- a narrow strip (approximately 5m wide) of mixed woodland across the centre of the subject land, aligned from east to west (approximately 0.36ha);
- approximately 5.99ha of Grey Gum - Blue-leaved Stringybark Woodland along the eastern side of the development area. Whilst most of this vegetation is in moderate condition, that located adjacent to the existing cleared pasture is often modified and degraded by grazing stock and/or weed infestation;
- approximately 0.86ha of highly degraded Grey Gum - Stringybark Woodland around the existing farmhouse in the northern half of the subject land;
- an area of Paperbark Closed Forest along a minor drainage line in the central part of the subject land, occupying approximately 0.71ha; and
- approximately 0.92ha of Kunzea Shrubland/Heathland along the eastern periphery of the development area. The patch of that vegetation close to the existing farmhouse in the northern part of the land is also highly modified and degraded.

Table 7 Areas of vegetation to be removed, modified and/or retained on the subject land

Vegetation Community	Removed (ha)	Modified in APZs (ha)	Retained (ha)	Total (ha)
Cleared	21.41	0.93	0	22.34
Scribbly Gum - Bloodwood Forest	0.41	0	0	0.41
Mixed Woodland Strip	0.37	0	0	0.37
Grey Gum - Stringybark Woodland	5.98	1.53	7.07	14.48
Degraded Grey Gum - Stringybark Woodland	0.86	0.42	0.46	1.74
Kunzea Shrubland/Heathland	0.92	0	0	0.92
Regrowth Woodland with Kunzea Heath	0.29	0	0.22	0.51
Paperbark Closed Forest	0.71	0	0.08	0.79
Spotted Gum – Blackbutt Forest	0	0	1.63	1.63
Total	30.95	2.88	9.46	43.29

As noted above, most of the vegetation which is to be removed for the proposed development on the subject land at Mundamia has been modified or disturbed to various degrees over a long period of agricultural activities on the land. Nevertheless, a small proportion of the areas to be cleared are in at least moderate condition, and some parts of those areas of vegetation provide relevant habitat or resources for potential or known threatened species (see below).

It should be noted that the areas of vegetation to be removed (Table 7) constitute only a small proportion of those present in the general locality. In particular:

- there are substantial tracts of Grey Gum/Blue-leaved Stringybark forest and woodland in the immediate vicinity and general locality, including extensive areas in existing reserves (*eg* the adjoining Thompson Reserve, Council land and the Triplarina Nature Reserve), and/or on the subject land as well as on adjacent lands;

- whilst the Kunzea Shrubland/Heathland along the eastern periphery of the proposed development in the southern half of the subject land is to be removed, that vegetation type is common and widespread in the immediate vicinity and general locality, and is not regarded *per se* as of particular ecological value;
- the small area of Kunzea Shrubland/Heathland in the northeastern part of the land, which is to be removed, is already highly modified and degraded;
- the two narrow strips of trees in the central part of the land (along the western boundary and across the centre of the land) are highly modified and of poor quality; and
- the band of Paperbark Closed Forest along the upper drainage line in the northeastern part of the subject land will mostly be removed for the proposed development.

8 POTENTIAL IMPACTS on THREATENED SPECIES

8.1 Threatened Ecological Communities

There are no "*threatened ecological communities*" (TECs) present on the subject land at Mundamia.

As discussed above (in Chapter 4.3), the Paperbark Closed Forest vegetation present in the northeastern part of the subject land is not an example of the Swamp Sclerophyll Forest on Coastal Floodplains "*endangered ecological community*" (EEC), because the subject land is not located on a "*coastal floodplain*". Nor is it relevantly "*associated with .. a coastal floodplain*".

8.2 Threatened Species

8.2.1 Relevant Threatened Species

As detailed in Chapters 4 and 5 of this *Report*, there are a number of threatened species which will or are likely to be affected by the proposed development on the subject land at Mundamia.

The Nowra Heath-myrtle is known to occur within the development footprint, as well as within the *Conservation Area* (see below). There are records (either direct or indirect) of several threatened fauna species, including the Yellow-bellied Glider, Glossy Black Cockatoo, Gang Gang Cockatoo, Grey-headed Flying Fox and two threatened microchiropteran bats.

Two additional threatened fauna species have been recorded in the vicinity of the development area – the Powerful Owl (recorded in the northeastern part of the subject land, in the *Conservation Area*) and the Square-tailed Kite (which was recorded flying over the land).

There will unavoidably be adverse impacts imposed upon at least some individuals of some of these various threatened biota. For the threatened fauna species, those impacts will predominantly be indirect (*ie* through the removal of resources or habitat features such as hollow-bearing trees or preferred food trees), whereas for the Nowra Heath-myrtle, there will be both direct impacts (by the loss of individuals) and indirect impacts (by the loss of some areas of habitat).

8.2.2 Nowra Heath-myrtle

With respect to the Nowra Heath-myrtle, a small area of known habitat for the species will be removed, as it is located within the proposed development footprint, including:

- approximately 0.29ha in the northern part of the proposal, where there is a dense stand of Nowra Heath-myrtle in an area which has recently been slashed (*ie* within the last 2-4 years); and
- less dense individuals in shrubby woodland and open forest along the eastern side of the development footprint, particularly in the northeast.

The greatest density of the Nowra Heath-myrtle on the subject land is located in the northern part of the property (Figure 8). Much of this patch had been contained within the previous development footprint (extending into the current *Conservation Area* to the north), and had been subjected to recent (in the last 4 years) slashing, with the subsequent removal of most of the Kunzea shrub layer. This portion of

the land now consists of a scattered woodland tree canopy with areas of Kunzea regrowth and a moderate density of Nowra Heath-myrtle, and other areas which are almost a monotypic stand of Nowra Heath-myrtle below the scattered tree canopy (Figure 8).

As a consequence of the detailed mapping of the Nowra Heath-myrtle by Environmental InSites undertaken in 2010, amendments to the northern part of the proposed residential subdivision have been made. Those amendments have enabled the retention of the overwhelming majority of the large stand of Nowra Heath-myrtle to the north of the proposed subdivision (Figure 8), and have also increased the quantum of that plant retained in the northeastern corner.

It should also be noted that most of the large stand to the north of the proposed subdivision is located upslope of the proposal and/or across slope, and will therefore not be affected by any stormwater run-off or other effects of the residential subdivision.

It is noted also that whilst there will be some loss of specimens of the Nowra Heath-myrtle as a result of the proposed development on the subject land at Mundamia, that loss is offset by:

- the retention of the majority of the population and most of the suitable habitat for the species within the *Conservation Area* on the subject land;
- the proposal to implement a dedicated *Vegetation Management Plan* within the *Conservation Area*, designed specifically *inter alia* to protect and enhance populations of the Nowra Heath-myrtle; and
- a commitment within the *Statement of Commitments* (SoC) to monitor the population of the Nowra Heath-myrtle within the *Conservation Area*, and to provide data and information to Council and/or the OEH until the *Conservation Area* is dedicated to Council or the OEH for biodiversity conservation purposes.

8.2.3 Threatened Fauna

With respect to the threatened fauna species known or likely to occur within those areas of vegetation to be cleared for the proposed residential development of the subject land:

- a small proportion of resources which are of relevance for the Yellow-bellied Glider (including some hollow-bearing trees and a few sap feed trees) are located within the development footprint;
- however, these resources are also abundant within the *Conservation Area* on the subject land and in the adjoining vegetated lands (the Thompson Reserve to the north, the crown land along Flat Rock Creek to the east, and additional crown land and the Triplarina Nature Reserve to the south and southeast);
- the total area of open forest and woodland to be removed for the proposal represents only a minute portion of that present in the locality and identified in the *Nowra-Bomaderry Structure Plan* as being retained for biodiversity conservation purposes;
- with respect to microchiropteran bats, the loss of hollow-bearing trees as roost sites and of open forest or woodland habitat for foraging purposes will represent only a minor reduction in the extent of those resources and habitats in the locality;

- further, the proposal incorporates a *Hollow-bearing Tree Protocol* (Chapter 17) which is to be implemented as part of the project to salvage, re-use and/or replace any tree-hollows which need to be removed;
- similar considerations apply to the Glossy Black Cockatoo, for which there will be a minor reduction in potential and/or recorded feed trees (*Allocasuariana* species), noting also that there are substantial such resources within the *Conservation Area* on the subject land and in other areas of vegetation which are to be retained in the locality;
- only a very few potential nest trees for the Glossy Black Cockatoo will be removed (perhaps one or two), noting also that there is no evidence for any breeding by Glossy Black Cockatoos on the subject land;
- the proposal will remove a small area of habitat within which the Powerful Owl could potentially forage on arboreal mammals. However, there are no hollow trees with suitable features for breeding by the Powerful Owl; and
- the removal of some woodland vegetation will have little or no impact upon either the Grey-headed Flying Fox or the Square-tailed Kite, given that both species are highly mobile and very wide-ranging, and that there are no specific resources of particular value for these species present on the subject land.

As is the case with the Nowra Health Myrtle, the potential significance of the imposition of adverse impacts on those threatened fauna species needs to be considered in the light of the relevant impact amelioration and environmental management measures proposed as part of the activity, and (particularly) the protection of a substantial portion of high quality native vegetation on the subject land within a *Conservation Area*. The proximity of the subject land to other areas of native vegetation to be retained in the vicinity and locality is also of particular relevance in this case.

8.3 Impact Analysis

With respect to threatened fauna and/or habitats or resources for threatened species, the proposed development on the subject land at Mundamia will involve:

- the loss of 30-40 hollow-bearing trees of various sizes. Most of the hollow-bearing trees, however, are of only moderate size at best, and there are very few large tree-hollows which will require removal (see discussion below regarding the salvage and re-use of tree-hollows);
- the removal of a number of Yellow-bellied Glider food trees in the eastern part of the proposed development footprint;
- the loss of a number of Glossy Black Cockatoo feed trees; and
- the loss of a small proportion of the Nowra Heath-myrtle population, which extends well into the proposed *Conservation Area*, particularly in the north and northeast of the subject land (where the development has been re-designed to reduce the loss of Nowra Heath-myrtle required).

Whilst the proposed development as detailed in the *Concept Plan*, and as discussed above, will require the removal of some areas of native vegetation and of habitat and resources for threatened biota (as well as individuals of the Nowra Heath-myrtle), there are a number of relevant considerations when assessing the significance of potential or likely environmental impacts of the proposal.

In this regard, it is relevant to include consideration of:

- the extent of retention of habitat, resources and individuals of threatened biota, as well as significant areas of native vegetation, within the *Conservation Area* in the eastern and northern parts of the subject land (Figure 7);
- the extent of habitat and resources, as well as populations and individuals of threatened biota, on surrounding lands, much of which have been designated for biodiversity conservation purposes in the *Nowra-Bomaderry Structure Plan* (Figure 11; Chapter 16);
- the implementation of a program to capture and relocate threatened species during any clearing of the subject land;
- the protection of most of the Nowra Heath-myrtle population within the *Conservation Area*, including within APZs, following modifications to the design of the northern part of the proposal (Figure 8);
- the implementation of a *Hollow-bearing Tree Protocol*, including the salvage and re-use of tree-hollows which require removal for the proposed residential development, with the relocation of salvaged tree-hollows into the *Conservation Area* and/or their use as hollow logs, and the replacement by artificial nest boxes of any tree-hollows lost, in the *Conservation Area*;
- the implementation of a 'best practice' stormwater management regime within the project to ensure, both during construction and during subsequent occupation, that discharge stormwater quality and quantities are appropriate (see Chapter 9);
- the implementation of a *Vegetation Management Plan* (VMP) for the whole of the *Conservation Area* (including the APZs), designed specifically to protect and manage habitat and resources, as well as native vegetation and threatened biota, within the *Conservation Area*;
- management of APZs around the development (where located within the *Conservation Area*) to facilitate and/or to enhance habitat and resources for threatened biota; and
- the long-term management of the *Conservation Area* for biodiversity conservation purposes by its dedication to Council to expand the adjoining *Flat Rock Creek Reserve* (to the east).

Detailed consideration of the impact amelioration and environmental management measures that are included as integral parts of the project are provided in Chapter 17 of this *Report*.

9 IMPACTS of the STORMWATER MANAGEMENT REGIME

A *Water Cycle Management Report* for the subject site has been prepared by Storm Consulting (2012), which addresses issues relating to the management of stormwater during construction activities for future development on the subject site, as well as ongoing management of stormwater once residential development has been completed.

Bio-retention swales are proposed along the eastern boundary of the residential area and throughout the residential area itself (Figure 9), with individual lots being provided with rainwater gardens to return stormwater to the soil. SLR Ecology (previously Environmental InSites) had liaised with Storm Consulting in the design of the stormwater management system to ensure that the existing groundwater conditions downslope of the development are maintained, insofar as is possible. This will involve a combination of infiltration of stormwater into the groundwater layer and the 'over-topping' of the swales to maintain soil moisture and hydrological conditions with the *Conservation Area*.

As noted in the *Water Cycle Management Report* (Storm Consulting 2012), the "*Proposed Stormwater Management Strategy*" includes:

- the preparation and implementation of a *Soil & Water Management Plan* in accordance with *Managing Urban Stormwater: Soils and Construction*, "*Version 4*" documents (prepared by Landcom in 2004) for all construction works on the site; and
- the creation and ongoing management of an operational stormwater management regime, which includes the implementation of *Water Sensitive Urban Design* elements and specific measures for the maintenance and management of stormwater quality and quantity once development activities have commenced.

There are two vegetation types which would appear to be partially dependent upon groundwater drainage and discharges – the Swamp Paperbark community contained within and adjacent to a shallow drainage line in the northeastern part of the subject land, and some small 'moss gardens' on the eastern side of the land. Both of those communities will be partially removed as a result of the proposed development of the subject land at Mundamia.

However, neither of those communities is restricted to the subject site, and neither is regarded of particular conservation concern. Furthermore, neither is considered to be entirely reliant on groundwater, as incipient rainfall is also doubtless an important and necessary resource for both communities.

Nevertheless, vegetation adjacent to the eastern side of the subject land is proposed to be maintained by the use of bio-retention swales within and adjacent to the development. These are designed *inter alia* to maintain groundwater conditions downslope of the subject land, and would facilitate the maintenance of areas of those vegetation types which are to be retained within the *Conservation Area*.

It is noted that whilst the Nowra Heath-myrtle often occupies moist areas and areas of impeded drainage, there are many areas on the subject land where specimens of the Nowra Heath-myrtle, and substantial stands of species, are present in xeric locations. Furthermore, the overwhelming majority of the population of that species on the subject land is located to the north of the proposed development area, on a slope which is outside of the catchment of the development. Thus, there will be no adverse impacts upon the overwhelming majority of that population as a consequence of the proposal.

As noted above, the proposed stormwater management measures contained within the concept design for the residential development at Mundamia have incorporated a range of measures intended specifically *inter alia*:

- to capture and re-use stormwater throughout the development;
- to utilise on-site infiltration and bio-retention swales to return stormwater to the soil;
- to incorporate measures to minimise the discharge of phosphorus, nitrogen and other contaminants (including sediment) during construction activities and throughout occupation of the subject land; and
- to provide supplementary habitat for native biota (in bio-retention swales) and to provide for maintenance of the soil and moisture regime downslope of the development.

Whilst the proposed development will doubtless result in some impacts as a result of changes to stormwater discharges, particular attention has been paid during the design phase to limit the potential for adverse impacts by the implementation of a stormwater management regime which is cognisant of and sensitive to the potential for adverse impacts to be imposed. The proposal has sought to implement appropriate measures for the management and treatment of stormwater discharges from the development.

The stormwater management regime which is to be implemented as part of the residential development of the subject land will not involve the imposition of a significant impact on any native biota, threatened or otherwise. In particular, as noted above:

- no threatened biota listed in the TSC Act will be adversely affected to any significant extent, by virtue of the areas of vegetation to be retained both on the subject land itself and in its immediate vicinity (particularly to the east);
- the stormwater management regime is intended *inter alia* to maintain (insofar as is possible) existing soil moisture levels to the north and east of the development area; and
- there will be no significant impact upon any *Matters of National Environmental Significance* (MNES) as a consequence of the stormwater management regime for the proposed development of the subject land (see Chapter 15).

10 IMPACTS of BUSHFIRE PROTECTION MEASURES

In the northeastern and southeastern parts of the subject land, there is a requirement for the provision of *Asset Protection Zones* (APZs) in retained native vegetation within the *Conservation Area*, beyond the proposed development footprint (Figure 10). However, the APZ requirements within the *Conservation Area* (Figure 10) occupy only a narrow band in the southeast of the site, east of the perimeter road (EcoLogical 2012).

It is noted that an existing APZ is provided around the existing farmhouse on the residue lot on the subject land. Most of that vegetation is already highly modified and thinned, however, and ongoing management for the APZ will require only limited further modification of the patches of retained native vegetation.

The provision and maintenance of the APZ in the southeast will require *inter alia*:

- some (but not total) removal of trees to provide a discontinuous canopy;
- the thinning of dense shrubs and a reduction in leaf litter and fallen branches in places; and
- the ongoing maintenance of the APZs to maintain the required fine fuel levels on the ground, and to provide appropriate bushfire protection.

As documented in the *Vegetation Management Principles Plan* (VMPP) attached to this *Report* (Appendix G), the management of vegetation within the APZ is to be undertaken in a manner sensitive to the native biota present. In particular, the VMPP and the subsequent *Vegetation Management Plan* (VMP) for the *Conservation Area* will ensure that:

- hollow-bearing trees are retained within the APZ on a preferential basis;
- Yellow-bellied Glider feed trees will also be retained on a preferential basis;
- individuals and stands of the Nowra Heath-myrtle within the APZ will be identified to ensure that individuals of this species are retained, noting that an open understorey favours this species; and
- a monitoring regime within the APZ to ascertain the efficacy of the management regimes, and to provide opportunities to refine the APZ management regime.

Given the approach to be adopted with respect to the management of the APZ, and in particular the identification of individuals of and habitat and resources for the relevant threatened biota, management of the APZ does not represent a threat to the survival of any of the relevant threatened biota.

In the case of the Nowra Heath-myrtle, management of the APZ is likely to be beneficial for its ongoing survival. As is evident currently in the northern part of the land, the slashing of woodland containing this species can favour the Nowra Heath-myrtle, with this species now dominating the understorey at this location.

The preferential retention of hollow-bearing trees, and of Yellow-bellied Glider and Glossy Black Cockatoo feed trees, on a preferential basis within the APZ will also ensure that species which are dependent upon those resources will not be disadvantaged or adversely affected by the management of the APZ as proposed.

11 CUMULATIVE IMPACTS

All development involves a contribution to the imposition of "*cumulative impacts*". More houses, more people and more infrastructure in any location inevitably lead to an increase in general impacts (both direct and indirect) on the natural environment.

However, the imposition of adverse impacts upon the natural environment in general and upon threatened biota in particular (including those present on the subject land), has been taken into account:

- in the *Nowra-Bomaderry Structure Plan*, which *inter alia* identified the subject site as an appropriate location for residential development;
- in the *South Coast Regional Strategy* (DoP 2006) which *inter alia* reinforces the development potential of the subject land; and
- in the assessment process contained in this *Report* for the current proposal.

As noted above, the Department of Planning (DoP) itself, through the vehicle of the *South Coast Regional Strategy* (the *Strategy*), is actively promoting the development for urban purposes of the subject land itself and land to its west – as Area 5 in the *Nowra-Bomaderry Structure Plan* (Figure 11).

Furthermore, as additional residential development throughout New South Wales is inevitable, it is proper to determine where are the best and most appropriate places for such development to occur. Generally speaking, it can reasonably be assumed that most further residential development would best be located adjacent or close to existing residential areas. That is precisely what is being promoted by the DoP in the *South Coast Regional Strategy* and the *Nowra-Bomaderry Structure Plan* (Figure 11).

That there will inevitably be "*cumulative impacts*" on the natural environment and on threatened biota as a result of the proposed development on the subject land, as well as on the adjoining lands to the west, is acknowledged and accepted. Each of those developments will inevitably contribute to the "*cumulative impacts*" in the locality. However, it cannot be the requirement of any one development to address and deal with the "*cumulative impacts*" of all development in the vicinity. Nor is it possible to avoid the imposition of "*cumulative impacts*" in any such development.

In any case, the proposed development of the land at Mundamia has sought to limit and/or ameliorate impacts (both potential and real) which would or might arise from the proposed urban development of the land *inter alia* so as to minimise the contribution of the project to "*cumulative impacts*".

In this regard, the proposed development:

- has been confined substantially to areas which had previously been identified in the *Nowra-Bomaderry Structure Plan* as being appropriate for residential development;
- has involved an iterative approach, which has reduced the development *inter alia* to protect additional stands and individuals of the Nowra Heath-myrtle;
- incorporates specific stormwater regime design elements intended to maintain water quality and soil moisture levels;
- is committed to a management regime for APZs around the development which preferentially protects relevant resources (hollow-bearing trees, food trees *etc*); and
- provides for an increase in conserved lands by a commitment to dedicating the *Conservation Area* to Council to expand the adjoining Council Reserve (to the east).