and west;
- The fire run length criteria and the length of fire run.

The following table provides an Asset Interface Classification [AIC], at a broader scale for the urban edge of Canberra;

Table 1: Asset Interface Classification

	Length of Fire Run to Asset Interface (through unmanaged vegetation)		
Aspect of Fire Run	<100	100 – 350	>350
N	**Secondary**	**Primary**	**Primary**
NW	**Secondary**	**Primary**	**Primary**
W	**Secondary**	**Primary**	**Primary**
SW	**Lee**	**Secondary**	**Primary**
S	**Lee**	**Secondary**	**Secondary**
SE	**Lee**	**Lee**	**Lee**
E	**Lee**	**Lee**	**Secondary**
NE	**Lee**	**Lee**	**Secondary**

An examination of the Asset Interface Classification at a precinct level for the Coombs estate identifies that the northern, north-western and western aspects of the development precinct have a primary classification – based on the vegetation in the Stromlo Forest Park, the Open grassy Woodland vegetation on the land to the northwest of Holdens Creek and the Woodland vegetation within the Molonglo River corridor not being managed, in order to reduce the fuel hazard.

The AIC to the north-eastern aspect of Coombs is secondary – based on potential unmanaged vegetation on the land to the northeast of the river corridor whilst the AIC to the south, from the vegetation in the corridor between Cotter Road and Holder, if the vegetation is not managed, is 'Secondary'.

3.5 Likely Fire Scenarios.

The following fire scenarios have been identified as a probability for impact on the development site:

Fire Scenario No. 1:

A fire in the open grassy woodland vegetation on the former leased land to the northwest of the development precinct and northwest of Holdens Creek, spreading under north-westerly winds towards the northern edge of Coombs. This potential fire impact will remain if the current management practices are removed or are not effective during periods of growth in the grass/woodland vegetation.

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This fire occurrence is likely during consecutive fire seasons when conditions are such that the grassland vegetation has not been grazed/managed and the Fire Danger Index is Extreme (FDI > 50);

Fire Scenario No. 2:

A fire in the Forest/Woodland vegetation within the Stromlo Forest Park to the west of the suburb of Wright, spreading across Uriarra Road and the Holdens Creek corridor towards the north-western edge of Wright and Coombs.

This potential fire impact will remain so long as the Stromlo Forest Park development project does not proceed to the extent as shown on the Master Plan. The risk remains that the management of re-vegetation of the Stromlo Forest Park will not address the provision of a fuel managed vegetation community to the west and northwest of the new suburb of Wright and with a resulting impact on the north-western corner of Coombs.

Should the Stromlo Forest Park not be managed to mitigate the potential fire paths from the west and northwest, the potential for fire impact on the north-western corner of Wright, spreading into the Holdens Creek corridor towards Coombs is almost certain during any fire season when conditions are such that fine fuel levels are allowed to exceed maximum fuel weights for manageable fires and the FDI extends 50. The inter-fire period for major fire occurrence would be 5 - 8 years, depending on fuel management intervals and potential ignition sources of the fuel.

Fire Scenario No. 3:

A fire in the Forest/Woodland in the Molonglo River riparian corridor / PTWL Habitat spreading along the river to the southeast, under a north-westerly wind influence.

This potential fire impact will remain so long as the chance exists that ignition can occur in the area of Misery Point [& further to the north], spread by ember attack to the southern bank of the bend in the river, running upslope to the development edge as it progresses towards Weston Creek and North Weston. This fire will also spread through any unmanaged vegetation on the north-eastern side of the river towards the Australian Defence College and Tuggeranong Parkway.

Fire Scenario No. 4:

A fire occurrence in the unmanaged re-growth Pinus Radiata forest to the northeast of the Molonglo River corridor, spreading under northeast wind influences towards the north-eastern edge of the new suburb of Coombs.

This fire scenario will result in fire spreading downslope to the river. Should embers spread the fire across the river the fire will continue to spread rapidly upslope to the north-eastern edge of Coombs.

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This potential fire impact will remain so long as the land between the river corridor and the Arboretum remains unmanaged and/or undeveloped and weather conditions prevail where a fire can spread to the southwest under the influence of north-easterly winds.

Fire Scenario No. 5:

A fire occurrence in the vegetated corridor between Cotter Road and the suburb of Holder, east from Stromlo Village to Streeton Drive, spreading from the south under south-easterly winds.

This potential fire impact will remain if the vegetation in the corridor is not managed during the bushfire danger period and ignition occurs during wind changes to the southeast.

3.6 Risk Statement.

Table 2 provides a list of qualitative measures of consequence [or impact] whilst Table 3 provides a list of qualitative measures of likelihood – used to determine the level of risk in Table 5. Table 4 provides a qualitative risk analysis matrix – used to determine the level of risk in Table 5.

Table 5 provides a statement of risk for each fire scenario that may impact the Coombs estate [prior to mitigation measures being adopted/implemented] and assigns risk levels reflecting identified levels of likelihood and consequences for a 'worst case' fire occurrence which may occur if the vegetation on the land to the north, northwest, west and in the Molonglo River corridor were not managed to reduce the combustible fuels available to burn during severe fire weather conditions.

Table 2 – Qualitative Measures of Consequence or Impact.

Level	Descriptor	Detail Description
1	Insignificant	No public safety injuries or impact to buildings
2	Minor	No public safety injuries – minor impact to buildings
3	Moderate	Burns and Respiratory Issues – moderate damage to buildings
4	Major	Death of people exposed to radiant heat & major property damage
5	Catastrophic	Death of people exposed to radiant heat and total destruction of buildings

Table 3 – Qualitative Measures of Likelihood.

Level	Descriptor	Detail Description
A	Almost Certain	Is expected to occur during severe fire danger periods
B	Likely	Will probably occur during severe fire danger periods
C	Possible	May occur during severe fire danger periods
D	Unlikely	Unlikely to occur during severe fire danger periods
E	Rare	Will rarely occur during severe fire danger periods

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Table 4 – Qualitative risk analysis matrix.

Likelihood	Risk Rating				
	Consequences				
	Insignificant 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
A – almost certain	High	High	Extreme	Extreme	Extreme
B – likely	Moderate	High	High	Extreme	Extreme
C – possible	Low	Moderate	High	Extreme	Extreme
D – unlikely	Low	Low	Moderate	High	Extreme
E – rare	Low	Low	Moderate	High	High

Table 5 – Bushfire Risk Register – Severe Bushfire Event – if high levels of combustible fuels/unmanaged vegetation exist in the landscape.

The Risk What can happen? Fire Scenario:	The consequences of an event happening Consequences	Likelihood	Adequacy of existing protection measures	Consequence Rating	Likelihood Rating	Level of Risk	Risk Priority
(1) Fire burning in unmanaged open grassy woodland to the north of Coombs – under north-westerly wind influences	Catastrophic – long fire run through unmanaged vegetation	Almost Certain	Good when site inspection undertaken Nil if current fuel management is modified	5	A	Extreme	1
(2) Fire burning in the Woodland / Forest vegetation in the Stromlo Forest Park, to the west of Wright/Coombs – under NW, westerly winds	Catastrophic – long fire run through unmanaged vegetation	Almost Certain	No fuel management present at the time of site inspection	5	A	Extreme	1
(3) Fire burning in the Molonglo River corridor – under the influence of north-westerly winds	Catastrophic – long fire run through unmanaged vegetation	Almost Certain	No fuel management present in un-grazed section of corridor at time of site inspection	5	A	Extreme	1
(4) Fire burning in the re-growth Pinus Radiata Forest vegetation on the land to the northeast of Coombs – under NE winds	Major – long fire run through unmanaged vegetation	Likely	No fuel management present at the time of site inspection	4	B	Extreme	1
(5) Fire burning in the vegetation between Cotter Road and the suburb of Holder – under SE winds	Major – long fire run through unmanaged vegetation	Possible	In adequate fuel management present at time of site inspection	4	C	High	1

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3.7 Summary of Bushfire Risk.

Fire Scenario No. 1:

Fire ignitions that occur in the open grassy woodland vegetation on the land to the north of Holdens Creek, if the current management practices are removed, will place the northern edge of Coombs at extreme level of risk from a northerly and north-westerly wind driven fire.

[Whilst the south-westerly aspect of Coombs is currently exposed to unmanaged vegetation in the future suburb of Wright and therefore an extreme level of risk, the current development works associated with the construction of the arterial road reduces bushfire risk. The removal of the existing Pinus Radiata regrowth vegetation and development works within the suburb of Wright will remove the bushfire risk to the southwest of Coombs].

Fire Scenario No. 2:

The development and management of the Stromlo Forest Park is not certain, relative to the commencement of construction of dwellings within the new suburbs of Wright & Coombs, and therefore the risk assessment has determined that the risk to the north-western corner of Wright, and therefore Holdens Creek and Coombs, is extreme during a fire event which spreads through the re-growth forest vegetation on the land northwest of the northern edge of Wright and Coombs, under the influence of north-westerly winds.

Fire Scenario No. 3:

The incorporation of a vegetated habitat/riparian corridor within the Molonglo River corridor and the potential for this vegetation not to be managed to reduce the bushfire hazard provides a 'wick' for the passage of fire along the river corridor during strong north-westerly winds.

If ignition occurs, through ember attack or by accidental or deliberate acts, the risk to the future residents located in dwellings adjacent to the river corridor is extreme, with potential fire over-run from the corridor to the proposed residential and existing development in North Weston.

The future development of the suburbs to the north of Coombs will not reduce the level of risk from a fire occurrence in the river corridor as the chance exists that the vegetation along the river, north of Misery Point will create a fire with sufficient potential to spread rapidly, under north-westerly winds, across Misery Point and burn upslope, across the PTWL Habitat, towards the residential development in Coombs – this fire event would also continue to spread to the southeast, along the corridor, being influenced by the turbulence created by the shape of the river corridor.

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Fire Scenario No. 4:
The existence of the re-generating Pinus Radiata Forest on the land to the northeast of the river corridor, northeast of the new suburb of Coombs presents an extreme level of risk to the north-eastern edge of the suburb – should a fire burn towards the river from the northeast, under a north-easterly wind influence.

Should this fire event occur, the fires advance would be slowed by the downslope fire path to the river, however if ember ignition occurs on the south-western bank of the river, this fire event has the potential to burn rapidly upslope through any unmanaged vegetation adjoining the residential development.

Fire Scenario No. 5:
The vegetation on the land between Cotter Road and the suburb of Holder, south of the southern end of the new suburb of Coombs has sufficient width [> 350m] to be accessed as having a 'Primary' Asset Interface Classification [AIC].

However, this vegetation is 'land locked' and will only present a threat if ignition occurs during periods of south-easterly wind influences. The risk has been assessed as high should management of the vegetation not be sufficient to reduce the bushfire hazard in this corridor.

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SECTION 4

REVIEW OF BUSHFIRE MANAGEMENT OPTIONS FOR THE APRASIA HABITAT

4.1 Introduction.

The *Land Development Agency* has prepared three options for the layout of the proposed development of the north-eastern corner of the new suburb of Coombs, adjacent to the Aprasia [Pink-tailed Worm Lizard] Habitat confirmed by Wong & Osborne [University of Canberra 2010].

These options have been determined given the advice from the ESA that the required width of the bushfire protection zones required to address the bushfire risk to the north-western aspect of the suburb of Coombs is the provision of a 50 metre wide Inner Asset Protection Zone [IAPZ] with a 100 metre wide Outer Asset Protection Zone [OAPZ] – a total fire protection zone of 150 metres, measured from the north-western boundary of the future blocks.

The Ember Zone/Construction standards to the future buildings remain as recommended in the April 2010 *Bushfire Risk Assessment Report* prepared by ABPP.

Option 1 – Pink-tailed Worm Lizard habitat and the **20 metre wide habitat buffer zone excluded from bushfire protection measures.**

The Molonglo River corridor [including PTWL medium/high quality habitat and 20 metre wide habitat buffer zone] is not managed for bushfire fuel reduction and a minimum 150 metre wide bushfire protection zone [OAPZ + IAPZ] is provided between the buffer zone to the medium/high quality PTWL habitat and the future development [a total of 170 metre wide separation to the PTWL medium/high quality habitat.

Option 2 – Pink-tailed Worm Lizard medium/high quality habitat excluded from bushfire protection measures with the **20 metre wide buffer zone to the medium/high quality habitat included as part of the bushfire protection zone.**

The Molonglo River corridor [including PTWL medium/high quality habitat] is not managed for bushfire fuel reduction and a minimum 150 metre wide bushfire protection zone [OAPZ + IAPZ] is provided between the PTWL medium/high quality habitat and the future development [a total of 150 metre wide separation to the PTWL medium/high quality habitat.

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Option 3 – Pink-tailed Worm Lizard medium/high quality habitat **and the 20 metre wide habitat buffer zone to the medium/high quality habitat**, is included as part of the bushfire protection zone to the northwest of the future development.

The Molonglo River corridor is not managed for bushfire mitigation and a minimum 150 metre wide buffer [OAPZ + IAPZ] is provided to the northwest of the future development, including the buffer zone and PTWL medium/high quality habitat.

Refer to Option 1, 2 & 3 layouts on following pages.

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Figure 9 – Option 1 – Medium/High Quality habitat + the 20 metre wide buffer zone excluded from the 150 metre wide bushfire protection zone.

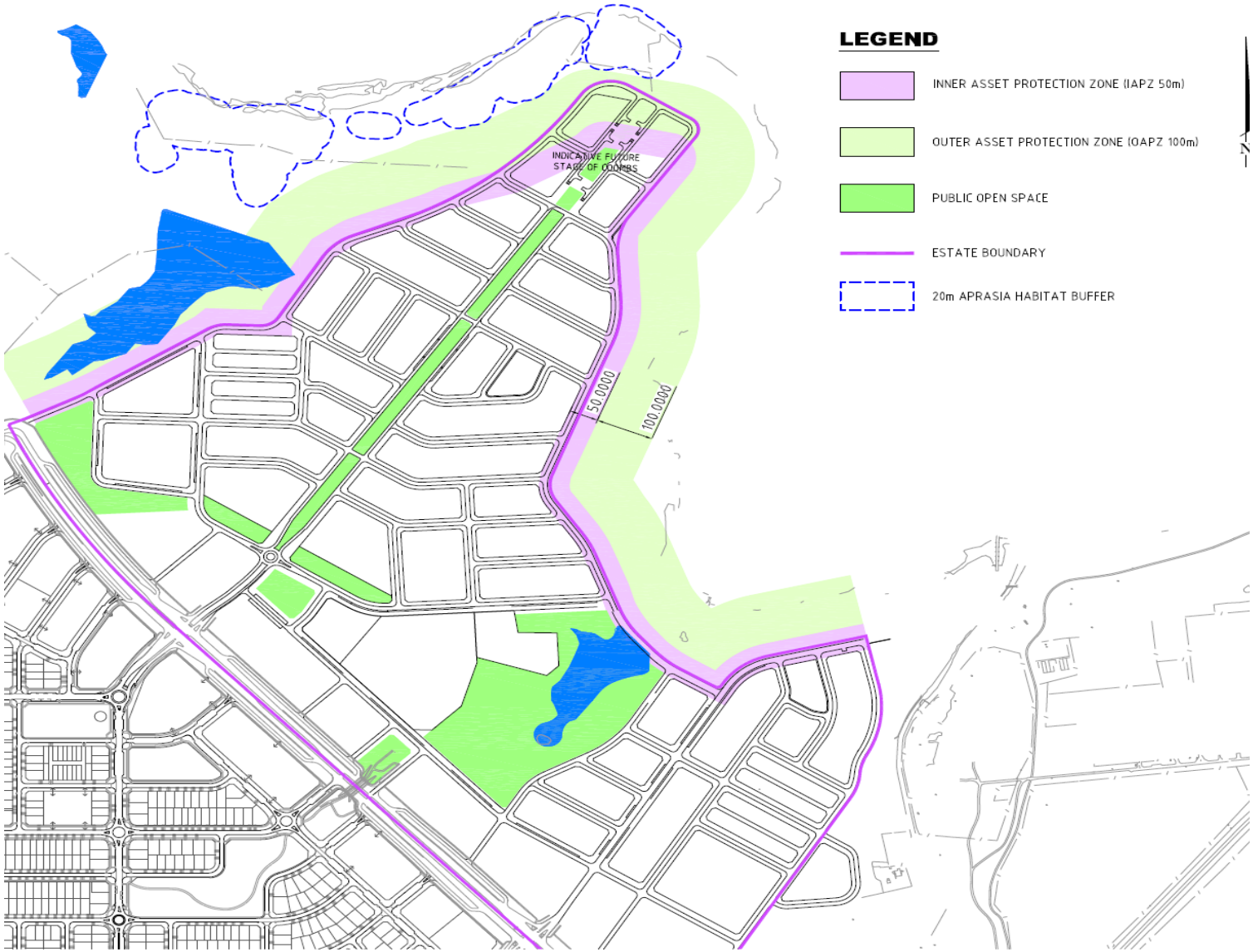

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Figure 10 – Option 2 – Medium/High quality habitat excluded from 150 metre wide bushfire protection zone – 20 metre wide buffer zone to medium/high quality habitat included in the bushfire protection zone

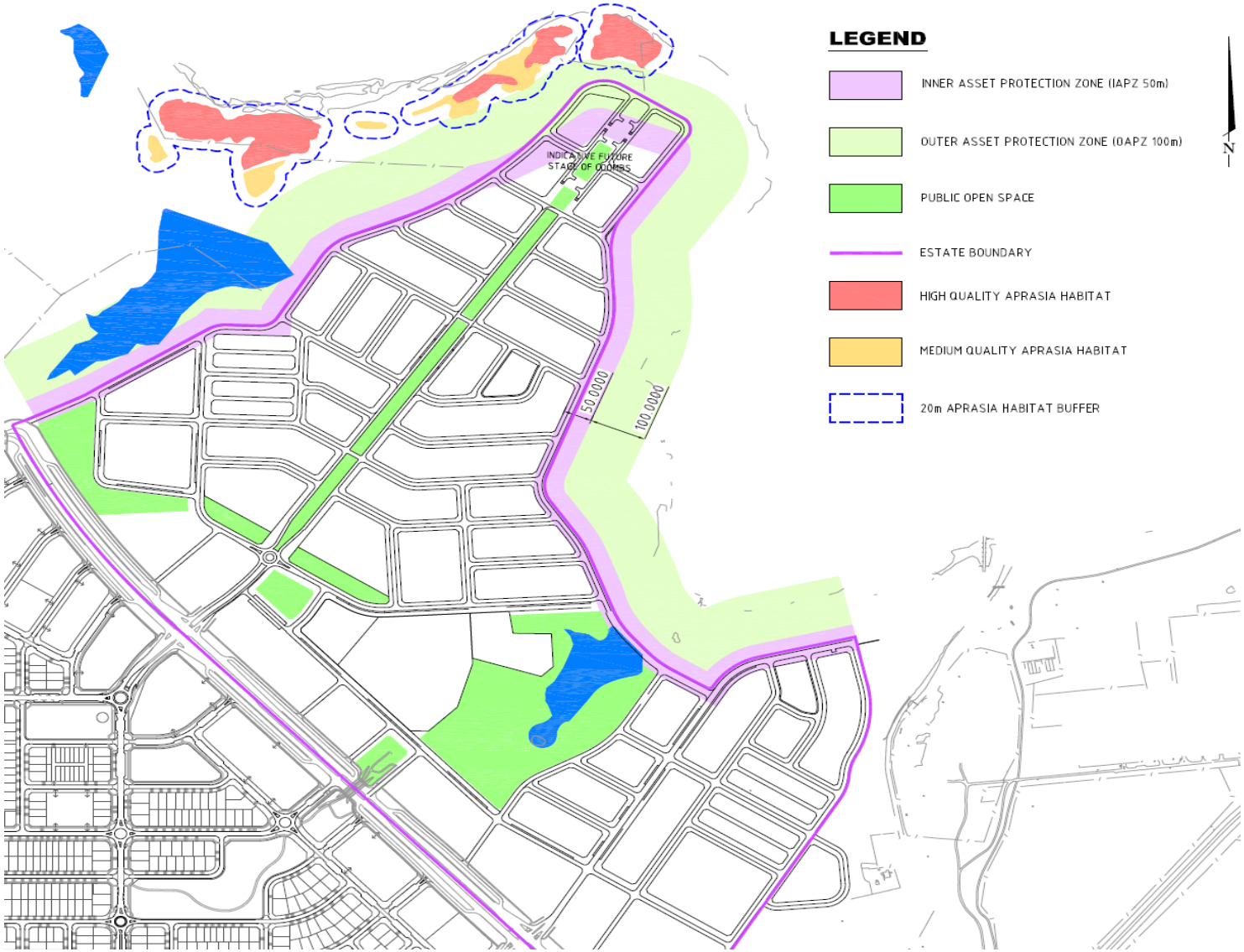

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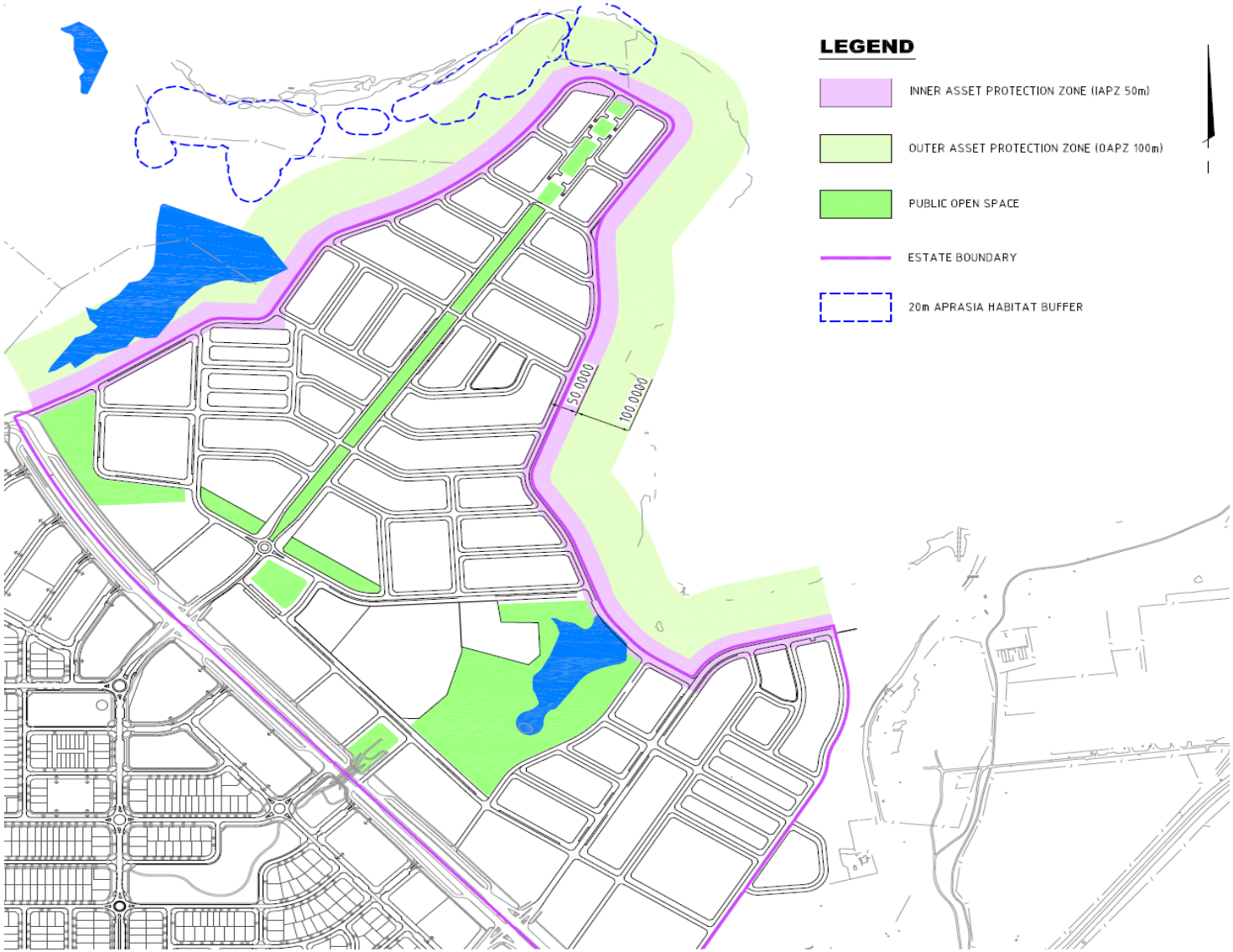
Figure 11 – Option 3 – The medium/high quality habitat & 20 metre wide habitat buffer zone included in the 150 metre wide bushfire protection zone.



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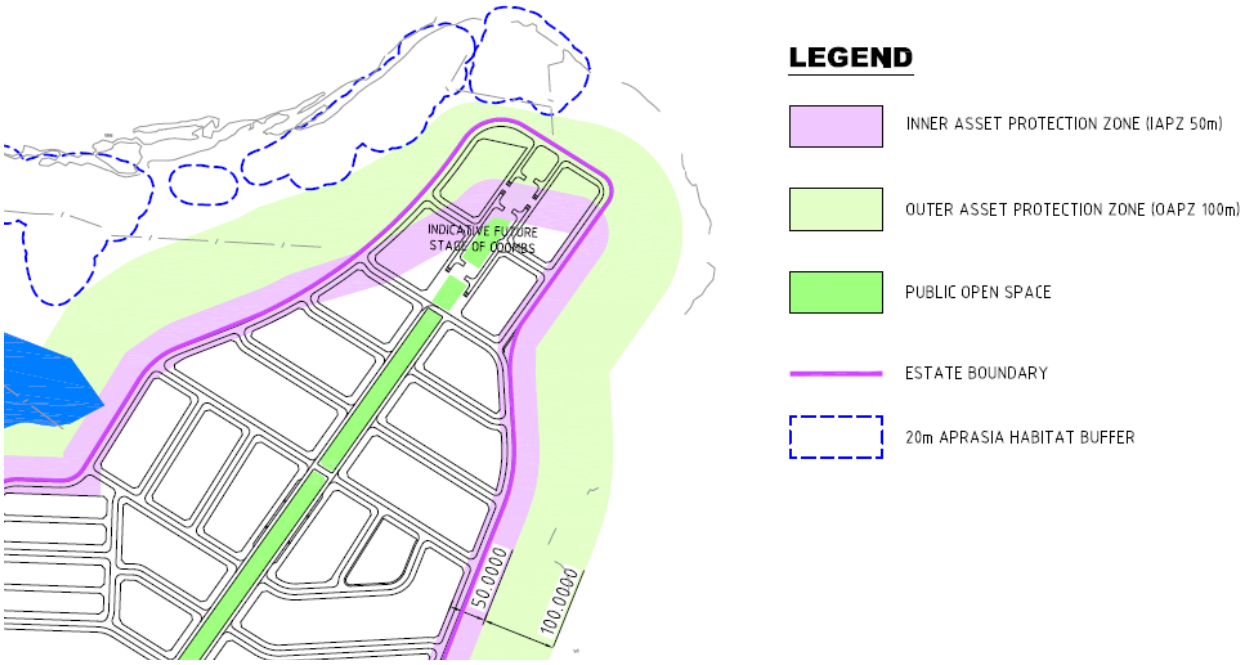
4.2 Review of Option 1 Layout.

The Option 1 layout removes future development from the north-eastern portion of the Coombs development precinct so that the requisite 150 metre wide Outer/Inner Asset Protection Zone can be achieved without impacting on the medium/high quality PTWL habitat and the 20 metre wide buffer zone.

Figure 12 – Option 1 Layout.



This option does not require bushfire fuels within the PTWL [Aprasia] Habitat and the buffer zone to be managed to provide the approved fire protection zones to the northwest of the future development. The Inner Asset Protection Zone [Purple] and Outer Asset Protection Zone [light green] can be managed to meet the specifications of the *Strategic Bushfire Management Plan for the ACT – 2009.*

This option substantially decreases the development yield while not achieving a reduction in the bushfire risk to the future development which remains constant at extreme due to the unmanaged vegetation in the Molonglo River corridor.

4.3 Review of Option 2 Layout.

The Option 2 layout removes future development from the north-eastern portion of the Coombs development precinct so that the requisite 150 metre wide Outer/Inner Asset Protection Zone can be achieved without impacting on the medium/high quality PTWL habitat. The 20 metre wide buffer zone to the medium/high quality PTWL Habitat is included in the management of the 100 metre wide Outer Asset Protection Zone

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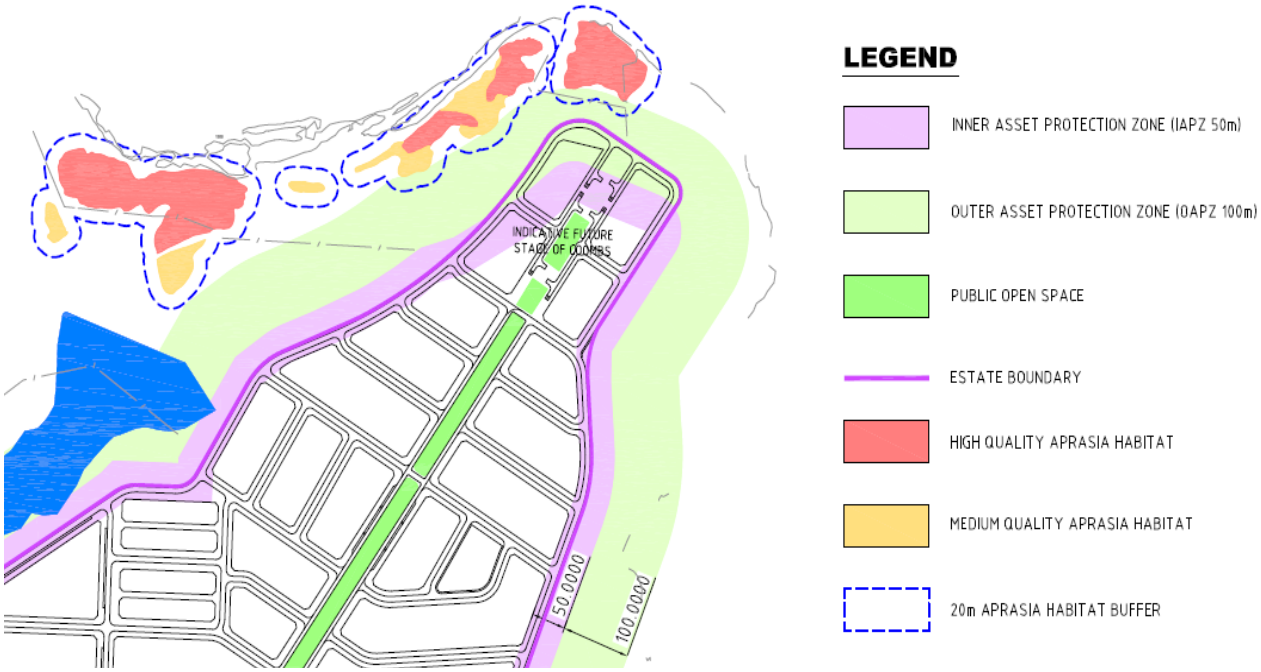
Figure 13 – Option 2 Layout.



This option decreases the development yield while not achieving a reduction in the bushfire risk to the future development which remains constant at extreme due to the unmanaged vegetation in the Molonglo River corridor.

The extension of the Outer Asset Protection Zone into the 20 metre wide buffer zone to the PTWL [Aprasia] Habitat requires management of the grassland fuels [within the habitat buffer] to achieve a Grass Fuel Hazard of < 35.

The following management prescriptions satisfy a Grass Fuel Hazard of < 35:

(1) Moisture Content: 30% [70% cured], density cover < 50%, fuel height < 0.7m; or

(2) Moisture Content: 30% [70% cured], density cover < 30%, fuel height < 1.0m; or

(3) Moisture Content: 30% [70% cured], density cover < 100%, fuel height < 0.3m; or

(4) Moisture Content: 30% [70% cured], density cover < 80%, fuel height < 0.4m; or

(5) Moisture Content: 30% [70% cured], density cover < 60%, fuel height < 0.5m.

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As can be observed from the above list of performance prescriptions, there are numerous management scenarios which comply with a Grassland Fuel Hazard rating of < 35, as required by the *Strategic Bushfire Management Plan for the ACT – 2009.*

Recent photographs taken of the PTWL [Aprasia] Habitat [refer to Site Photographs 5 – 11 below] to the north and northwest of the north-eastern corner of Coombs indicates that this level of variation exists within the medium/high quality habitat area with increased density cover of grassland vegetation in the habitat buffer zone.

In order to achieve the long term management goals for native grassland, *Eddy [2002]* recommends some form of defoliation is essential to maintaining the structure and botanical composition of most native grasslands. Furthermore, a suitable habitat for Pink-tailed Worm Lizard requires an open structure to the vegetation in order to prevent shading and to allow sun-light to warm the rocks under which the lizards shelter.

The *ACT Lowland Native Grasslands Conservation Strategy* recommends grazing, mowing / slashing and burning as suitable management methods, undertaken outside periods when the grassland is flowering and seed production [mainly late spring to early summer] and mowing/slashing is performed not more than once or twice a year.

The Fuel and Fire Suppression Guidelines for the Pink-tailed Worm Lizard [TAMS] suggests that slashing should not disturb surface rocks during the process and do not slash below 10cm [100mm].

Item 8.2 of the EPBC decision requires that any fire, biomass management, or fuel reduction undertaken within the 20 metre buffer zone to medium and high quality habitat shall be conducted in an ecologically sympathetic manner with the conservation of the Pink-tailed Worm Lizard.

The recommendations of *Eddy [2002]* in respect to the requirement for management of native grassland and the management recommendations of the TAMS Pink-tailed Worm Lizard Fuel and Fire Suppression Guidelines substantiates the management of the buffer zone to achieve a Grassland Fuel Hazard of < 35, without significantly impacting on the Pink-tailed Worm Lizard Habitat.

This will permit the extension of the Outer Asset Protection Zone into the 20 metre wide buffer zone to the moderate and high quality habitat with regular monitoring of curing, density and status of the growth of the grassland to ensure compliance with the ecological requirements for seed production, biomass reduction and the requirement to maintain a maximum Grassland Fuel Hazard of 35.

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Photograph No. 5 – view looking west across Aprasia habitat showing height and elevated density of grassland.

Photograph No. 6 – view looking northwest across Aprasia habitat to the Molonglo River with Misery Point on the northern side of the river.

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Photograph No. 7 – view looking northeast across Aprasia habitat showing height and elevated density of grassland

Photograph No. 8 – Close up view looking east across Aprasia habitat

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Photograph No. 9 – view showing example of rock/grass density.

Photograph No. 10 – view showing example of rock/grass density.

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Photograph No. 11 – view showing example of rock/grass density.

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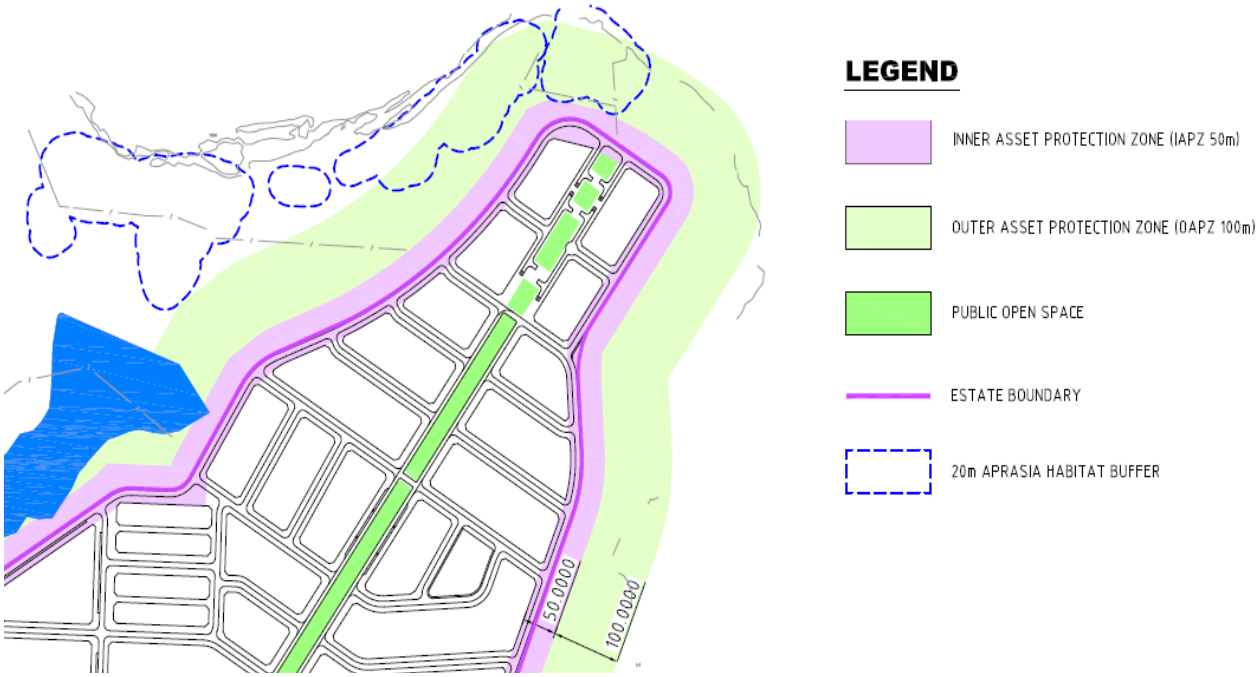
4.4 Review of Option 3 Layout.

The Option 3 layout retains the possible maximum development footprint in the north-eastern tip of the Coombs development precinct and extends the ESA approved 100 metre wide Outer Asset Protection Zone plus 50 metre wide Inner Asset Protection Zone from the block boundaries.

This extends the fire protection zone into the buffer zone and medium and high quality Pink-tailed Worm Lizard [Aprasia] Habitat.

Figure 14 – Option 3 Layout.



This option extends the 50 metre wide Inner Asset Protection up to the edge of the of the buffer zone to the medium/high quality habitat to the northeast and northwest of the development precinct with the 100 metre wide Outer Protection Zone extending across the 20 metre wide buffer and into the medium/high quality PTWL Habitat.

This option maximises the development yield while not achieving a reduction in the bushfire risk to the future development which remains constant at extreme due to the unmanaged vegetation in the Molonglo River corridor.

As discussed in Option 2, the provision of the Outer Asset Protection Zone requires management of the grassland fuels to achieve a Grass Fuel Hazard of < 35.

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The recommendations of *Eddy [2002]* in respect to the requirement for management of native grassland and the management recommendations of TAMS Pink-tailed Worm Lizard Fuel and Fire Suppression Guidelines substantiates the management of the Outer Asset Protection Zone to achieve a Grassland Fuel Hazard of < 35, without significantly impacting on the Pink-tailed Worm Lizard medium/high quality habitat.

The management of the 50 metre wide Inner Asset Protection Zone is achieved without impacting on the medium/high quality habitat or the 20 metre wide buffer zone to the PTWL Habitat and requires grassland vegetation located beyond the edge road to be maintained at less than 200mm height when grassland curing is > 70%.

4.5 Review Conclusions.

Section 4 of this report examines three development options for the north-eastern corner of the future suburb of Coombs, located adjacent to the PTWL [Aprasia] Habitat and identifies that irrespective of the option chosen, the bushfire risk from the vegetation within the Molonglo River corridor remains high to extreme on this part of the proposed new suburb.

A review of the management requirements for native grassland vegetation, provided in the *ACT Lowland Native Grassland Conservation Strategy,* has revealed that the need exists for regular defoliation of the grassland in order to maintain the structural and botanical composition of native grassland. This defoliation can be undertaken by grazing, slashing/mowing and burning to prescriptions which allow the grassland to grow freely enough to replenish root reserves, flower and set seed *[Eddy 2002]*. Furthermore, Pink-tailed Worm Lizards prefer sites that have not been heavily grazed and rocks that receive some direct sunlight, since they are used for thermoregulation *[Australian National University 2009].*

The TAMS Fuel and Fire Suppression Guidelines specify management activities for Pink-tailed Worm Lizard and potential impact on its habitat. These activities include slashing, which should be undertaken not to disturb surface rocks and to a height of not less than 100mm. The *ACT Lowland Native Grassland Conservation Strategy* recommends that this method of management should only occur once or twice in a 12 month period.

The *Strategic Bushfire Management Plan for the ACT* specifies performance standards for Inner and Outer Asset Protection Zones with the OAPZ requiring grassland to be maintained to a Grass Fuel Hazard of < 35. This prescription can be achieved in ‘cured’ grassland by modifying the density [% cover] or height of the fuel [grass].

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The site photographs of the PTWL [Aprasia] Habitat, taken in November 2010 show that whilst the ground density of the grass is 45 - 50%, the elevated density is more like 80 – 90% cover, over a given area.

From Table 4 – *Grassland Fuel Hazard* of the *Strategic Bushfire Management Plan for the ACT,* the height of fuel should be 300 – 400mm to achieve a Grass Fuel Hazard of < 35 for a density cover of 80 – 90%.

It is recognised that the management of the Outer Asset Protection Zone to achieve a Grass Fuel Hazard of < 35 is compatible with the defoliation requirements of native grassland.

The performance standard for an Inner Asset Protection Zone is for the grassland to the maintained at less than 200mm height when grassland curing is > 70%. However, the options reviewed locate the Inner Asset Protection Zone on the land beyond the medium/high quality PTWL Habitat and also outside the 20 metre wide buffer zone to the medium/high quality PTWL Habitat and this management prescription can be achieved without impacting on the medium/high quality PTWL Habitat or the buffer zone to the habitat.

It is therefore concluded that:

- Irrespective of the layout chosen, the bushfire risk to the future development, from a bushfire occurrence in the unmanaged Molonglo River corridor is constant;

- Option 1 layout substantially reduces the development yield but will require additional management costs and possible duplication of the Outer Asset Protection Zone to achieve the management outcomes for native grassland and PTWL Habitat as recommended by *Eddy* and the *ACT Lowland Native Grassland Conservation Strategy*;

- Option 2 layout reduces the development yield, retains an unmanaged medium/high quality Pink-tailed Worm Habitat whilst managing the 20 metre wide buffer zone to the medium/high quality Pink-tailed Worm Habitat as an Outer Asset Protection Zone. This option provides a compromise between exclusion of all management from the PTWL Habitat for bushfire protection and Option 3 which proposes management of the PTWL Habitat/Buffer zone as an Outer Asset Protection Zone.

  This option will also need additional management costs and possible duplication of the Outer Asset Protection Zone to achieve the ecological outcomes for native grassland and PTWL Habitat as recommended by *Eddy* and the *ACT Lowland Native Grassland Conservation Strategy*;

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- Option 3 maintains maximum development yield, places the Inner Asset Protection Zone outside the medium/high quality PTWL Habitat and buffer zone to the medium/high quality PTWL Habitat.

  The maintenance of the Inner Asset Protection Zone can be undertaken to achieve the management requirements of an Inner Asset Protection Zone pursuant to the specifications of the *Strategic Bushfire Risk Management Plan for the ACT* and will not impact on the medium/high quality PTWL Habitat.

  The Outer Asset Protection Zone is located within the medium/high quality PTWL Habitat and buffer zone to the medium/high quality PTWL Habitat. The recommendations of *Eddy [2002]* in respect to the requirement for management of native grassland, the management recommendations of TAMS Pink-tailed Worm Lizard Fuel and Fire Suppression Guidelines and the *ACT Lowland Native Grassland Conservation Strategy,* substantiates that the management of the Outer Asset Protection Zone can be undertaken to achieve a Grassland Fuel Hazard of < 35, without significantly impacting on the Pink-tailed Worm Lizard habitat.

  The interval of the management will be based on the maximum twice annual period as recommended by *Eddy [2002]* and will be dependent on winter/spring rainfall and vegetation growth with some years probably not requiring any management due to dry conditions and the cropping by Kangaroos.

It is therefore concluded that Option 3 provides a development layout which maximises yield whilst ensuring that the benefit gained through the required management of the medium/high quality PTWL Habitat/buffer zone, in order to maintain the structural and botanical composition of the native grassland and the PTWL Habitat, is not lost.

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SECTION 5

BUSHFIRE PROTECTION MEASURES.

5.1 Introduction.

On the basis that the following assumptions are correct:

- The open grassy woodland vegetation on the land to the north of Holdens Creek is not managed to prevent the spread of fire towards the northern edge of Coombs, under north-westerly and northerly wind influences;

- The development and management of the Stromlo Forest Park does not adequately address the potential for fires to occur and spread across the landscape towards the western edge of the new suburb of Wright and therefore into the Holdens Creek corridor;

- The Molonglo River is not dammed to create Lake Molonglo as assessed in the Molonglo Stage 2 Bushfire Risk Assessment and the river corridor is retained and rehabilitated as a habitat/open space corridor;

- The re-growth forest to the northeast of the Molonglo River corridor remains unmanaged; and

- The management of the vegetation in the open space corridor to the south of Coombs does not adequately address the reduction of the fire hazard.

the following fire protection measures shall be implemented:

5.2 Bushfire Protection Measures.

The following fire protection measures shall apply to the proposed development:

5.2.1 Northern aspect to Coombs

(a) Management of the Holdens Corridor:

The full width of the Holdens Creek corridor, including the edge road and landscape buffer as shown on Section D [Page 24] of the Wright/ Coombs Concept Plan shall be maintained as an Inner Asset Protection Zone. The minimum width of the IAPZ shall be 50 metres, as agreed by ESA.

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(b) Provision of Managed Outer Asset Protection Zone:

There shall be provided an Outer Asset Protection Zone, of a minimum width of 100 metres, to the north of the Holdens Creek corridor, measured from the northern edge of the Inner Asset Protection Zone, as agreed by ESA.

(c) Provision of Ember [HAPZ] Zone:

There shall be provided an Ember Zone of a minimum width of 100 metres, measured from the Inner Asset Protection Zone, where those buildings erected within the first 25 metres of the HAPZ are constructed to comply with BAL 19 and the remainder to BAL 12.5, in accordance with A.S. 3959 – 2009 – *'Construction of Buildings in Bushfire Prone Areas'.*

5.2.2 Northern aspect to the north-eastern portion of Coombs

(a) Provision of Inner Asset Protection Zone:

There shall be provided a 50 metre wide Inner Asset Protection Zone [as agreed by ESA], measured from the block boundary.

(b) Provision of Managed Outer Asset Protection Zone:

There shall be provided an Outer Asset Protection Zone, of a minimum width of 100 metres, measured from the northern edge of the Inner Asset Protection Zone, as agreed by ESA. The OAPZ shall incorporate the land within the medium/high quality PTWL Habitat and shall be manually maintained to the satisfaction of TAMS in order to address the *ACT Lowland Native Grassland Conservation Strategy* and to achieve a Grassland Fuel Hazard of < 35, without significantly impacting on the Pink-tailed Worm Lizard habitat.

(c) Provision of Ember [HAPZ] Zone:

The Ember Zone [HAPZ] to the residential precinct which faces Misery Point and the remainder of the river corridor shall be BAL 19 for 25 metres plus BAL 12.5 for the next 75 metres, in accordance with A.S. 3959 – 2009 – *'Construction of Buildings in Bushfire Prone Areas'.*

5.2.3 South-western edge to Coombs.

(a) Management of the future suburb of Wright:

Should the construction of the new suburb of Wright not occur concurrently or before the new suburb of Coombs, the regenerating vegetation within the future suburb of Wright shall be slashed or removed in order to minimise the change of a fire starting and spreading, under south-westerly winds, towards the south-western edge of Coombs.

The management prescription for this work shall be that combustible fuels shall be maintained to a maximum height of 100mm.

The minimum width of this management shall be 500m, including the width of the proposed north-south arterial road corridor.

5.2.4 North-western corner to Coombs.

(a) Provision of Managed Outer Asset Protection Zone:

Until such time that the Stromlo Forest Park development can provide a managed buffer zone to the northwest corner of Wright, capable of minimising the passage of fire from the northwest, there shall be provided, to the northwest of the Uriarra Road corridor a minimum 400 metre wide managed Outer Asset Protection Zone.

5.2.5 Molonglo River Corridor.

(a) Rehabilitation and bushfire hazard management of the vegetation within the river corridor.

The Molonglo Stage 2 Bushfire Risk Assessment recommended a 30 metre wide IAPZ and a HAPZ of between 30 – 50 metres – based on the advice that the river would be dammed and that the river corridor would be managed as a 'foreshore reserve'. This advice has now been withdrawn as the proposal is for the river corridor to be rehabilitated as a habitat/riparian corridor, increasing the potential bushfire risk from unplanned bushfire events occurring in unmanaged vegetation.

The reduction of the fuel hazard in this corridor is critical to the safety of the occupants of the future suburb of Coombs [and North Weston] and the emergency services that will attend to fire events in the river corridor. The difficulty is however, reaching a balance between retaining a habitat corridor and reducing the bushfire risk, exacerbated by the difficulty of managing steep, rough land which is also the habitat for the Pink Tailed Worm Lizard, whilst retaining water quality in the river.

The rehabilitation of the vegetation within the corridor should remove the introduced species and replicate the natural River Sheoak community with scattered 'patches' maintained along the edge of the river bank – broken by wide sections of native grasses in order to provide a disconnected canopy along both sides of the river.

The steeper, rocky sections of the higher river bank shall be retained as open grassland with the remainder of the corridor rehabilitated and maintained as an 'open woodland community' with an open, separated tree canopy and a grassy understorey. Canopy separation between the River Sheoak and the woodland community is important.

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Management of bushfire fuels, by traditional methods such as slashing, is impractical due to the nature of the landform and the requirement to minimise damage to the Pink Tailed Worm Lizard habitat [surface rocks] which prevails across much of the river corridor.

It is therefore recommended that a Fire Management Plan be prepared specifically for the corridor which establishes a management protocol based on the primary management being by stock grazing, hand slashing in the PTWL Habitat areas, mechanical slashing [where possible] and periodic ecological hazard reduction burning in order to provide certainty over the reduction of the bushfire fuels to levels which are identified, in the Strategic Bushfire Management Plan for the ACT – Version Two, to maintain the corridor as an Outer Asset Protection Zone.

The corridor should not be gazetted as a 'Nature Reserve' and annual funding shall be provided, specifically [& separately] for the fuel management of the river corridor. Funding for the maintenance of the existing fire access trails along the north-eastern side of the river corridor shall also be provided in order to provide access for maintenance and fire-fighting access.

An edge road shall be provided to the full perimeter of the river corridor including across the stormwater detention ponds in order to provide continuity of fire-fighting access.

A 50 metre wide Inner Asset Protection Zone shall be provided to the blocks facing the river corridor with a 100 metre wide Outer Asset Protection Zone extending from the outer edge of the IAPZ and managed to provide a maximum Overall Fuel Hazard Level of < 35 – as agreed by ESA.

The Ember Zone [HAPZ] to the residential precinct which faces the river corridor shall be BAL 19 for 25 metres plus BAL 12.5 for the next 75 metres, in accordance with A.S. 3959 – 2009 – *'Construction of Buildings in Bushfire Prone Areas'.*

The stormwater detention ponds on Holdens Creek, Weston Creek and the internal creek lines shall be maintained as an Inner Asset Protection Zone.

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5.2.6 Southern edge to Coombs [Cotter Road]:

The southern edge to the new suburb of Coombs adjoins the Open Space corridor between Warragamba Avenue and Cotter Road. This corridor has been replanted with various species of trees.

The Molonglo Stage 2 Bushfire Risk Assessment [ABPP – 2006] identified that this corridor, if unmanaged, would provide a high level of risk to the southern edge of Coombs [& Coombs]. This level of risk has been determined by this risk assessment.

The Risk Assessment also recommended that a 40 metre wide IAPZ and 50 metre wide HAPZ be provided to this aspect of the new suburbs.

Therefore, it is recommended that the full width of the Cotter Road corridor, the landscape buffer zone, Service Street and the front of the blocks facing Cotter Road shall be managed as an Inner Asset Protection Zone.

A minimum 50 metre wide Ember [HAPZ] Zone shall be established inside southern edge of the new suburb, to the east from the eastern edge of the Stromlo Rural Village, measured from the Inner Asset Protection Zone, where those buildings erected are constructed to comply with BAL 12.5 in accordance with A.S. 3959 – 2009 *'Construction of Buildings in Bushfire Prone Areas'.*

5.3 Fuel Management Protocols:

(a) Asset Protection Zones:

The management of the Inner Asset Protection Zones, the Outer Asset Protection Zones recommended in this report shall comply with the management protocols as provided in Schedule C – Fuel Management Standards for Fire Management Zones of the '*Strategic Bushfire Management Plan for the ACT – Version 2 – October 2009'.*

The management of the Outer Asset Protection Zone located within the PTWL Habitat shall be shall be manually maintained to the satisfaction of TAMS in order to address *ACT Lowland Native Grassland Conservation Strategy* and to achieve a Grassland Fuel Hazard of < 35, without significantly impacting on the Pink-tailed Worm Lizard habitat.

(b) Parks, Recreation Urban Open Space Zones and Stormwater Detention Ponds:

The management of the Neighbourhood Parks/Recreation Open Space Zones and Stormwater Detention Ponds within the new suburb of Coombs shall include the regular maintenance of lawns/grasses to minimize combustible ground litter, to the standards of an Inner Asset Protection Zone.

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Landscaping and trees shall be maintained in discrete clumps with limbs to trees under-pruned to provide a 2m clearance to the lower branches.

5.4 Access for Fire-fighting Operations:

Edge roads shall be constructed within the Inner Asset Protection Zone setback to all bushfire prone interfaces and shall be continuous to allow access to the full length of the bushfire prone interface and constructed to a width of 7.5 metres with corners, intersections and turning heads designed to accommodate both an Urban Pumper and Aerial Appliances in locations with multi-level development and Rural Fire Service Tankers (Refer to Access provisions provided by each Service).

Corners and round-abouts shall be constructed to provide access for urban and rural fire service vehicles with a turning circle of 24 metres, with an inner radius of 6 metres and an outer radius of 12 metres for corners. Bridges and road surfaces shall be designed to carry a live load of 25 tonnes.

Internal estate roads shall have a minimum width of 5.5 metres with parking/passing bays located clear of the formed road width and a 3 metre verge to each side to allow unencumbered access by emergency crews to all sides of their vehicles. Corners and round-abouts shall be constructed to accommodate Urban Pumpers, Aerial Appliances in locations of multi-level medium density development.

Turning circles of 24 metres for Rural Fire Service Vehicles with internal corners having an inner radius of 6 metres and an outer radius of 12 metres.

5.5 Water Supplies for Fire Fighting Operations:

A hydrant supply shall be installed to comply with the agreed standards for water supply and require type F5 standard 45 l/s single standard hydrants at 60 metre intervals.

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SECTION 6

RESIDUAL RISK.

6.1 Introduction.

Table 6 evaluates the residual bushfire risk to the future development within the new suburb of Coombs, following the implementation of the recommended bushfire protection measures, and determines the vulnerability of the proposed development, the possible consequences and residual bushfire risk during catastrophic fire danger periods.

Table 6 – Bushfire Risk Register & Action Treatment Plan – catastrophic bushfire events, post implementation of the recommended protection measures.

The Risk What can happen? Fire Scenario	The consequences of an event happening Consequences	Likelihood	Risk before mitigation	Strategy to reduce the risk	Consequences & Likelihood after mitigation measures applied	Residual Level of Risk	Risk Priority
(1) Fire burning in unmanaged open grassy woodland to the north of Coombs – under north-westerly wind influences	Catastrophic – long fire run through unmanaged vegetation	Almost Certain	Extreme	Provision & management of Asset Protection Zones & construction standards to buildings	Moderate/ possible	High risk	1
(2) Fire burning in the Woodland / Forest vegetation in the Stromlo Forest Park, to the west of Wright/Coombs – under NW, westerly wind influences.	Catastrophic – long fire run through unmanaged vegetation	Almost Certain	Extreme	Manage vegetation within Stromlo Forest Park	Moderate/ Likely	High risk *[Refer to Section 6.2 below]*	1
(3) Fire burning in the Molonglo River corridor – under the influence of north-westerly winds	Catastrophic – long fire run through unmanaged vegetation	Almost Certain	Extreme	Vegetation rehabilitation to specification provided plus management of river corridor as an Outer Asset Protection Zone	Moderate/ Likely	High risk	1
(4) Fire burning in the re-growth Pinus Radiata Forest vegetation on the land to the northeast of Coombs – under NE wind influences.	Major – long fire run through unmanaged vegetation	Likely	Extreme	Provision & management of Asset Protection Zones, construction standards to buildings	Moderate / unlikely	Moderate risk	2
(5) Fire burning in the vegetation between Cotter Road and the suburb of Holder – under SE wind influences	Major – long fire run through unmanaged vegetation	Possible	High		Moderate/ Unlikely	Moderate Risk	2

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6.2 Summary of Residual Bushfire Risk.

Table 6 provides a review of the residual level of risk to residents and emergency services personnel and others within the future suburb of Coombs and has been determined on the basis that the recommended bushfire mitigation measures are implemented and maintained over the life of the development.

[This level of residual risk to the north-western corner of Coombs will remain until such time that the Stromlo Forest Park development is completed and a positive bushfire fuel management program is implemented. Should this not occur the risk will remain as determined in Table 6].

The implementation and management of the temporary and permanent Asset Protection Zones, the construction of the buildings to standards [which mitigate the potential levels of ember attack] will play a significant role in decreasing the bushfire hazards and the level of risk from fire events within the open grassy woodland vegetation to the north; the forest/woodland vegetation in the Stromlo Forest Park to the west of Wright and Holdens Creek; the habitat corridor along the Molonglo River corridor and the threat from fires that may occur in the vegetation to the south of the new suburb of Coombs.

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SECTION 7

CONCLUSION.

The development proposal reviewed in this risk assessment is the Draft Estate Development Plan [DEDP] for the new suburb of Coombs which, with the new suburb of Wright, is the first development precinct within the Molonglo Valley urban release area.

The development proposal is for the subdivision of the Coombs development precinct into RZ1 Residential Suburban Zone; RZ5 Residential Zone [High Density]; CZ5 Commercial Mixed Use Zone and PRZ1 – Parks and Recreational Urban Open Space Zone.

The development precinct occupies the south-eastern corner of the Molonglo Valley Urban release area with the new suburb of Wright occupying the land to the southwest of the proposed north/south arterial road.

The Stage 1 & 2 Bushfire Risk Assessments prepared for the Molonglo Valley [ABPP 2005 & 2005] identified that the Molonglo Valley is one of the driest areas of the ACT and has a known fire path from the northwest and west with catastrophic fires occurring in this area in 1952 and again during the 2003 Canberra Bushfires. The recommendations of the Stage 2 Bushfire Risk Assessment were based on the advice that the Molonglo River corridor was to be dammed and the provision of a 'managed foreshore reserve' provided along both sides of the river in order to mitigate the bushfire risk to the future residential development.

The current advice is that the dam will not be constructed and that a riparian/habitat corridor will be provided in lieu of the managed foreshore reserve, resulting in the river corridor retaining vegetation and therefore increasing the bushfire risk rating to extreme. This bushfire threat will remain, even after the Molonglo development precinct is fully established, due to the exposure of the river corridor to hot, dry northwest, west and southwest 'fire winds' which are prevalent during summer.

There also remains a concern over the management of the proposed re-vegetation of those areas of the Stromlo Forest Park which could continue to provide a fire path to the north-western corner of Wright and Holdens Creek Coombs.

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This report has examined the likely fire-paths and the resultant bushfire risk to the development within the new suburb of Coombs and has recommended number of protection strategies aimed at reducing the assessed level of risk to the future residents and emergency services personnel, if the predicted fire event occurs and the suburb is exposed to the effects of a catastrophic fire event.

These measures include advice on the rehabilitation of the Molonglo River corridor and the need to manage this corridor to minimise the bushfire fuels whilst observing the need to maintain, protect and enhance the habitat for the Pink Tailed Worm Lizard [PTWL].

In this respect the report examines the management of the PTWL Habitat in relation to the establishment of the Outer Asset Protection Zone within the medium/high quality habitat and draws on a number of existing ecological studies on PTWL and native grasslands [including TAMS Pink Tailed Worm Lizard Fuel and Fire Suppression Guidelines] to establish that the OAPZ and the ecological management of PTWL habitats are compatible.

It is evident from the Confirmation Surveys for Pink Tailed Worm lizards [Aprasia parapulchella] by David Wong and William Osborne in 2010, that PTWL potential habitats are classified into High, Moderate and Low quality habitats based on the species and coverage of native grasses.

High quality potential PTWL habitats are dominated by Kangaroo Grass while moderate habitats are dominated by Spear Grasses and low habitats are dominated by exotic species and no longer support native ground cover.

In order to conserve the health and native grass cover of the PTWL habitats the bushfire plan has incorporated the ongoing protection, management and restoration strategies outlined in the ACT Lowland Native Grassland Conservation Strategy Action Plan 28.

The ACT lowland Native Grassland Conservation Strategy was developed in 1990 and builds on more than ten years of survey, monitoring, research, conservation planning and management in relation to lowland native grasslands in the ACT and region. These management practises protect grassland habitats for a range of endangered species and are still considered to be best practise today.

The Action Plan clearly states defoliation is essential to maintaining the structure and botanical composition of most native grasslands. Without regular removal of some herbage, excess grass will accumulate and die and can inhibit the growth of many plant species in the sward.

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There may also be a loss of vigour of dominant grasses, e.g. Kangaroo grass. The amount of defoliation required is related to the productivity of the site and the dominant grass species found there. Productive areas carrying Kangaroo Grass will need more intensive treatment than areas of poorer soils carrying spear grasses which have much less biomass and shorter life spans [The ACT lowland Native Grassland Conservation Strategy].

The three main forms of grassland defoliation are grazing, mowing and slashing, and burning. The timing of defoliation must allow native grasses to grow freely to replenish root reserves, flower and set seed which mainly occur late spring / early summer [The ACT lowland Native Grassland Conservation Strategy].

The management of the fuel loads in the OAPZ allow grasses up to 1m high depending on their moisture content. The report has concluded that the timing and amount of fuel reduction is compatible with the ecological management of the native grasses and management methods permitted in the TAMS PTWL Fuel and Fire Suppression Guidelines.

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REFERENCES:

- *Strategic Bushfire Management Plan for the ACT* – January 2009;
- *The Canberra Spatial Plan* – ACT Planning & Land Authority – March 2004;
- *AS/NZ - 4360 : 2004 Risk Management;*
- *Emergency Risk Management – Applications Guide. (EMA) 2000);*
- Overall Fuel Hazard Guide – NRE. May 1999;
- *Planning for Bushfire Risk Mitigation* 2006 & Update 2009;
- *ACT Lowland Native Grassland Conservation Strategy – Action Plan No. 28;*
- *Confirmatory surveys for Pink-tailed Worm Lizards – Department of Applied Ecology – University of Canberra;*
- *TAMS Fuel and Fire Suppression Guidelines – Pink-tailed Worm Lizard;*
- *Restoring Kangaroo Grass [Themeda triandra] to grassland and woodland understoreys –a review of establishment requirements and restoration exercises in south-east Australia – Ecological Management & Restoration Vol. 6 No. 1 April 2005;*
- *Draft Flora and Fauna Guarantee Action Statement – Pink-tailed Worm Lizard – DSE Victoria;*
- *Bushfire Risk Assessment – ABPP – April 2010.*

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SECTION 8 – Plan of Bushfire Protection Measures.

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Appendix D

Stormwater Quality Modelling of Coombs & Wright

Stormwater Quality Modelling of Coombs and Wright

Summary

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Introduction

This study investigates the proposed development in Coombs and Wright and the stormwater treatment facilities that would be needed for this development to meet the requirements set out in the WaterWays - Water Sensitive Urban Design General Code.

Table 1: Waterways: Water Sensitive Urban Design General Code Stromwater Quality Targets

		Development or Redevelopment	*Regional or catchment - wide*
WaterWays WSUD Stormwater Quality Requirements	Reduction in average annual Suspended Solids (SS) export load	60%	85%
	Reduction in average annual Total Phosphorus (TP) export load	45%	70%
	Reduction in average annual Total Nitrogen (TN) export load	40%	60%

This works builds on the analysis carried out by Cardno Young in their "*Molonglo Valley - Stormwater Management Strategy*" Aug 2006, and "*Molonglo Valley Ponds and Lakes Options Study*" Aug 2006. The proposed areas of development that were modelled were based on the *Concept Plan* completed by ACTPLA (2008), and included in the *Territory Plan*.

Changes to Concept Plan

There have been some changes in the location of infrastructure since the compilation of the Concept Plan. It is now anticipated that Pond B will have to move upstream by about 100m to avoid potential habitat of the Pink-tailed Worm-lizard. Consequently, one of the small ponds located immediately upstream (to the South of Pond B – sub-catchment L), has been erased, as has a small pond immediately to the West of Pond B (sub-catchment Q), and there has been the inclusion of another pond in the catchment immediately to the north-east (sub-catchment K), which will pick up all the stormwater on the north-east of the Coombs 'peninsula'. This is shown in Appendix A – Territory Plan with Pond locations.

Modelling

A map of all the catchments is shown in Appendix B – Total Catchment Areas.

Three catchments where modelled – Catchments A, B and C. Each catchment flows into the Ponds A, B and C respectively. The Rural area, Stromlo Forrest Park and Stromlo Estate were modelled as they currently exist.

The characteristics of the Urban development including, density, catchment areas and flow paths, have been based on the Concept Plan 2008 and the Territory Plan (including Variation 281). Any alterations from this that have been suggested from the planning / engineering studies have been included in the modelling. When details of the development (density and form) are bedded down further, then this work may need to be revisited, altered and revised to represent these changes. This is especially true if the land use varies significantly from the Territory Plan and the Concept Plans.

For the purposes of this modelling, the following assumptions where made.

Table 2: Assumptions for MUSIC modelling

		Higher density	Lower density	Open Space
Options Modelled	% impervious	60%	50%	10%
	% roof into tank	50%	50%	-
	% of total area onto roof	20%	15%	-
	Tank Size per dwelling	2000L	2000L	-
	Density	30 dwellings/Ha	15 dwellings/Ha	-

Higher density areas include the Commercial and Community Facility zones.

Rural Catchments

When modelling the stormwater quality requirement of these catchments, it is important to consider the upstream rural catchments and the downstream effect the pollutants created from these areas have. The stormwater quality targets – under the Territory Plan – are not required to treat the pollutants from the rural catchments, only the urban catchments. The calculation method used to account for the pollutants from the rural areas is shown in the below equation.

$$\text{\% Pollution Reduction from Urban Area} = \frac{(\text{Pollution out of Pond} - \text{Pollution out of Rural Area})}{\text{Pollution out of Urban Area}} \times 100$$

Sub-catchment targets

Due to the range of catchment types, and the limited ability in some catchments to install large stormwater treatment facilities, it was considered too onerous to make every catchment reach the Regional stormwater quality targets. Therefore, the catchments were classified into 4 types and each catchment was assigned targets as a range of the Developer targets. These are listed in the table below.

Table 3: Pollutant reduction targets for sub-catchments

		TSS		TP		TN	
	Target	lower	upper	lower	upper	lower	upper
No Ponds Downstream	100-150% of Developer	60%	90%	45%	68%	40%	60%
Large Pond D/S only	50%-75% of Developer	30%	45%	23%	34%	20%	30%
Small Pond with Large Pond D/S	75%-100% of Developer	45%	60%	34%	45%	30%	40%
Small Pond D/S only	100-150% of Developer	60%	90%	45%	68%	40%	60%
Out flow from Large ponds	Regional	85%		70%		60%	

Results

The results of this modelling are shown Table 4. This table shows the trial stormwater features for each catchments, pollution generated from each sub-catchment and the % reduction of the pollution.

Table 4: Pollution Reduction from Sub-catchments

							Actual Reduction			Pollutant Load off Urban Area		
Sub catchment	Area (Ha)	Major Pond D/S	Minor Pond	Pond Area (m^2)	Pond Volume (kL)	Swale Length	TSS	TP	TN	TSS	TP	TN
A	18	A	small A	2,000	2,000		116.3%	70.5%	52.0%	10,100	14.6	174
B	*14.4*	*A*	*small B*			*150*				*8,100*	*11.7*	*140*
C	*3.2*	*A*	*small B*	*2,000*	2000	-	*83.2%*	*54.2%*	*43.1%*	*1,810*	*2.6*	*31*
D	*7.9*	*A*	*small B*			-				*4,440*	*6.4*	*77*
E	17.2	A		-	-	-	27.2%	25.3%	23.8%	11,200	16.2	193
F	9.3	A		-	-	100	25.3%	24.7%	24.3%	4,110	6.0	71
G	8.7	A		-	-	100	24.3%	20.0%	18.3%	5,680	8.2	98
H	20.5	A		-	-	-	23.9%	20.1%	18.5%	13,400	19.4	232
I	*16.5*			-	-	*3*60*	*81.0%*	*50.1%*	*33.7%*	*9,420*	*13.6*	*163*
J	*9.0*			-	-	*3*50*	*86.7%*	*56.1%*	*40.4%*	*5,050*	*7.3*	*87*
K	14.9		small D	1,700	1,265	80	86.1%	64.1%	53.4%	8,361	12.1	144
L	*11.1*	*B*		-	-	-	21.0%	18.0%	17.1%	*6,230*	*9.0*	*108*
M	*8*	*B*		-	-	-	21.2%	18.0%	16.8%	*4,490*	*6.5*	*78*
N	*8.7*	*B*		-	-	-	27.2%	24.9%	24.2%	*5,670*	*8.2*	*98*
O	23	B	small C	2,000	2,000	60	84.1%	59.8%	48.5%	13,500	19.5	233
P	*3.5*	*B*		-	-	-	21.2%	17.8%	16.7%	*1,980*	*2.9*	*34*
Q	*6.7*	*B*		-	-	-	23.5%	21.6%	20.9%	*3,360*	*4.9*	*58*
R	*5.5*	*B*		-	-	-	27.1%	24.9%	24.2%	*3,580*	*5.2*	*62*
S	17.2	B	small E	3,000	4,000	220	90.3%	76.6%	62.9%	8,740	12.6	151
T	*11.4*	*C*		-	-	-	24.0%	21.4%	20.3%	*7,070*	*10.2*	*122*
U	*3.8*	*C*		-	-	-	27.3%	25.1%	24.1%	*2,450*	*3.5*	*42*
V	*12.3*	*C*		-	-	-	16.7%	15.3%	14.8%	*4,250*	*6.2*	*74*
W	*7.6*	*C*		-	-	-	23.2%	20.7%	19.6%	*4,490*	*6.5*	*78*
X	5.7	C	ret. Basin			-				3,210	4.7	56
Y	9.5	C	ret. basin	20,000	0	100	62.0%	36.4%	22.0%	1,900	2.8	33
Z	14.9	C	ret. basin			-				8,370	12.1	145
Total	288.5	-	-	28,700	9,265	810	55.5%	39.9%	32.3%	160,961	233	2,781

Below Target
Within target
Above Target

+3bioretention 20m
+3bioretention 20m

Table 5: Total Reduction from all Stormwater Quality meesures for large Pond Catchments

				Total Reduction of urban pollutants for all Stormwater Quality measures		
	Urban Area (Ha)	Volume (ML)	SA (m^2)	TSS	TP	TN
Pond A	99.2	25	12.5	98.7%	70.5%	58.9%
Pond B	83.7	40	15	99.5%	88.1%	72.4%
Pond C	65.2	40	11	89.1%	69.7%	61.2%

Table 6: Total Reduction from all Stormwater Quality measures with no smaller ponds

				Total Reduction of urban pollutants for all Stormwater Quality measures (No small Ponds)		
	Urban Area (Ha)	Volume (ML)	SA (m^2)	TSS	TP	TN
Pond A	99.2	25	12.5	95.7%	67.5%	53.5%
Pond B	83.7	40	15	88.6%	79.1%	62.6%
Pond C	65.2	40	11	NA	NA	NA

Discussion

Rainwater Tanks

Rainwater tanks are providing a relatively small reduction is pollution levels within the urban area. TSS, TN and TP pollutant levels each being reduced by around 20% in the lower density areas and by around 25% in the higher density areas. These reductions for the sub-catchments often do not reach the target range specified in Table 3. Even though the reduction is smaller than other stormwater quality features, it is still a valuable reduction when looking at the entire treatment train – reducing the reduction requirements of the other stormwater quality measures.

Smaller Ponds

Small ponds within the urban sub-catchments provide a relatively moderate reduction in pollutants generated within the urban areas. For the small ponds small A, small B, small C and small E, the pollution reduction achieved is above the targets that have been set in Table 3. If the smaller ponds are removed from the sub-catchments, then the stormwater quality is subsequently reduced, placing additional pollutants in the larger ponds. This is particularly true for Pond A, where the targets are not met for TP and TN (see Table 6).

The viability of these smaller ponds will need to be analysed for a water balance using climatic data from the years of 2000 through until 2008 (period of reduced rainfall).

It should be noted that these ponds and associated swales are not mandatory stormwater facilities. ACTPLA suggests that the targets for each sub-catchment remain the mandatory factor, rather than the specific stormwater measures. If these

targets can be met by other means (eg, more swales, bio-retention) and this produces a high quality, urban environment, then this will be considered acceptable.

Catchments I and J

The area of Catchments I and J are less than desirable in size to support ponds and so alternative measures were modelled. The swales and bio-retention facilities were modelled for catchments I and J. If analysed as a total catchment, then the mean annual pollution levels flowing out of the treatment facilities are within the target range.

Catchment K

Sub-catchment K is also a relatively small catchment and a permanent water body may not be viable (subject to water balance analysis, sewer locations and preferred landscaping option). Once the sewer locations are bedded down further, then the option to transfer all stormwater from this sub-catchment to Pond B can be investigated further. A decision on which is the preferred option should be made shortly.

Pond B

Although urban stormwater targets are met by Pond B, there needs to be an analysis of the effects of the Rural pollutants on the Pond. The analysis should investigate the water quality within the Pond and the processes occurring within the Pond, especially to ensure that stratification, algae growth and anaerobic activity does not occur from the increased sediment and nutrient loads. The CRC eWater POND model has been suggested for use in this analysis.

The bank level, bank location and spillway requirements will be strongly influenced by the potential habitat for the PTWL, sewer levels and road requirements. The pond design will take these issues into consideration.

Pond C

Pond C should also have a similar analysis on the effects from Rural pollutants. In addition, there is potential PTWL habitat that needs to be considered more closely in the Pond design. A survey of the potential habitat in the area has been conducted and this will need to be considered in further design work. Further more, there is a relatively large embankment (approx 35,000m^3) for the amount of water that is stored (40ML). These factors bring into question viability of the current concept developed by ACTPLA. Bill Guy and Partners suggest the diversion of the stormwater across into Pond B, this will be analyses further through the current Study that Bill Guy and Partners are undertaking.

Other factors will come into play with the sizing and design of these ponds. These include: -

- Trunk Sewer location and level;
- Road alignment and bridge crossings;
- Potential PTWL habitat;
- Geological considerations;
- Flood flow analysis;

- Spillway requirements
- Swale treatments;
- Landscaping;
- Stormwater harvesting;
- Aesthetics / Urban Design;
- Construction Cost;
- Operation and Maintenance Cost and
- Surrounding Spoil disposal needs

Conclusion

MUSIC modelling suggests that Stormwater Quality Targets can be achieved through the installation of rainwater tanks, swales, bio-retention facilities, smaller ponds and larger ponds.

The larger ponds are a significant size, Pond A being 25ML, Pond B 40ML and Pond C 40ML. These values can be increased or decreased in size as required and subject to analysis.

The option of additional swales, bio-retention facilities and larger rainwater tanks could also be investigated to see if these would be viable options to the smaller ponds within the sub-catchments. The viability of these smaller ponds will need to be analysed for a water balance using climatic data from the years of 2000 through until 2008 (period of reduced rainfall).

ACTPLA does not wish to mandate the type and size of all stormwater treatment facilities within the urban areas – rather it wishes to emphasise that the targets are mandated. These targets can be reached through a range of measures, ideally those that would be deemed to have the best environmental, social and financial outcome.

Appendix A – Territory Plan with Pond locations.